SMTB1101	MATRICES AND CALCULUS (COMMON TO ALL BRANCHES EXCEPT BIO GROUPS)	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- The Objective of this Course is to identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- The purpose of this course is for Modeling the Engineering problems and obtaining its solutions mathematically.
- This helps in understanding Science, Engineering and Computer Science analytically and logical thinking is attained.

UNIT 1 MATRICES 9 Hrs.

Characteristic equation of a square matrix – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen Vectors – Cayley - Hamilton theorem (without proof) – verification, finding inverse and power of a matrix – Diagonalization of a matrix using orthogonal transformation – Quadratic forms – Nature of quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS 9 Hrs.

Definitions – Derivative of standard functions (Results only) - Differentiation of function of function – Logarithmic differentiation – Derivatives of implicit function- Curvature – Centre, Radius and Circle of Curvature in Cartesian co-ordinates – Evolutes.

UNIT 3 FUNCTIONS OF SEVERAL VARIABLES 9 Hrs.

Partial derivatives (Definition) – Total derivative – Jacobian - Taylor's expansion – Maxima and minima of functions of two variables – Constrained maxima and minima using Lagrange's multiplier method.

UNIT 4 INTEGRAL CALCULUS I 9 Hrs.

Beta and Gamma integrals – Relation between Beta and Gamma integrals – Properties of Beta and Gamma integrals with proofs – Evaluation of definite integrals in terms of Beta and Gamma function.

UNIT 5 INTEGRAL CALCULUS II 9 Hrs.

Double integrals in Cartesian and Polar co-ordinates – Change of order of integration – Change of variables from Cartesian to Polar coordinates – Area of plane curves using double integrals. Triple integrals – Volume using triple integrals in Cartesian co-ordinates -Simple Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Convert the quadratic form to canonical form by orthogonal transformation.
CO2 - Construct the Circle of Curvature and Evolute of any curve.
CO3 - Examine the maxima and minima of function of several variables.
CO4 - Analyze the relationship between Beta and Gamma functions and its applications.
CO5 - Evaluate double integrals in various coordinate systems.
CO6 - Apply the concept of triple integrals in engineering problems.

TEXT / REFERENCE BOOKS

1. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi publications, Reprint, 2008.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.
3. Grewal B.S., Higher Engineering Mathematics, 41th Edition, Khanna Publications, Delhi, 2011.
4. Kandaswamy P & Co., Engineering Mathematics for First Year, IX revised edition, S. Chand & Co Pub., 2010.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
6. Veerarajan T., Engineering Mathematics for First Year, II Edition, Tata McGraw Hill Publishers, New Delhi, 2008.
7. Venkataraman M.K., Engineering Mathematics – First Year (2nd edition), National Publishing Co., 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SPHB1101	PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite : Nil **Co**
Requisite: SPHB2101

COURSE OBJECTIVES

- To understand the concept of crystal structures and symmetry, the physics of scattering and diffraction theory, experimental diffraction from single crystals, instrumentation and powder diffraction.
- Students will be able to understand the Identify and describe properties of matter, including: flexibility, strength and transparency.
- The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics and to use this knowledge to explore various applications.
- Differentiate between various acoustic terms and understand how these apply to different materials and acoustic design solutions.
- To give knowledge about semiconductor physics and discus working and applications of basic devices, including p-n junctions, BJTs and FETs.

UNIT 1 QUANTUM MECHANICS 9 Hrs.

Introduction to Quantum mechanics-Energy distribution function, Wave – particle duality-de Broglie matter waves – Concept of wave function and its physical significance – Heisenberg's Uncertainty Principle – Schrodinger's wave equation – Time independent and Time dependent equations – Particle in a one dimensional rigid box – tunnelling (Qualitative)– Scanning Tunnelling Microscope (STM).

UNIT 2 PROPERTIES OF MATTER 9 Hrs.

Introduction- Elasticity- Hooke's law - Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment–bending of beams - bending moment– cantilever:-Theory and experiment–uniform and non-uniform bending: theory and experiment- Magnetism - Basic definitions - Magnetic permeability, susceptibility, relation between permeability and susceptibility - Bohr magneton. Classification of magnetic materials-Hysteresis.

UNIT 3 CRYSTAL PHYSICS 9 Hrs.

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances – coordination number and packing factor for SC, BCC, FCC, HCP.– crystal imperfections: point defects, line defects –growth of single crystals: solution and melt growth techniques.

UNIT 4 SEMICONDUCTOR PHYSICS 9 Hrs.

Classification of materials-Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors - Fermi level in intrinsic and extrinsic semiconductors. Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, V-I characteristics, junction capacitance and voltage breakdown. Zener diode and its characterisation- Avalanche breakdown- JEFT- I-V characteristics- amplifying and switching.

UNIT 5 LASER AND ITS APPLICATIONS 9 Hrs.

Absorption and Emission of Radiation by atoms, ions and molecules. Laser medium Phenomenon of population inversion. Laser cavity (fiber laser, and other cavities), generation of coherent beam, Q-switching, short pulse generation, power amplification. Basic Laser Principles: Theory of Laser, Properties of Laser, Fundamental Optical properties, Modified Optical properties, Laser output – its characteristics.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Solve the time independent Schrodinger wave equation for a particle in a box to obtain the Eigen values and Eigen functions.
CO2 - Understand the dual nature of radiation and matter.
CO3 - Estimate the atomic packing factor for SC, BCC & FCC structures.
CO4 - Recognize sound level descriptors and how they are used in architectural acoustics andanalyse acoustic properties of typically used materials for design consideration.
CO5 - Understanding the working, design considerations and applications of various semi conducting devices including p-n junctions, BJTs and FETs.
CO6 - Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.

TEXT / REFERENCE BOOKS

1. Pillai S.O., Solid state Physics, New age International Publishers, 7th Edition.
2. Arthur Beiser, Concepts of Modern Physics, Tata McGraw Hill Publications.
3. M.N.Avadhanulu & P.G.Kshirasagar. A text book of Engineering Physics, S. Ch.Publishing.
4. B. B.Laud,Lasers and nonlinear optics, New age International Publishers, II-Edition.
5. R. Murugesan, Modern Physics, S. Chand Publishing, 15th Edition (2015).
6. D. S. Mathur, Elements of Properties of Matter, S. Chand Publishing (2014).
7. A. K. Bandyopadhyay, Nanomaterials, New age International Publishers.
8. K. K. Chattopadhyay, Introduction to nano science and nano technology, PHI publisher.
9. Sulabha Kulkarni, Introduction to Nanoscience and Nanotechnology 2nd Edition.
10. David Griffiths, Introduction to electrodynamics, Addison-Wesley publishing 3rd Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SECB1101	FUNDAMENTALS OF ELECTRONIC DEVICES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: Nil **Co**
Requisite: SEEB2201

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study Nano devices

UNIT 1 BASIC SEMICONDUCTOR DEVICES 9 Hrs.

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications- Rectifiers, Limiting and Clamping Circuits, Zener diode-construction and VI characteristics.

UNIT 2 BIPOLAR JUNCTION TRANSISTORS 9 Hrs.

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations-Input and Output characteristics of CE, CB, CC-Ebers Moll Model-Multi Emitter Transistor, Gummel Poon-model

UNIT 3 FIELD EFFECT TRANSIST 9 Hrs.

FETs–Drain and Transfer characteristics,-Current Equations-Pinch off voltage and its significance-MOSFET-Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET-Characteristics – Comparison of MOSFET with JFET, DUAL GATE MOSFET

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES 9 Hrs.

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Phototransistor, Gallium Arsenide device

UNIT 5 NANO DEVICES 9 Hrs.

Nano Sensors for measurement of temperature, humidity, pressure- Bio Sensors for measurement of blood pressure, heart rate, glucose level, SPO_2– Chemical Sensors for pH, gas measurement- sensors for automation, Linearity characteristics of sensors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Apply the knowledge of basic semiconductor materials by understanding fabrication processes.
CO2 - Analyze the characteristics of various electronic devices
CO3 - Analyze the various circuit configurations and its classifications of Transistor and MOSFETs.
CO4 - Analyze the characteristics of special semiconductor devices.
CO5 - Analyze the performance characteristics of various sensors.
CO6 - Select suitable sensors for automation.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices",4thEdition,Tata McGraw Hill Inc.2012.
2. Wolfgang Fritzsche (Editor), Jürgen Popp (Editor) "Optical Nano- and Microsystems for Bio-analytics (Springer Series on Chemical Sensors and Biosensors Book 10)" 2012th Edition.
3. Juin J. Liou (Editor), Shien-Kuei Liaw (Editor), Yung-Hui Chung (Editor)," Nano Devices and Sensors Hardcover – Import, 25 April 2016".
4. Salivahanan.S, SureshKumar.N,Vallavaraj.A,"Electronic Devices and circuits",3rd Edition, Tata McGraw Hill,2008.
5. David Bell, "Fundamentals of Electronic Devices and Circuits",5thEdition, Oxford University Press2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SECB1102	Fundamentals of Digital Systems	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on various types of Binary logics.
- To design a binary logic circuit for an arithmetic expression.
- To understand the usage of registers and counters used in various digital circuits.
- To understand the design of memory devices used.
- To get an exposure about the electronics behind design of Basic digital logical elements.

UNIT 1 NUMBER SYSTEMS, LOGIC FUNCTIONS AND BOOLEAN ALGEBRA 9 Hrs.

Number systems – Number systems conversions - Binary arithmetic – Binary codes – Logic functions- Universal gate functions - Boolean algebra – Functionally complete operation sets, Reduction of switching equations using Boolean algebra, Realization of switching function.

UNIT 2 DESIGN OF COMBINATIONAL LOGIC 9 Hrs.

Design procedure of Combinational Logic – Design of two level gate networks - Sum of Products (SOP) - Product of Sums(POS) - Canonical SOP - Canonical POS - Karnaugh Map - Simplifications of Boolean functions using Karnaugh Map and implementation using Logic function – Advantages and limitations of K-Map - Tabulation method - Simplifications of Boolean functions using Tabulation method.

UNIT 3 COMBINATIONAL CIRCUITS 9 Hrs.

Introduction to Combinational circuits – Half Adder, Full Adder - Half Subtractor, Full Subtractor- Parallel binary Adder, Parallel binary Subtractor - Carry look ahead Adder- BCD Adder- Decoders- Encoders - Priority Encoder- Multiplexers- MUX as universal combinational modules- Demultiplexers- Code convertors- Magnitude Comparator.

UNIT 4 SEQUENTIAL CIRCUITS 9 Hrs.

Introduction to Sequential circuits – Flip flops – SR, JK, D and T flip flops, Master Slave flip flop, Characteristic and excitation table – Realization of one flip flop with other flip flops – Regisrers – Shift registers – Counters – Synchronous and Asynchronous counters – Modulus counters – Ring Counter – Johnson Counter – State diagram, State table, State minimization – Hazards.

UNIT 5 DIGITAL LOGIC FAMILIES, MEMORIES AND PROGRAMMABLE DEVICES 9 Hrs.

Classification and characteristics of logic family – Bipolar logic family – Saturated logic family – Non saturated family – Unipolar family – MOS, CMOS logic families. Classification and Organization of memories – Programmable Logic Devices – Programmable Logic Array(PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) .

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze various coding techniques and number conversion systems.
CO2 - Develop suitable techniques to minimize the Boolean equations.
CO3 - Design the digital circuit using combinational logic.
CO4 - Design the digital circuit using sequential logic.

CO5 - Analyze the performance of various digital logic families.
CO6 - Solve the arithmetic expressions using memories and programmable logic devices and implement memory units with Programmable logic devices.

TEXT / REFERENCE BOOKS

1. John M. Yarbrough, “Digital logic: Applications and Design”, Thomas - Vikas Publishing House, 2002.
2. Morris Mano, “Digital design-With an Introduction to the Verilog HDL”, 5th Edition, Pearson, 2013.
3. R.P.Jain, “Modern Digital Electronics”, 4th Edition, TMH, 2010.
4. Thomas L Floyd, “ Digital Fundamentals”, 11th edtion, Pearson, 2015
5. William H. Gothmann, “Digital Electronics”, Prentice Hall, 2001.
6. Tutorial Website: https://www.tutorialspoint.com/digital_circuits/index.htm.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3Hrs.**

PART A :10 Questions of 2 marks each –No choice **20 Marks**
PART B :2 Questions from each unit with internal choice; each carrying16 marks **80 Marks**

S11BLH12	PROBLEM SOLVING TECHNIQUES USING C	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre Requisite:Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- Understand control structures, functions and Arrays in C.
- Construct modules for real time applications using Functions in C.
- Comprehend pointers and file handling mechanisms.

UNIT 1 BITS AND BYTES IN COMPUTING 9 Hrs.

Computers : Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages – Evolution from COBOL, FORTRAN to C, Python – Need. Algorithms: Role in problem solving – Analysis – Design – Flowcharts: Role in problem solving – Symbols – Design – Pseudocode: Role in problem solving – Design - Program: Role in problem solving – Design.

Practice Problems:

1. Describe a simple real world problem in your domain/department and describe it in the form of problem statement, input, output and provide its solution in terms of algorithm, flowchart, pseudo code and program.

UNIT 2 C: MATH BEHIND CODING 9 Hrs.

C: Structure of program – Character set – Tokens – Keywords – Identifiers – Constants – Variables – Datatypes – Strings – Operators and its types – Functions – Header Files. Algorithmic Strategies: Iteration and Recursion – Efficiency – Role of Time and Space consumption while building an algorithm – Complexities.

Practice Problems:

1. Describe a simple real world problem in your domain/department and provide a computing and non-computing solution for the same. Calculate the time and space consumed in both solutions. Compare and contrast the pros and cons in both solutions.
2. Write an algorithm, flowchart, pseudo code followed by a simple C code to do find the Factorial and Fibonacci series using both iteration and recursion.

UNIT 3 C: MAGIC BEHIND INSTANT OUTPUTS 9 Hrs.

Advanced Coding Concepts: Decision Making using Branching Statements and its types – Decision Making using Looping Statements and its types– Switch Statements –Break – Continue – Goto – Jump Statements Case Study: Fun with Code -- Printing Alphabets / Flags of Countries / Flying Alphabet Screensaver.

Practice Problems:

1. Describe a problem statement in your domain/department whose solution involves repetition of same steps and provide code as solution involving for, while and do while loops.
2. Describe a problem statement in your domain/department whose solution involves decision making and provide code as solution involving if-else, nested if-else and ladder if-else.
3. Develop a simple scientific calculator using Switch case statement.

UNIT 4 STORING GROUP OF HOMOGENOUS ELEMENTS: ARRAYS 9 Hrs.

Diving into Arrays: Definition – Syntax – Types – Representation: Row & Colum Order – Dynamic Arrays. Idea behind Functions: Declaration – Definition – Types – Calling – Arguments – Prototypes – Call by Value – Call by Reference – Pointers.

Case Study: Fun with Code – Simple Game Development using Arrays and Functions

Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of same type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. You're playing UNO cards, suddenly a person is getting rev card. Write a C program to reverse the round by storing the number of players in array.
3. Write a C program for Vehicle Regulation System where odd number ending vehicles can use the road on odd days and even number ending vehicles can use the road on even days using two separate arrays to store and display the odd and even numbers.

UNIT 5 STORING GROUP OF HETROGENOUS ELEMENTS: ARRAYS 9 Hrs.

Outset of Structure and Union: Structure Definition & Declaration – Structures Fusion with: Arrays – Pointers – Functions– Union Initiation, Definition & Declaration. Working with Files: File Handling Functions – Read – Write – Other Operations – Different File Types .

Case Study: Report on using File Functions to create Score Board for any game, importing it to. Program.

Practice Problems:

1. Describe a problem statement in your domain/department where you need to work with group of different type of data. Provide a solution in terms of C program to store and manage the data effectively.
2. Write a C program to get the details of the student (roll no, name, date of birth, state, 10th percentage and 12th percentage) using Structure. Calculate the age of the student and display the eligibility status for his admission.
   Eligibility criteria: more than 60 percent in 10th and 12th, age>=17, state==TN.
3. Write a menu driven C program for library management system with ten entries:
   (i).Add Book (ii). Add Author (iii). Add Category (iv). Book Cost (v). Display - Book by Author, Book by Category, Book under cost.
4. Write a C program to create an employee Union with employee details (id, name, salary) Accept the details of 'n' employees, rearrange the data in ascending order of employee name, id and salary as three different functions and display it.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Interpret the difference between components of problem solving such as algorithm, flowchart, pseudo code and source code.

CO2 - Build simple solution for any given problem statement using various components of problem solving techniques and measure its efficiency in terms of time and space.

CO3 - Infer and examine the roots and foundation of C programming’s key concepts like data types, operators.

CO4 - Devise and correlate the use of different core concepts such as arrays and functions in C language.

CO5 - Formulate real time solutions through programs using structure and union in C language.

CO6 - Design and develop various application oriented program for solving real time societal problems.

TEXT / REFERENCE BOOKS

1. YashavantKanetkar, 'Let us C', BPB Publications, Fourteenth Edition
2. R.G.Dromey "How to solve it by computer", Pearson Education, Low Price Edition.
3. Balagurusamy, "Programming in ANSI C", McGrawHill Publications, Eighth Edition.
4. Greg Perry, Dean Miller "C Programming Absolute Beginner's Guide", Third Edition.

ENDS EMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A	**MCQ Questions**	**20 Marks**
PART B	**Laboratory Practical**	**80 Marks**

SMEB2102	ENGINEERING DRAWING AND DESIGN (Common to CSE,IT,ECE,EEE,BIOTECH, BIOMEDICAL & CHEMICAL)	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: Nil **Co Requisite:** Nil

COURSEOBJECTIVES

The main learning objective of this course is

- To Understand the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products and to expose them to existing national standards related to technical drawings.
- To make the student to visualize and read the drawings.
- To make the students to understand the importance of sectioning and development of surfaces.
- To learn about the orthographic and pictorial projections.

CONCEPTS AND CONVENTIONS

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

UNIT 1 PLANE CURVES 9 Hrs.

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction ofellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — Drawing of tangents and normal to the above curves.

UNIT 2 PROJECTION OF POINTS AND LINES 9 Hrs.

Projection - Types of projection - Projection of points lying in four quadrants - Projection of lines (First angle projection only) -Projection of lines parallel and inclined to one or both the planes

UNIT 3 PROJECTION OF SOLIDS 9 Hrs.

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis isinclined to one of the principal planes and parallel to the other by rotating object method.
Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT 4 SECTION OF SOLIDS 9 Hrs.

Purpose of sectioning - Sectional views - Hatching - Section plane perpendicular to one plane and parallel to other plane -Section plane inclined to HP-True shape of the section. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination**)**

UNIT 5 DEVELOPMENT OF SURFACESAND FREEHAND SKETCHING 9 Hrs.

Need for development of surfaces - Types of development of surfaces - Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids, cylinders and cones. Orthographic Projection-:Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

C01 - Identify the national standards related to the Engineering drawing based on BIS and construct conic sections and polygons.
C02 - Solve practical problems involving projection of lines.
CO3 - Draw orthographic projections of solids.
CO4 - Draw orthographic section of solids and improve the students visualization skill to develop New products .
CO5 - Draw the Development of surfaces and its applications in manufacturing industry
CO6 - Draw the orthographic view of solids and learn to convert pictorial into orthographic projection.

TEXT / REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House,53rd Edition, 2019.
2. Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3. Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P)Limited,2018.
4. Engineering drawing practice for schools and colleges, SP 46 – 1988 (http:// web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf).

PUBLICATION OF BUREAU OF INDIAN STANDARDS

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each -No choice **20 Marks**
PART B: 2 Questions from each unit with internal choice; each carrying16 marks **80 Marks**

SPHB2101	PHYSICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	2	0	1	100

Pre Requisite: SPHB1101 **Co**
Requisite: Nil

COURSE OBJECTIVE

- To introduce experiments in optics, semiconductors, magnetism, thermal physics and quantum mechanics in order to acquire the first hand information and to realize the basic physics concepts.

SUGGESTED LIST OF EXPERIMENTS (Any SIX experiments & TWO demonstrations)

1. Determine the Rigidity modulus of a given wire by Torsional pendulum.
2. To determine the angle of Minimum Deviation by I - D curve method.
3. Determine V-I characteristics of a photodiode.
4. To determine the Numerical aperture of an optical fiber.
5. To find the Energy gap of a semiconductor.
6. Determination of Young's modulus- Non-uniform bending.
7. Determination of Young's modulus- Uniform bending.
8. Determination of the wave length of the laser using grating- Laser.
9. Determination of thickness of a thin sheet/wire- Air wedge.
10. Determination of Numerical Aperture and acceptance angle- Optical fibre.
11. Photoelectric effect.
12. Michelson Interferometer.
13. V-I characterisation of solar cell.
14. CRO- FUNCTIONS.
15. DFT Theory and calculations.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Measure the rigidity modulus of a given wire by oscillations.
CO2 - Measure the angle of minimum deviation by spectrometer.
CO3 - Analyse the I-V characteristics of the given photo diode.
CO4 - Measure the band gap of the given semiconductor.
CO5 - Measure the young's modulus of bar by uniform bending method.
CO6 - Determine the wavelength of the given laser light source.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:50 **Exam Duration: 2 Hrs.**

CAE	Evaluation of Regular Lab class	**15 Marks**
	Model practical exam	**10 Marks**
ESE	End Semester Practical exam	**25 Marks**

	ADVANCED CALCULUS AND STATISTICS	**L**	**T**	**P**	**EL**	**Credits**	**Total Marks**
SMTB1201	**(COMMON TO ALL BRANCHES EXCEPT BIO GROUPS)**	**3**	**0**	**0**	**0**	**3**	**100**

Pre Requisite: SMTB1101

Co Requisite: Nil

COURSE OBJECTIVES

- The Objective of this Course is to identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements. The purpose of this course is for modeling the Engineering problems and obtaining its solutions mathematically. This helps in understanding Science, Engineering and Computer Science analytically and logical thinking is attained.

UNIT 1 DIFFERENTIAL EQUATIONS 9 Hrs.

Higher order linear differential equations with constant coefficients – Particular Integral for e^{ax}, sinax or cosax, x^n, $x^n e^{ax}$, xsinax, xcosax, e^{ax}sinbx or e^{ax}cosbx – Method of Variation of Parameters – Homogeneous equation of Euler's and Legendre's type.

UNIT 2 VECTOR CALCULUS 9 Hrs.

Vector Differentiation - Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields-Vector Integration – Simple problems on line, surface and volume Integrals – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (without proofs)– Simple applications involving cubes and rectangular parallelopipeds.

UNIT 3 LAPLACE TRANSORMATION 9 Hrs.

Laplace transform – Transforms of standard functions – properties – Transforms of derivatives and integrals – Transforms of the type $e^{at}f(t)$, $tf(t)$, $f(t)/t$ – Transform of periodic functions – Transform of unit step function and impulse function – Inverse Laplace transforms – Convolution theorem – Initial and final value theorems – Applications - Linear ordinary differential equation with constant coefficients.

UNIT 4 PROBABILITY AND STATISTICS 9 Hrs.

Measures of central tendency: Mean, Median, Mode – Measures of dispersion: Standard deviation for discrete and grouped data. Definitions: Sample Space, Events – Addition Law of probability Multiplication law of probability – Conditional probability – Baye's theorem (without proof).

UNIT 5 THEORY OF SAMPLING AND TESTING OF HYPOTHESIS 9 Hrs.

Test of Hypothesis – Large samples – Z test – Single proportion – Difference of proportions – Single mean – Difference of means – Small samples – Student's t test – Single mean – Difference of means –Test of variance – Fisher's test – Chi square test: Goodness of fit, Independence of attributes.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Solve any higher order linear differential equations.
CO2 - Apply concepts of calculus on vector and scalar valued functions.
CO3 - Use Laplace Transform for transformation of functions.
CO4 - Evaluate problems on conditional probability using Baye's theorem.
CO5 - Analyze the concept of testing of hypothesis in small and large samples.
CO6 - Construct the Chi-Square test for goodness of fit and independence of attributes of real data.

TEXT / REFERENCE BOOKS

1. Bali N.P and Manish Goyal, A Text book of Engineering Mathematics, Eigth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.
3. Grewal B.S., Higher Engineering Mathematics, 41th Edition, Khanna Publications, Delhi,2011.
4. Ross L, Differential Equations, 3rd Edition,Wiley India,2009.
5. Veerarajan T, Probability, Statistics and Random Process, 4th Edition, Tata McGraw Hill, 2014.
6. Veerarajan T, Engineering Mathematics for First Year, II Edition, Tata McGraw Hill Publishers, 2008.
7. Venkataraman M.K., Engineering Mathematics – First Year, 2ndEdition, National Publishing Co., 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit with internal choice; each carrying16 marks **80 Marks**

SHSB1101	ENGLISH	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand specialized subject areas and skills included for their study.
- To comprehend and react in oral and written forms to the specialized texts.
- To respond to listening, reading and writing tasks by using digital tools.
- To enhance communication, collaboration and critical thinking skills.
- To explore creativity through blended learning contexts.

UNIT 1 **9 Hrs.**

Listening : Listening to choose the correct answer from the options given (MCQ).
Speaking : Self Introduction, Talking about likes and dislikes.
Reading : Comprehending a passage- Skimming, scanning, detailed reading.
Writing : Letter of Job Application, Resume, Letter to the Editor (problems and solutions).
Vocabulary : Kinds of Sentences, Affixes**,** Collocations, Sequence words, contextual guessing of words.
Language Focus : Parts of Speech, Tense and its types, Voice - Impersonal Passive.
Language Lab work : Focus Digital literacy: students join zoom platform/ using online tools.

UNIT 2 **9 Hrs.**

Listening : Listening to advertisements about a product, say true or false.
Speaking : JAM on current topics, mini presentations.
Reading : Identifying topic sentences by reading content.
Writing : Writing compare/ contrast paragraphs, process description, E-Mail Writing
Vocabulary : Verbal phrases, Prepositions and Prepositional phrases, Concord, Discourse Markers.
Language Focus : Clauses, Conjunctions, Sentence Types - Simple, Compound & Complex.
Language Lab : Digital literacy: Responding to quiz using Kahoot application.

UNIT 3 **9 Hrs.**

Listening : Listening to summarize the information, debates/ discussions.
Speaking : Group discussion on a given topic.
Reading : To find specific information and to prepare notes using the format.
Writing : Framing open ended questions- Survey Report- Arranging the sentences in the right order.
Vocabulary : Paired expressions, Adjectives/ adverbs, Technical definitions, Compound Nouns.
Language Focus : Punctuation, Editing, Same words used as different parts of speech
Language Lab : Digital literacy: Power point tools –Slide share to make presentation on the survey report.

UNIT 4 **9 Hrs.**

Listening : Listening to differentiate instructions and recommendations
Speaking : Debate on current issues
Reading : Reading to understand and classify the information
Writing : Instructions, Recommendations, Preparation of User Manual

Vocabulary : Classification of words, Abbreviations, Acronyms,
Language Focus : Reported Speech, Causatives, Basic Sentence Patterns
Language Lab : Digital literacy: Using online discussion forum

UNIT 5 **9 Hrs.**

Listening and summarizing : Listening to identify the structure of sentences, small talks, TED talks.
Speaking : Giving impromptu talks, Speech Writing.
Reading : Read argumentative essays and paragraphs.
Writing : Essay writing, Checklist preparation, Note making.
Vocabulary : Homophones/Homonyms, Idioms and Phrases.
Language Focus : Negatives, Tag questions, Similes and Metaphors.
Language Lab : Digital literacy: Creating own Blogs and interactive exercises and quizzes online.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Classify technical words to use them in sentences framing, compose problem solving paragraphs.
CO2 - Categorize information based on the understanding of reading materials to prepare notes.
CO3 - Prepare and document to report, identify elements of editing.
CO4 - Interpret technical definitions related to the text and design a user manual using instructions.
CO5 - Summarize reading materials and outline an essay on any topic given.
CO6 - Demonstrate their language learning activities in the classroom/ online group environment.

TEXT / REFERENCE BOOKS

1. Technical English [2019], Department of English, Sathyabama Institute of Science & Technology.
2. Beer, David F., and David McMurrey. A Guide to Writing as an Engineer. 4th ed., Wiley, 2013.
3. Alred, Gerald J., et al. Handbook of Technical Writing. 11th ed., Bedford/St. Martin's, 2019.
4. Pearsall, Thomas Edward. Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals. McGraw-Hill Education, 2017.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. O'Conner, Patricia T. Woe is I: The Grammarphobe's Guide to Better English in Plain English. Riverhead Books, 2019.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit with internal choice; each carrying16 marks **80 Marks**

SCYB1101	CHEMISTRY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: Nil **Co**
Requisite: SCYB2101

COURSE OBJECTIVES

- To understand the basic concepts of quantum chemistry from bonds to bands.
- To learn the principles and applications of energy levels in molecules.
- To know the importance of electrochemistry in batteries.
- To explore the concept of corrosion mechanism and design principles.
- To study the various synthetic approaches in nano chemistry.

UNIT 1 ATOMIC AND MOLECULAR STRUCTURE 9 Hrs.

Introduction to quantum chemistry – Motion of a quantum mechanical particle in one dimension (time-independent) – Physical meaning of wave function –Schrodinger equation for Hydrogen atom (No derivation. Only wave function).Angular and radial wave functions and probability densities – Quantum numbers – Principal, azimuthal, spin and magnetic quantum numbers – Wave functions and orbital shapes - s,p,d,f - LCAO-MO of H_2 – Band theory of solids: Conductors, semi-conductors– Role of As and Ga doping on band structures.

UNIT 2 MOLECULAR SPECTROSCOPY 9 Hrs.

Electromagnetic spectrum – Interaction of radiation with matter – Energy levels in molecules – Microwave spectroscopy – Principle – Classification of molecules based on moment of Inertia – Rotational energy expression (J levels) – Calculation of J for CO molecule – Vibrational spectroscopy – Normal modes of vibrations – Vibrations of polyatomic molecules (CO_2 and H_2O) – Determination of Force constant – Electronic transitions in organic molecules – Mathematical derivation of Beer-Lambert's law.

UNIT 3 ELECTROCHEMISTRY 9 Hrs.

Electrochemistry: Galvanic cell - Electrochemical cell representation - EMF series and its significance. Batteries: Terminology –Mechanism of Lead-acid accumulator - Mechanism of Nickel-cadmium batteries. Mechanism of Lithium batteries: Li/$SOCl_2$ cell - Li/I_2 cell - Lithium ion batteries. Mechanism of Fuel Cells: Hydrogen-oxygen fuel cells - Solid oxide fuel cell (SOFC).

UNIT 4 CORROSION SCIENCE 9 Hrs.

Introduction: Definition. Types: Dry corrosion: Mechanism - Pilling-Bed worth rule - Wet Corrosion: Mechanism. Types: Galvanic corrosion and differential aeration cell corrosion. Galvanic series and its significance. Factors influencing corrosion. Corrosion prevention: Material selection and design - Cathodic protection – Sacrificial anodic method and Impressed current method – Inhibitors – Anodic and Cathodic inhibitors.

UNIT 5 CHEMISTRY OF MATERIAL SCIENCES 9 Hrs.

Phase equilibria : Gibbs phase rule – Terms involved in Phase rule – Phase diagram of water system – Thermal method of analysis – Construction of simple eutectic system (Lead-Silver alloy system).

Fuels : Classification of fuels – Determination of calorific values of solid fuels by bomb calorimeter– Manufacture of synthetic petrol by Fischer-Tropsch method – Knocking in IC engines – Chemical structure – Octane and cetane rating of fuels.

Nanomaterials : Size dependent properties of nanomaterials – Synthesis of gold and silver

nanoparticles by Chemical reduction method–Applications of nanoparticles in medicine.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Apply the principles of quantum chemistry for energy level quantisation in molecules.
CO2 - Analyse the molecular transitions by interaction of EMR with matter.
CO3 - Assess the reaction mechanism in electrochemical storage device.
CO4 - Comprehend the corrosion mechanism for environmental sustainability. Examine the mechanism of corrosion for mitigation.
CO5 - Interpret the role of phase diagram/ fuels/ nano particles in chemical/ material science.
CO6 - Apply the concept of chemical science in real world applications.

TEXT / REFERENCE BOOKS

1. A.K.Chandra, Introductory Quantum Chemistry, Tata McGraw-Hill, 4th edition, 2019.
2. Ira N. Levine, Physical chemistry, 6th Edition, 2018.
3. Ira N. Levine, Quantum chemistry, 7th Edition, 2013.
4. David W. Ball and Thomas Baer, Physical Chemistry, Wadsworth Cengage Learning, 2nd Edition, 2014.
5. Mars G Fontana, Corrosion Engineering, 3rd Edition, Tata McGraw Hill, 2018.
6. Douglas A. Skoog and Donald M.West, Principles of Instrumental Analysis, Cengage, 6th Edition, 2014.
7. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai Publication, 2018.
8. David Linden, Thomas B Reddy, Handbook of Batteries, 4th Edition, McGraw-Hill, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Questions of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit with internal choice; each carrying16 marks **80 Marks**

SEEB1201	CIRCUIT THEORY AND NETWORK ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre Requisite: Nil **Co**
Requisite: SEEB2201

COURSE OBJECTIVES

- To equip the students to analyze electrical circuits and networks
- To educate the phasor concepts in A.C circuits.
- To convey the knowledge of resonance and transients.

UNIT 1 D.C.CIRCUITS 9 Hrs.

Electrical quantities, Ohm's Law, Resistors - Series and parallel combinations, Current Division rule, Voltage Division rule, Source transformation - Kirchhoff's laws, Nodal and Mesh Analysis, Star Delta Transformation.

UNIT 2 SINGLE AND THREE PHASEACCIRCUITS 9 Hrs.

Sinusoidal Functions - RMS(effective) and Average Values - Phasor Representation - J operator – Sinusoidal Excitation Applied to Purely Resistive - Inductive and Capacitive Circuits - RL - RC and RLC Series and Parallel Circuits- Power and Power Factor.-Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced

UNIT 3 NETWORK THEOREMS (Both DC and AC)9 Hrs.

Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem.

UNIT 4 NETWORK PARAMETERS 9 Hrs.

Network Parameters - Z,Y, h and ABCD- Conditions for Reciprocity - Parameter Conversion-Inter connection of Networks.

UNIT5 TRANSIENT ANALYSISANDRESONANCE 9 Hrs.

Time Domain Analysis - Transient response of RL, RC & RLC Networks with DC Input and Sinusoidal AC input. Series and Parallel resonance - Quality factor and Bandwidth.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to.

CO1 - Analyze dc circuits by different methods.
CO2 - Determine both magnitude and phase angle for various parameters of AC circuits.
CO3 - Apply Electrical theorems to solve complex electrical circuits.
CO4 - Determine the various parameters for electrical circuits.
CO5 - Analyze and interpret the transient response characteristics of electrical circuits.
CO6 - Create resonance in AC circuits.

TEXT / REFERENCE BOOKS

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9thedition, New Delhi, 2020.
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.
3. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill, First

Edition, 2019.
4. Mittle B.N., Aravind Mittle, "Basic Electrical Engineering", Tata McGraw Hill", 2nd Edition, July2017.
5. Charles Alexander, Mathew Sadiku,"Fundamentals of Electric Circuits", Tata McGraw Hill, 6th Edition,2017.
6. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", PHI Learning Private Ltd, 2nd Edition,2010.
7. Abhijit Chakrabarti, Sudiptanath & Chandan Kumar Chanda, "Basic Electrical Engineering", Tata McGraw Hill, 1st Edition,2010.
8. Wadhwa C.L., "Basic Electrical Engineering", New Age International, 4th Edition, 2007, Reprint June2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SEEB1202	DC MACHINES AND TRANSFORMERS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre Requisite: Nil **Co**
Requisite: SEEB2202

COURSE OBJECTIVES

- To analyze the electromechanical system.
- To impart knowledge in construction details, principle operation and performance characteristics of DC machines and transformer.
- To evaluate the different losses and performance of DC machines and transformer using different testing methods.
- To analyze the performance characteristics of DC machines.
- To impart knowledge in three phase transformer connection.

UNIT 1 MAGNETIC CIRCUITS 9 Hrs.

Terminologies in magnetic circuits - Analogy of Electric and Magnetic Circuits - Leakage Factor - force on current car-rying conductor – Expression for generated EMF -Reluctances in Series and Parallel (Series and Parallel Magnetic Cir-cuits)- Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws -statically and dynamically induced EMF- Self and mutual induced EMF -Self and mutual inductance.

UNIT2 D.C.GENERATORS 9 Hrs.

Constructional Details - Principle of Operation - E.M.F Equation - Methods of Excitation - Types – losses and efficiency- No load and Load characteristics of Series, Shunt and Compound generators - Armature Reaction, Effects, Methods of Compensation – Commutation - Methods of Improving Commutation – Applications.

UNIT3 D.CMOTORS 9 Hrs.

Principle of Operation - Significance of Back E.M.F - Torque Equation - Characteristics of Series, Shunt & Com-pound Motors -Starters -Speed Control of DC Series & Shunt Motors - Testing of DC Machines - load Test and No load Test - Hopkinson's Test – Applications.

UNIT4 SINGLEPHASETRANSFORMER 9 Hrs.

Principle of Operation - Constructional Details - E.M.F. Equation - Transformation Ratio - losses and efficiency – Transformer on No Load - Parameters Referred to HV / LV Windings - Equivalent Circuit - Transformer On Load – Phasor diagram - Regulation - Testing of Transformer - Open Circuit and Short Circuit Test - All day Efficiency - Sumpner's Test.

UNIT5 THREE PHASE ANDSPECIALTRANSFORMERS 9 Hrs.

Auto Transformer - Saving of copper in comparison with Two winding Transformer - Parallel Operation of Single Phase Transformers - Construction of Three Phase Transformer - Transformer Connections – Scott connection - Three Phase to Single Phase Transformer conversion - Elementary Ideas on Instrument Transformers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyse the parameters of magnetic circuits.

CO2 - Explain the principle, types, effect of armature reaction and commutation of DC generator.

CO3 - Analyze the performance characteristics of DC motor using various testing methods.
CO4 - Examine the equivalent circuit and performance of a single phase transformer.
CO5 - Distinguish the saving of copper of auto transformer with a two winding transformer.
CO6 - Analyze the various transformer connection for specific application.

TEXT / REFERENCE BOOKS

1. A K Theraja & B L Thereja, “A Text book of Electrical Technology (Vol II)”, S Chand & Co- 23rd Edition 2008.
2. I J Nagrath and D P Kothari, “Electrical Machines”, Tata McGraw Hill Publishing Company Limited New Delhi, 3rd Edition, 2007.
3. R.K.Rajput, “Electrical Machine”, Laxmi Publications, 5th Edition2008.
4. S K Sen, “Electrical Machinery”, Khanna Publishers, New Delhi, Reprint2002.
5. John Hindmarsh, U.M.I.S.T England, ”Electrical Machines & their applications", Pergamon, 4th edition2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SCYB2101	ENGINEERING CHEMISTRY LAB	L	T	P	EL	Credits	Total Marks
		0	0	2	0	1	100

Pre Requisite: SCYB1101 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand the basic principle involved in volumetric and instrumental analysis.
- To acquire practical knowledge in pHmetry, potentiometry and conductometry.
- To develop the skill in water analysis.

LIST OF EXPERIMENTS

1. Estimation of mixture of acids by conductometry.
2. Estimation of ferrous ion by potentiometry.
3. Determination of pKa value of glycine by pHmetry.
4. Estimation of hardness of water by EDTA method.
5. Determination of alkalinity of water
6. Estimation of Iron by photocolorimetry.
7. Estimation of copper in brass
8. Determination of high molecular weight polymer using Ostwald viscometer.

COURSE OUTCOME

On completion of the course, student will be able to

CO1 - Estimate the ionic conductance of mixture of acids.
CO2 - Construct a redox cell for the emf measurement.
CO3 - Interpret the concept of Zwitter ion in aminoacids
CO4 - Predict the quality of water sample for domestic and industrial applications.
CO5 - Demonstrate the validity of Beer-Lambert's law.
CO6 - Apply Poiseuille's law for molar mass measurement.

TEXT / REFERENCE BOOKS

1. G,H. Jeffery, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition. Persons Education 2004.
2. S. S. Dara, Experiments and Calculations in Engineering Chemistry, S. Chand and Co. 2010.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks:50 **Exam Duration:2Hrs**

CAE	Evaluation of Regular Lab class	**15 Marks**
	Model practical exam	**10 Marks**
ESE	University Practical exam	**25 Marks**

SEEB2201	ELECTRICAL CIRCUITS AND ELECTRONIC DEVICES LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: SEEB1201,SECB1101 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To know the usage of Electrical and Electronic equipment.
- To know the testing of components.
- To understand the transient and resonance circuits.
- To understand the PN diode operation in forward and reverse bias.
- To know the characteristics of transistor in CB, CE configurations.

SUGGESTED LIST OF EXPERIMENTS

Electrical Circuits Lab

1. Verification of Kirchoff's Law.
2. Verification of Theorems.
3. Series and Parallel A.C circuits.
4. R-L and R-C transients with DC transients.
5. Series and Parallel Resonance.
6. Clippers and Clampers.

Electronic Devices Lab

1. Characteristics of Semiconductor diode and Zener diode to find static and dynamic resistance from the characteristics.
2. Characteristics of CB configuration.
3. Characteristics of CE configuration.
4. Drain and transfer characteristics of JFET. To obtain gain, trans conductance and amplification factor.
5. Characteristics of SCR, find holding current, break over voltage and holding voltage.
6. Characteristics of UJT, find intrinsic standoff ratio, Peak voltage and valley voltage.
7. Characteristics of LDR with illumination and without illumination.
8. Voltage multipliers.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze waveforms generated using function generator and measure voltage, frequency and phase of any waveform using CRO.
CO2 - Select electrical components to verify Kirchoff's Law.
CO3 - Apply laws to verify various theorems.
CO4 - Analyze the performance of transients and resonance circuits.
CO5 - Analyze the characteristics of different electrical and electronic devices such as diodes, transistors etc.
CO6 - Design and verify the characteristics of different electronic circuits like rectifiers, amplifiers etc.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100 **Exam Duration:3 Hrs.**

CAE	Evaluation of Regular Lab class	**30 Marks**
	Model practical exam	**20 Marks**
ESE	University Practical exam	**50 Marks**

SEEB2202	DC MACHINES AND TRANSFORMERS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: SEEB1202
Co Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge to conduct test on various types of machines and transformer.
- To practice different types of wiring and apparatus connection.
- To analyze the operation of various DC machines with different load condition.
- To obtain the characteristics of DC machines and transformer by performing suitable test.

SUGGESTED LIST OF EXPERIMENTS

1. OCC and load characteristics of self excited DC shunt generator.
2. OCC and load characteristics of separately excited DC shunt generator.
3. Load characteristics of DC series generator.
4. Load characteristics of DC compound generator (Differential and Cumulative).
5. Load characteristics of DC shunt motor.
6. Load characteristics of DC series motor.
7. Load characteristics of DC compound motor (Differential and Cumulative).
8. Speed control of DC shunt motor.
9. Swinburne's test on DC shunt motor.
10. Hopkinson's test.
11. OC and SC test on Single Phase Transformer.
12. Load test on Single Phase Transformer.
13. Parallel Operation of Single Phase Transformer.
14. Sumpner's Test on Single Phase Transformer.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the performance characteristics of various DC generators.
CO2 - Examine the performance characteristics of various DC motors.
CO3 - Predetermine the losses and control the speed of a DC motor.
CO4 - Predetermine the losses and efficiency of Single Phase Transformer.
CO5 - Determine the efficiency of Single Phase Transformer.
CO6 - Analyze the load sharing of Single Phase Transformer.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100 **Exam Duration:3 Hrs.**

CAE	Evaluation of Regular Lab class	**30 Marks**
	Model practical exam	**20 Marks**
ESE	University Practical exam	**50 Marks**

SMTB1301	TRANSFORM TECHNIQUES AND COMPLEX ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre Requisite: SMTB1201 **Co**
Requisite: Nil

COURSE OBJECTIVES

- The Objective of this Course is to identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- The purpose of this course is for modeling the Engineering problems and obtaining its solutions mathematically.
- This helps in understanding Science, Engineering and Computer Science analytically and logical thinking is attained.

UNIT 1 FOURIER TRANSFORMATION 9 Hrs.

The infinite Fourier transform – Sine and Cosine transform – Properties – Inversion theorem – Convolution theorem – Parseval's identity – Finite Fourier sine and cosine transform.

UNIT 2 Z TRANSFORMATION AND DIFFERENCE EQUATIONS 9 Hrs.

Z Transform – Elementary properties – Inverse Z Transform – Partial fraction method, Convolution method, Residue method – Formation of difference equations – Solution of difference equations using ZTransform.

UNIT 3 COMPLEX VARIABLES 9 Hrs.

Analytic functions – Cauchy - Riemann equations in Cartesian and polar form – Harmonic functions – Properties of analytic functions – Construction of analytic functions using Milne – Thompson method – Some Standard Transformations – Translation, Magnification and Rotation, Inversion and Reflection and simple problems based on the above - Bilinear transformation.

UNIT 4 COMPLEX INTEGRATION 9 Hrs.

Cauchy's integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's series – Singularities – Poles and Residues – Cauchy's residue theorem and problems.

UNIT 5 PARTIAL DIFFERENTIAL EQUATION 9 Hrs.

Formation of equations by elimination of arbitrary constants and arbitrary functions – Solutions of First order Linear PDE – Lagrange's linear equation – Solution of Linear Homogeneous PDE of higher order with constant coefficients.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze Fourier Transform with its properties
CO2 - Apply Z Transform with its properties to solve difference equations.
CO3 - Create analytic function, bilinear transformation with its properties.

CO4 - Evaluate complex integration using Cauchy Integral theorem and Cauchy Residue theorem
CO5 - Create partial differential equation by eliminating arbitrary constant or functions
CO6 - Solve first order linear PDE and homogeneous higher order PDE's

TEXT / REFERENCE BOOKS

1. Bali N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. J.W. Brown and R.V. Churchill, Complex Variables and Applications, 7th Edition, Mc.Graw Hill, 2004.
3. Erwin Kreyszig, Advanced Engineering Mathematics (8th Edition), John Wiley and Sons, Singapore, 2001.
4. Grewal B.S., Higher Engineering Mathematics, 41th Edition, Khanna Publications, Delhi,2011.
5. Kandasamy P., Thilagavathy K. & Gunavathy K., Engineering Mathematics, (4th Revised Edition),S.Chand & Co., New Delhi, 2001.
6. Veerarajan T., Higher Engineering Mathematics, Tata Mcgraw Hill Publishing Co., NewDelhi, First Edition, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB1301	AC MACHINES	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre Requisite: SEEB1202 **Co**
Requisite: SEEB2301

COURSE OBJECTIVES

- To impart knowledge on Construction and principle operation of Asynchronous and Synchronous machines.
- To impart knowledge on not self-starting AC machines.
- To convey knowledge on speed control of three-phase induction motors.
- To analyze performance characteristics of Synchronous and Asynchronous machines.
- To convey knowledge on synchronized operation of an Alternator with an Infinite bus bar.

UNIT 1 SYNCHRONOUSGENERATORS 10 Hrs.

Constructional features - EMF Equation - Armature Reaction - Synchronous Reactance - Voltage Regulation -Synchronous Impedance Method - MMF and Potier Methods - Synchronising & Parallel Operation - Two Reaction Theory - Determination of Xd and Xq (Slip test).

UNIT 2 SYNCHRONOUS MOTORS 9 Hrs.

Principle of Operation - Starting Methods - Effect of Increased Load with Constant Excitation - Effect of Changing Excitation on Constant Load - Different Torque - Power flow equation - Phasor diagram - V and inverted V curves - Hunting and suppression methods.

UNIT 3 THREE PHASE INDUCTION MOTORS 9 Hrs.

Construction - Types of 3- Phase Induction Motors - Rotating Magnetic Fields - Torque Equation – Condition for Maximum Torque - Slip, Torque Slip Characteristics - Power Stages in Induction Motors - Losses and Efficiency - Plugging - Cogging and Crawling - Concept of Induction Generator.

UNIT 4 CIRCLE DIAGRAM AND CONTROL METHODS OF 3- PHASE INDUCTION MOTOR 9 Hrs.

No load and Blocked rotor tests - Equivalent circuit - Construction of Circle diagram - Starting methods - Speed control - Double cage Induction motor.

UNIT 5 SINGLE PHASE AC MOTORS 8 Hrs.

Double Field Revolving Theory - Types of Single Phase Induction Motor - Equivalent Circuit (Qualitative) -Repulsion Motor - Series Motor - Universal motor, AC Servomotor, Linear Induction Motor, Hysteresis motor.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the principle and predetermine the regulation of a Synchronous Generator.

CO2 - Analyze the operation of synchronous motor under various excitation conditions.
CO3 - Evaluate the characteristics and losses of three phase induction motor.
CO4 - Realize the various methods of starting and testing of three phase induction motor.
CO5 - Evaluate the equivalent circuit of single phase induction motor.
CO6 - Select a suitable AC motor for particular application.

TEXT / REFERENCE BOOKS

1. A K Theraja & B L Thereja, "A Text book of Electrical Technology (Vol II)", S Chand & Co., 23rd Edition 2008.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017
3. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
4. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, edition 2, 2021.
5. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB1302	ELECTROMAGNETIC FIELD THEORY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SMTB1101 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To be familiar with some elementary phenomena and concepts in field theory.
- Acquire knowledge on the concepts of Electro-magnetic field which is essential for understanding the working principle, design and analysis of Electrical machines.
- Can derive, formulate and solve field problems with the help of static and dynamic fields and potentials and use them for electrical systems.
- Analyze the electromagnetic wave propagation using Maxwell's equations, derive Poynting theorem and interpret the physical meaning.

UNIT 1 ELECTRICFILEDS 9 Hrs.

Introduction - Concepts of Different Co-Ordinate Systems, Vector algebra, Vector calculus, Sources and effects of electromagnetic fields - Coulomb's Law, Electric Field Intensity, Electric Field due to Point Charge, Line Charge, Surface Charge and Volume Charge Distributions - Electric Flux Density - Gauss Law - Application of Gauss Law - Electric Potential - Potential Gradient - Divergence and Divergence Theorem - Poisson's and Laplace equation.

UNIT 2 CONDUCTORSANDDIELECTRICS 9 Hrs.

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field - Field due to Dipoles - Dipole Moment - Boundary Conditions at Dielectric and Conductor Surfaces - Capacitor and Capacitance of a System of Conductors - Energy Stored and Energy Density - Capacitance due to Spherical Shell, Coaxial cable and Two Wire Transmission Line - Electrostatic Potential Energy Associated with Different Charges.

UNIT 3 MAGNETICFIELDS 9 Hrs.

Current and Current Density - Conduction and Convection Current - Force on a Current Element - Lorentz force - Biot- Savart's law - Force between Current Carrying Conductors - Torque on Closed Conductors - Ampere's Law- Magnetic Flux Density - Curl and Stokes Theorem - Magnetic Vector Potential - Boundary Condition at the Magnetic surfaces.

UNIT 4 FARADAY'S LAW OFELECTROMAGNETICINDUCTION 9 Hrs.

Faradays' Laws - Self and Mutual Inductance - Inductance of Solenoids, Toroids, Transmission Lines and Cables - Energy Stored and Density in Magnetic Circuits - Relation between field theory and circuit theory, Applications.

UNIT 5 MAXWELL'S EQUATION ANDELECTROMAGNETICWAVES 9 Hrs.

Wave parameters; velocity, intrinsic impedance, propagation constant - Concept of Displacement and

Conduction Current - Modified Ampere's Circuital Law - Maxwell's Equations in point and Integral Forms - Wave Equations - Plane Waves in Free Space - Polarization - Poynting's Theorem and Poynting Vector and its Significance - Energy in Electromagnetic Field - Plane wave reflection and refraction – Standing Wave, Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the various laws used in electromagnetic fields.
CO2 - Analyze the concepts of capacitance in cables and transmission lines.
CO3 - Apply the concepts of basic theorems and laws relating to magnetic field.
CO4 - Analyze self and mutual inductance in solenoid, toroid, transmission lines and cables.
CO5 - Evaluate the interaction of electric and magnetic fields in various media.
CO6 - Design electrical system using Maxwell's equation.

TEXT / REFERENCE BOOKS

1. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Sixteenth Edition Eighth Reprint :2015
2. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers,2018.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Fifth Edition (Schaum's Outline Series), McGraw Hill, 2018.
4. Karl.E.Lonngren, Sava.V.Savov, "Fundamentals of Electromagnetics with MATLAB", PHI,2005.
5. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
6. R.Meenakumari & R.Subasri, "Electromagnetic Felds", New Age International Publishers, 2nd Edition, 2007.
7. E.C.Jordan & K.G.Balmain, "Electromagnetic Waves & Radiating Systems", Prentice Hall, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

S13BLH31	ELECTRONIC CIRCUITS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre Requisite: SECB1101 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To familiarize the student with the design and analysis of Rectifiers and power supplies.
- To understand different Transistor biasing circuits.
- To understand Small signal analysis of FET and MOSFET amplifiers.
- To understand working of feedback amplifiers, oscillators, tuned amplifiers and multivibrators.

UNIT 1 RECTIFIERS AND POWER SUPPLIES 9 Hrs.

Half Wave Rectifier - Full Wave Rectifier - Bridge Rectifier - Performance of Rectifiers - Filters - Types of Filters - L, C, LC and Filters - Ripple Factor Calculation for C, L, LC and Filter - Regulators - Shunt and Series Voltage Regulator - SMPS.

Practice Problems (in Hardware)

1. Determination of Ripple factor, % Regulation of HWR with and without filter.
2. Determination of Ripple factor, % Regulation of FWR with and without filter.
3. Design of series voltage regulator and perform line and load regulation.

UNIT 2 SMALL SIGNAL AMPLIFIERS 9 Hrs.

Biasing circuit of BJT, DC equivalent circuit of BJT, DC and AC Load Lines, Stability factor analysis, Two port devices and hybrid model - transistor hybrid model and h parameters - determination of h-parameters from the characteristics - Analysis of transistor amplifier using h -parameters - Low frequency FET model -Common Source and Common drain amplifiers.

Practice Problems (in Hardware)

1. Design and construct BJT Common Emitter Amplifier using voltage divider bias (self-bias) with and without bypassed emitter resistor.

UNIT 3 MULTI STAGE AMPLIFIERS AND LARGE SIGNAL AMPLIFIERS 9 Hrs.

Cascading amplifiers - direct coupled and capacitor coupled two stage CE amplifiers - Darlington Pair - Cascode Amplifier- Bootstrap amplifier- Classification of Power amplifiers - Class A Power Amplifier- direct and Transformer coupled amplifiers - Class B Push-pull arrangements and Complementary symmetry amplifiers - efficiency calculations, Amplifier distortion, power dissipation - Class AB amplifier - Power transistor heat sinking - Class C and D amplifiers.

Practice Problems (SIMULATION USING PSPICE):

1. Differential amplifier using BJT

2. Darlington Amplifier using BJT.

UNIT 4 FEEDBACK AMPLIFIERS AND OSCILLATORS 9 Hrs.

Feedback Amplifiers: Feedback concept - General characteristics of negative feedback amplifiers - Four basic types of feedback topologies - Voltage and current feedback amplifiers. Oscillators: Barkhausen criterion - LC oscillators - Analysis of Hartley, colpitts - RC oscillators - Phase shift and wein bridge types and analysis - Crystal oscillators and frequency stability.

Practice Problems (SIMULATION USING PSPICE)

1. Design of RC Phase shift oscillator for a specified frequency.
2. Frequency response of Series and Shunt Feedback amplifier.

UNIT 5 TUNED AMPLIFIERS AND MULTI VIBRATORS 9 Hrs.

Tuned Amplifiers - single tuned -double tuned -stagger tuned amplifiers - Instability of Tuned Amplifier - Neutralization and Unilateralization - Multivibrators - Collector coupled Astable, Monostable and Bistable Multivibrators.

Practice Problems (SIMULATION USING PSPICE):

1. Time and frequency response of Single Tuned Amplifier.
2. Time response of Astable Multivibrator, Mono stable Multivibrator and Bistable Multivibrator.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the equivalent circuits and characteristics of basic electronics devices.
CO2 - Analyze basic linear electronics circuits and their working principle.
CO3 - Design suitable DC Power supplies for world.
CO4 - Design suitable multistage amplifiers for real world.
CO5 - Design negative feedback amplifier circuits and oscillators.
CO6 - Analyze various solid state power amplifier circuits.

TEXT / REFERENCE BOOKS

1. S Millman and Halkias, “Integrated Electronics”, Tata McGraw Hill International, 2008.
2. R.L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Pvt. Ltd, India, 9th edition, 2008.
3. D.Roy Choudhury & Shail B Jain, “Linear Integrated Circuits”, 3rd edition. 2007.
4. David. A. Bell, “Electronic Devices and Circuits”, PHI Learning Private Ltd, India, 4th edition 2008.
5. R.A. Gayakwad, “Op-Amps and Linear integrated circuits”, PHI, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

PART A	**MCQ Questions**	**20 Marks**
PART B	**Laboratory Practical**	**80 Marks**

S11BLH22	FUNDAMENTALS OF PYTHON PROGRAMMING	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

Pre Requisite: Nil **Co**
Requisite: Nil

UNIT 1 INTRODUCTION

Introduction, History, Features of Python, Data types, Variables, Expressions, Conditional Statements, Operators, Looping, Control Statements

Practice Programs

1. Develop a python program to find the best of two test average marks out of three test's marks accepted from the user and compute the overall pass percentage for their placements.
2. Write a class Money with attributes Rupees and Paise. Overload operators +=, -=, and >= so that they maybe used on two objects. Also write functions so that a desired amount of money can be either added or subtracted from Money.

UNIT 2 FUNCTIONS AND STRINGS

Function Calls, Conversion of functions, Arguments, Fruitful Functions, Boolean functions, Strings, Looping and Counting, String Operations.

Practice Programs

1. Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.
2. Analyze the string similarity between two given strings using Python program

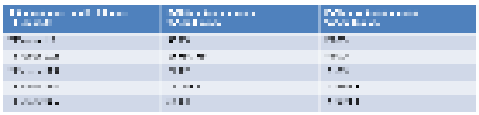
Sample Output:	Sample Output:
Original string:	Original string:
Python Exercises	Python Exercises
Python Exercise	Python Exercises

UNIT 3 LIST, TUPLES AND DICTIONARIES

List, List Operations Built in List functions, Tuple, Tuple Operations, Dictionary, Operations in Dictionary, Built in Dictionary Methods.

Practice Programs

A hospital has received a set of lab reports. Totally five tests are conducted in the lab and the report is prepared in such a way that the 'n^{th}' number correspond to value of $test_n$. Given the details of a test made for a patient, write an algorithm and the subsequent Python program to print if the test result is normal or not normal by referring the values in Table 1. Since the value is sensitive, provide a mechanism so that the values do not get altered.



An University has published the results of the term end examination conducted in April. List of failures in physics, mathematics, chemistry and computer science is available. Write a program to find the number of failures in the examination. This includes the count of failures in one or more subjects.
Write a program to maintain a telephone directory of the employees of an organization. If the employee has more than one number store all the numbers. Write a program to print the mobile numbers given full or part of the name of the employee. Eg: Given name of the employee as 'John' the program must print phone numbers of 'John Paul' and 'Michel John'.

UNIT 4 FILES AND REGULAR EXPRESSIONS

Files, File Handling Operations, User Defined Exceptions, Regular Expression, Types using Match function, Postfix, Infix, prefix conversion.

Practice Programs

A proctor of our university wants a student to write a program that calculates the average of marks scored by her wards in CAT1. She has the details such as name, register number, mark1, mark2 and mark3 of her proctees. The constraint given by the faculty is that any of the details must not be altered by mistake. Help the student to develop a Python program.
Consider the following scenario for finding the number of students who secured centum in mathematics in their examination. A total of 6 lakhs students appeared for the examinations and their results are generated automatically and updates to the portal using file.

UNIT 5 CREATING GUI FORM, CLASSES AND OBJECTS

Creating a GUI Window, Widgets, Buttons, Canvas, Layout Management, Designing GUI Applications using Tkinter module, Overview of OOP, class Definitions, Built in Class Attributes, Real time Examples using Classes and objects.

Practice Programs

A farmer with a fox, a goose, and a sack of corn needs to cross a river. Now he is on the east side of the river and wants to go to west side. The farmer has a rowboat, but there is room for only the farmer and one of his three items. Unfortunately, both the fox and the goose are hungry. The fox cannot be left alone with the goose, or the fox will eat the goose. Likewise, the goose cannot be left alone with the sack of corn, or the goose will eat the corn. Given a sequence of moves find if all the three items fox, goose and corn are safe. The input sequence indicate the item carried by the farmer along with him in the boat. 'F' – Fox, 'C' – Corn, 'G' – Goose, N-Nothing. As he is now on the eastern side the first move is to west and direction alternates for each step.
An university is setting up a new lab at their premises. Design an algorithm and write Python code to determine the approximate cost to be spent for setting up the lab. Cost for setting the lab is sum of cost of computers, cost of furniture and labour cost. Use the following formulae for solving the problem:

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Apply the concept of Data types, conditional statements and looping in Python programming.
CO2 - Apply functions in Python for real time problems.
CO3 - Analyze the use of List, Tuples and Dictionaries in Python programming.
CO4 - Develop python programming for web applications using regular expression.
CO5 - Design GUI in Python for various applications.
CO6 - Develop solution in Python for any specific real time problem.

TEXT / REFERENCE BOOKS

1. Introduction to Programming Using Python by Y. Daniel Liang (Pearson Publishing), ISBN 9780132747189.
2. http://www.pythontutor.com/visualize.html .
3. https://docs.python.org/2/tutorial .
4. The Practice of Computing Using Python, by W. Punch and R. Enbody, 3-rd edition, Pearson Publishing, ISBN 978-0- 13-437976-0.
5. https://www.learnpython.org.
6. https://www.youtube.com/watch?v=_uQrJ0TkZlc.

ENDS EMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A	**MCQ Questions**	**20 Marks**
PART B	**Laboratory Practical**	**80 Marks**

SISB4301	UNIVERSAL HUMAN VALUES	L	T	P	EL	Credits	Total Marks
		2	0	0	3	3	100

Pre Requisite: Nil **Co Requisite:** Nil

COURSE OBJECTIVES

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence
- To strengthen self-reflection
- To develop commitment and courage to act

UNIT 1 COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT 2 UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

7. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT 3 UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT 4 UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

1. Understanding the harmony in the Nature.
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT 5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

1. 22. Natural acceptance of human values.
2. 23. Definitiveness of Ethical Human Conduct.
3. 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
4. 25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. 26. Case studies of typical holistic technologies, management models and production systems.
6. 27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and

organizations.

7. 28. Sum up.
8. Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Total: 28 Lectures and 14 Practice Sessions

COURSE OUTCOMES

On completion of the course, the student are expected

CO1 - Explore about one's own self and self's interaction with its surroundings (family, society, nature).

CO2 - Solve problems with naturally acceptable sustainable solutions, while keeping human relationships and human nature in mind.

CO3 - Develop better critical ability by understanding that others are complementary and not competitive.

CO4 - Develop commitment towards right understanding, relationship and physical relationship.

CO5 - Apply what they have learnt to their own self in different day-to-day settings in real life, thereby at least a beginning would be made in this direction.

CO6 - Develop right skills to co-exist with nature which is the ultimate level of harmony.

TEXT /REFERENCE BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj – Pandit Sunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

ASSESSMENT

Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks
End Semester Examination: 50 marks

SEEB2301	AC MACHINES LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre requisite: SEEB1301 **Co**

Requisite: Nil

COURSE OBJECTIVES

- Acquire knowledge about the construction details of Synchronous and Asynchronous machines.
- To impart knowledge on self-starting methods of AC machines.
- To convey knowledge on Starting of three-phase induction motors.
- To analyze the operation of various Asynchronous machine with different load condition.
- To obtain the characteristics of Synchronous and Asynchronous machines by performing suitable test.

SUGGESTED LIST OF EXPERIMENTS

1. Regulation of Alternator by EMF and MMF method.
2. Regulation of Alternator by Potier method.
3. Regulation of salient pole Alternator by slip test.
4. Load test on 3 Phase Alternator.
5. Synchronizing and parallel operation of three phase Alternator with infinite bus bar.
6. V curve and inverted V curves of synchronous motor.
7. Brake load test on three phase squirrel cage induction motor.
8. Load test on three phase Slip ring Induction motor.
9. Load test on Single phase Induction motor.
10. Equivalent circuit of Single phase Induction motor.
11. Circle diagram and performance of three phase Induction motor.
12. Study on characteristics of Induction generator.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire knowledge about the predetermination of voltage regulation of alternator.
CO2 - Determine the voltage regulation of alternator with various types of load.
CO3 - Comprehend synchronized operation of an Alternator with an Infinite bus bar.
CO4 - Analyze the performance characteristics of synchronous motor.
CO5 - Determine and Predetermine performance characteristics of induction motor.
CO6 - Analyze the characteristics of induction generator.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100 **Exam Duration:3 Hrs.**

CAE	Evaluation of Regular Lab class	**30 Marks**
	Model practical exam	**20 Marks**
ESE	University Practical exam	**50 Marks**

SMTB1401	FOURIER SERIES AND NUMERICAL METHODS (COMMON TO ALL BRANCHES EXCEPT BIO GROUPS, CSE & IT)	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SMTB1301 **Co**

Requisite: Nil

COURSE OBJECTIVES

- The Objective of this Course is to identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- The purpose of this course is for modeling the Engineering problems and obtaining its solutions mathematically.
- This helps in understanding Science, Engineering and Computer Science analytically and logical thinking is attained.

UNIT 1 FOURIER SERIES 9 Hrs.

Fourier series – Euler's formula – Dirichlet's conditions – Fourier series for periodic functions – Parseval's identity (without proof) – Half range cosine series and sine series – simple problems – Harmonic Analysis.

UNIT 2 APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 9 Hrs.

One dimensional wave equation – Transverse vibrating of finite elastic string with fixed ends – Boundary and initial value problems – One dimensional heat equation – Steady state problems with zero boundary conditions – Two dimensional heat equation – Steady state heat flow in two dimensions- Laplace equation in Cartesian form(No derivations required).

UNIT 3 NUMERICAL METHODS FOR SOLVING EQUATIONS 9 Hrs.

Solution of algebraic equation and transcendental equation: Regula Falsi Method, Newton Raphson Method (including solving algebraic equations in two variables $f(x,y)=0$ and $g(x,y)=0$) – Solution of simultaneous linear algebraic equations: Gauss Elimination method, Gauss Jacobi method and Gauss Seidel method.

UNIT 4 INTERPOLATION, NUMERICAL DIFFERENTATION ANDINTEGRATION 9 Hrs.

Interpolation: Newton forward and backward interpolation formula, Lagrange's formula for unequal intervals – Numerical differentiation: Newton's forward and backward differences to compute first and second order derivatives – Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule and

Simpson's 3/8th rule.

UNIT 5 NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATIONS 9 Hrs.

Ordinary differential equations: Taylor series method, Runge Kutta method for fourth order - Partial differential equations – Finite differences – Laplace equation and its solutions by Liebmann's process – Solution of Poisson equation – Solutions of parabolic equations by Bender Schmidt Method – Solution of hyperbolic equations.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Develop Fourier series for different types of functions.
CO2 - Derive and obtain the solutions of wave and heat equations.
CO3 - Formulate numerical solution of algebraic, transcendental and simultaneous linear equations.
CO4 - Solve interpolation, numerical differentiation and integration problems.
CO5 - Analyze various numerical methods for the solution of ordinary differential equations.
CO6 - Apply numerical techniques to solve partial differential equations.

TEXT /REFERENCE BOOKS

1. Kreyszig E., Advanced Engineering Mathematics, (8th Edition), John Wiley and Sons (Asia)Pte Ltd., Singapore, 2001.
2. Grewal B.S., Higher Engineering Mathematics, , 41th Edition, Khanna Publications, Delhi,2011.
3. Kandasamy P., Thilagavathy K. &Gunavathy K., Engineering Mathematics, (4th Revised Edition), S.Chand & Co., New Delhi, 2001.
4. Veerarajan,T., Engineering Mathematics, Tata Mcgraw Hill Publishing Co., New Delhi, 2005.
5. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata Mcgraw Hill Publishing Co., NewDelhi, 2003.
6. Kandasamy P., Thilagavathy K. and Gunavathy, K., Applied Numerical Methods, S.Chand & Co., New Delhi, 2003.
7. E.Balagurusamy, Numerical Methods, McGraw-Hill Education (India) Pvt Limited, 1999.
8. B.S. Grewal, Numerical Methods In Engineering Science , Khanna Publisher, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SEEB1401	CONTROL SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SMTB1201 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.
- To analyze the response and error of various types of system in time domain.
- To understand the stability analysis of frequency domain systems.
- To analyze the open loop system in frequency domain.
- To implement the design of controllers and compensators.

UNIT 1 SYSTEMCONCEPTS 10 Hrs.

Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Mathematical Models of Physical System: Differential Equation- Transfer Functions of Single Input, Single Output and Multi Variable Systems - Simple Electrical Networks, Electrical Analogous of Mechanical Translational and Rotational System - D.C and A.C Servomotor - Mechanical System-Translational and Rotational System - Block Diagram Reduction Techniques - Signal Flow Graphs - Mason's Gain Formula.

UNIT 2 TIME RESPOSE ANALYSIS OFCONTROLSYSTEMS 9Hrs.

Standard Test Signals -Time Response of First and Second Order System, Time Domain-Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.

UNIT 3 STABILITY OFCONTROLSYSTEM 9Hrs.

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.

UNIT 4 FREQUENCYRESPONSEANALYSIS 9Hrs.

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin - Bode Plot - Nyquist Plot (Polar Plot).

UNIT 5 COMPENSATIONANDCONTROLLERS 8Hrs.

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag,

Lead and Lag-Lead compensation on system performance and design using bode plot - P, PI, PID Controllers design.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the types of control systems in different domains.
CO2 - Analyse the response of any linear time invariant system.
CO3 - Identify the type of errors and obtaining their constants.
CO4 - Determine and analyze the stability of the system.
CO5 - Perform the analysis of the control system in both time and frequency domains.
CO6 - Design a controller and a compensator in frequency domain.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International (p) Limited Publishers, 2nd Edition, 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th Edition,2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition2009.
4. M.N. Bandyo padhyay, "Control Engineering, Theory and Practice" PHI, 4th print,2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, Reprint,2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd Edition, reprint2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised Reprint 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each –No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SEEB1402	TRANSMISSION AND DISTRIBUTION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighboring circuits.
- To understand the mechanical design and performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand and analyze the distribution system.

UNIT 1 TRANSMISSION LINE PARAMETERS 9Hrs.

Structure of electric power system - Resistance, Inductance and Capacitance of Single Phase and Three Phase (Including Double Circuits) Transmission Lines - Stranded and Bundled Conductors - Symmetrical and Unsymmetrical Spacing - Transposition - Application of Self and Mutual GMD - Skin and Proximity Effect - Inductive Interference with Neighboring Circuits - Corona - Factors Affecting Corona - Advantages and Disadvantages of Corona - Methods of Reducing Corona Effect.

UNIT 2 MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9Hrs.

Performance of Transmission lines -Equivalent Circuits for Short, Medium (and T circuits) and Long Lines - Efficiency and Regulation - Attenuation Constant, Phase Constant, Surge Impedance and Surge Impedance Loading - Real and Reactive Power Flows in Lines - Power Circle Diagrams for Receiving and Sending Ends - Ferranti Effect.

UNIT 3 SAG CALCULATION AND LINE SUPPORTS 9Hrs.

Insulators - Types and Construction - Voltage Distribution in String Insulator - String Efficiency – Methods of Improving String Efficiency - Testing of insulators - Stress and Sag Calculations - Effect of Wind and Ice - Supports at Different Levels - Stinging Chart.

UNIT 4 UNDERGROUND CABLES 9Hrs.

Underground Cables – Types of cables - Construction of single-core and 3-core belted cables - Insulation Resistance -Capacitance of Capacitance of single-core and 3-core belted Cables - Dielectric Stress and Grading - Dielectric Loss - Thermal Characteristics .

UNIT 5 DISTRIBUTION SYSTEMS 9Hrs.

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions –Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement – Distribution Loss – Electrical Layout & Bus Bar Arrangement in Generating Sub Stations and Bulk Power Substation – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS -SVC,TCSC,STATCOM, UPFC(Qualitative treatment only).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Evaluate transmission line parameters for single and three phase system.
CO2 - Analyze the performance of over head transmission line.
CO3 - Design the overhead transmission line on mechanical aspect and estimate the performance parameters of the line.
CO4 - Design the underground cables and understand the performance analysis of underground cable.
CO5 - Examine the modelling and performance analysis of distribution system.
CO6 - Develop compensation techniques for transmission line using FACTS devices.

TEXT / REFERENCE BOOKS

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Sixth Edition, 2011.
2. C.L. Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Limited, New Delhi, 2010.
3. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
4. Arun Ingole, "Power transmission and distribution" Pearson Education, first edition, 2018
5. J.Brian Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2011.
6. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
7. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013
8. R.K.Rajput, 'A Text Book of Power System Engineering' 2nd edition, Laxmi Publications (P) Ltd, New Delhi, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each –No choice **20 Marks**

PARTB: 2 Questions from each unit of internal choice; each carrying16 marks **80 Marks**

SEEB1403	POWER ELECTRONICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SECB1101 **Co**
Requisite: SEEB2401

COURSE OBJECTIVES

- To impart knowledge on different types of power semiconductor devices and its switching characteristics.
- To study the operation, characteristics and performance parameters of controlled rectifiers.
- To understand the operations of choppers and inverters.
- To get acquainted with the applications of power electronics converters.

UNIT 1 POWER SEMICONDUCTOR DEVICES 9 Hrs.

Overview of switching devices - Switching characteristics of Power MOSFETS, IGBT, Thyristor, SiC device and - SCR Protection circuits - Thyristor Turn-ON methods - Firing circuits - Commutation techniques.

UNIT 2 PHASE CONTROLLED RECTIFIERS 10 Hrs.

Principle of phase controlled converter operation - single phase half wave converter, semi converter & full converter with R, RL & RLE load - Freewheeling diode - Inverter operation of full converter - Three phase Semi converter & full converter with RL load.

UNIT 3 DC & AC CHOPPERS 9 Hrs.

DC - DC: Principle of operation of Step down and step up choppers - Control Strategies - One, Two and Four quadrant operation. AC - AC Chopper: Single phase AC voltage controllers with R & RL load - Multistage sequence control. Single phase step up and step down cyclo converters.

UNIT 4 INVERTERS 9 Hrs.

Principle of operation: Single phase half bridge & full bridge voltage source inverters –Series Inverters – Parallel Inverters. Three phase Voltage source inverters (120° and 180° mode) - Single phase current source inverter. PWM techniques: Single pulse PWM, Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM.

UNIT 5 APPLICATIONS8 Hrs.

SMPS: Flyback and Push Pull - UPS: Redundant and Non-Redundant - HVDC Transmission systems –

DC – DC converters for Electric Vehicles - Power conversion techniques in for Electric Vehicles – converters for wired charging-Wire-less charging Inverters for standalone photovoltaic systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the V – I and Switching Characteristics of various Semiconductor Devices.

CO2 - Evaluate the various performance parameters of different converters.

CO3 - Analyze different Chopper Circuits.

CO4 - Design various Inverters based on real time applications.

CO5 - Analyze the Knowledge acquired in Power Electronics for High voltage applications.

CO6 - Design Power Electronic Converters to enhance the performance of Renewable Energy sources.

TEXT / REFERENCE BOOKS

1. Rashid M.H., “Power Electronics circuits Devices and Applications”, Prentice Hall, 3rd Edition, New Delhi, 2013.
2. P.S.Bimbhra, “Power Electronics”, Khanna Publishers, 4rd Edition, 2017.
3. P.C.Sen, “ Power Electronics”, Tata Mc Graw Hill Company, New Delhi, 2015.
4. M.D.Singh and K.B.Khanchandani, “Power Electronics” TMH, New Delhi, 2nd Edition, 2008.
5. Ned Mohan, Tore .M. Undel and William P. Robbins “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 3rd Edition, 2003.
6. Philip T. Kerin, “Elements of Power Electronics” Oxford University Press, 2004 Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

S11BLH31	DATA STRUCTURES USING C	L	T	P	EL	Credits	Total Marks
		2	0	2	0	4	100

Pre Requisite: Problem Solving Techniques using C **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart the basic concepts of data structures and algorithms.
- To be familiar with writing recursive methods.
- To understand concepts about searching and sorting techniques.
- To implement basic concepts about stacks.
- To apply the concepts of queues and its types.

UNIT I LINKED LIST 12 Hrs

Introduction-Singly linked list-Representation of a linked list in memory-Operations on a singly linked list-Merging two singly linked lists into one list - Reversing a singly linked list - Applications of singly linked list to represent polynomial -Advantages and disadvantages of singly linked list-Circular linked list-Doubly linked list-Circular Doubly Linked List.

UNIT II STACKS 6 Hrs

Basic Stack Operations - Representation of a Stack using Arrays - Algorithm for Stack Operations - Stack Applications: Reversing list - Factorial Calculation - Infix to postfix Transformation - Evaluating Arithmetic Expressions.

UNIT III QUEUES 6 Hrs

Basic Queue Operations - Representation of a Queue using array - Applications of Queues - Round robin Algorithm - Enqueue - Dequeue - Circular Queues - Priority Queues – Searching and Sorting Algorithm.

UNIT IV INTRODUCTION TO TREES 10 Hrs

Trees- Ordinary and Binary trees terminology, Properties of Binary trees, Implementation using Array and Linked list - Binary tree ADT representations, recursive and non - recursive traversals - Binary Search Tree - Insertion and Deletion - Threaded Binary Trees, AVL Tree, B-tree Insertion and deletion, Splay trees - Heap trees - Heapify Procedure.

UNIT V INTRODUCTION TO GRAPHS 11 Hrs

Terminology, Representation using Array and Linked List - Types of graphs - Graph traversals - BFS and DFS – Applications - Minimum Spanning Tree - Kruskal's, Prim's Algorithm - Shortest path using Dijkstra's Algorithm. All Modules include Experimental Studies.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Demonstrate the different types of data structures
CO2 Illustrate the operations on linear data structures.
CO3 Compare the operations of linear and non-linear data structure
CO4 Choose appropriate data structure as applied to specified problem definition
CO5 Formulate a data structure for given application
CO6 Design a linear and non-linear data structure

TEXT/ REFERENCE BOOKS

1. Jean-Paul Tremblay,Paul G.Sorenson,"An Introduction to Data Structures with Application",TMH,2017.
2. Richard F,Gilberg,Forouzan,"Data Structures",Cengage,2004,2nd Edition.
3. Larry R .Nyhoff,A DTs, "Data Structures, and Problem Solving with C++",Prentice Hall Edition,2004.
4. Thomas H.Cormen, Charles E.Leiserson,"Introduction to Algorithms",3rd Edition,2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3Hrs.

PART A: MCQ Questions **20 Marks**

PART B: Laboratory Practical **80 Marks**

SEEB2401	POWER ELECTRONICS AND ELECTRIC VEHICLE LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre requisite:SEEB1403 **Co**

Requisite: Nil

COURSE OBJECTIVE

- To enhance practical knowledge in power conversion technique
- To examine power converter circuits with various loads.
- To understand the operation of power converter using timing diagram
- To examine the controller used for motor in E-Vehicle
- To understand the charging and discharging characteristics of battery

SUGGESTED LIST OF EXPERIMENTS

1	Single Phase Half & Fully Controlled Bridge Rectifier
2	SCR based series and Parallel Inverter
3	AC Regulator-Phase Control Using DIAC &TRIAC
4	Single phase Cyclo converter
5	MOSFET Based Buck & Boost Converter
6	IGBT Based Single Phase PWM Inverter
7	MATLAB / Simulink Simulation Buck Converter Boost Converter Buck-Boost Converter Controlled Rectifier
8	Real Time FPGA controlled BLDC HUB motor drive for E-Bike
9	Real Time FPGA controlled Mid-Drive motor drive for E-Vehicle
10	Discharge characteristics of Lithium –Ion Battery for different load current.
11	Study and testing of two wheeler control components function
12	Design and testing of battery using battery emulator
13	Charging and Discharging test of real battery using battery emulator

COURSE OUTCOMES:

On completion of the course, student will be able to

–

CO1 - Apply power conversion to different load using SCR and MOSFET
CO2 - Analyze the DC-AC power conversion using different control methods
CO3 - Examine the AC power control for varying frequency and voltage
CO4 - Design a FPGA controller to control the BLDC motor for E-Vehicle
CO5 - Analyze the charging and discharging characteristics of battery using emulator
CO6 – Test of E-Bike control components function

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100 Exam Duration:3 Hrs

CAE	Evaluation of Regular Lab class	30 Marks	50 Marks
	Model practical exam	20 Marks	
ESE	University Practical exam		50 Marks

SCSBDPROJ	DESIGN THINKING AND INNOVATIONS	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- To apply knowledge in Real time problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to Engineering /Non-Engineering problems.

Activity 1:

Design thinking introduction:

- Phases of design thinking- a study approach
- Group Discussion on Ideation- Users perspective
  Formation of team – Thinking skills- Brain storming

Activity 2:

Problem identification (phase I)

- Selecting user requirements
- Survey on various user's applications
- Specific Problem selection to proceed with the work – Team presentation on identified problems and various possible solutions.

Activity 3:

Problem identification (Phase II)

- Study of an application and its importance to end user.
- Various models of an applications
- Finalize the identified problem

Activity 4:

Design ideation and various stages

- Sketch design diagram
- Architecture or full diagrammatic study

Activity 5:

Review and upgradation

- Review of the ideation (one to one interaction)
- Feedback
- Upgradation plan

Activity 6:

Implementation(Phase I)

- Build the prototype using available resources
- Record Module diagrams

Activity 7:

Implementation(Phase II)

- Display and review of the prototype.
- Record its functionality and its Usage-Technical manual

Activity 8:
Testing

- To test the product design with real time environment
- Record Process-user manual

Activity 9:
IPR-Activity I

- To study various IPR activities
- To prepare for IPR Process
- To file an IPR

Activity 10:
Start-ups Formation

- To exhibit the product to public: feedback approach
- To prepare full documentation

Start-ups registration/apply patent/publish paper/submit model/prototype/Apply for seed/submit as research proposal**COURSE OUTCOMES:**

On completion of the course, student will be able to

CO1 Solve real world problems by applying knowledge across domains

CO2 Develop various design products, processes or technologies for sustainable and socially relevant applications

CO3 Demonstrate knowledge of resource utilization/budgets to implement appropriate methodologies

CO4 Execute tasks by application of engineering standards/ requirements/ design criteria, within timelines

CO5 Conduct extended investigation that results in the translation of idea to product / production of a research thesis/ developing a proof of concept.

CO6 Communicate well organized technical and scientific findings effectively in written and oral forms, following ethical and professional norms

Text Book:

TEXT / REFERENCE BOOKS

1. Mueller-Roterberg, Christian. "Handbook of Design Thinking."Hochschule Ruhr West (2018).
2. Design Kit by IDEO.org. "The field guide to human centered design." (2015), ISBN: 978-0-9914063-1-9.
3. https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy
4. https://www.interaction-design.org/literature/article/stage-4-in-the-design-thinking-process-prototype
5. https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
6. https://uxplanet.org/what-are-insights-aa1f2d1b3b9c
7. https://labs.sogeti.com/using-design-thinking-to-design-business-models/
8. https://www.northeastern.edu/graduate/blog/implementing-business-model-innovation/

SECB1401	ANALOG INTEGRATED CIRCUITS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: Nil **Co**

Requisite: SECB1501

COURSE OBJECTIVES

- To have thorough understanding of Op-Amp.
- To be able to design circuits using op amp for various applications.
- To acquire knowledge about ADC and DAC.
- To study the basic principles of PLL and Timer Circuit.
- To understand the concept of Special function ICs.

UNIT1 INTRODUCTION TO OP- AMP ANDITSAPPLICATIONS.9Hrs.

OP-AMP- DC and AC Characteristics- Input offset voltage- Input bias current-Input offset current- Total output offset voltage- Thermal drift- Slew rate- CMRR -Inverting amplifier- Non-inverting amplifier- Voltage follower- Summing and differential amplifier- Integrator- Differentiator- Logarithmic and Anti logarithmic amplifiers-Comparator and Schmitt trigger.

UNIT2 FILTERS ANDSIGNALGENERATORS 9Hrs.

First order and Second order Butterworth filters- low pass, high pass, band pass and band reject filters -RC phase shift, Wein's bridge oscillator- Astable and Monostable multivibrator-Precision half wave and full wave rectifiers.

UNIT3 A/D ANDD/A CONVERTERS 9Hrs.

Sample and Hold circuit - Digital to analog converters: R-2R ladder network and Binary weighted - Characteristics of D/A converters - Analog to digital converters: Flash converter - Successive approximation converter - Dual slope ADC-Weighted- Capacitor DACs- Oversampling Converters.

UNIT4 PLL AND INSTUMENTATION AMPLIFIER 9Hrs.

Phase Locked Loop IC 565- Block schematic - Applications of PLL: FM demodulator and Frequency synthesizers Demodulator - AD623 Instrumentation Amplifier and its application as load cell weight measurement

UNIT5 WAVEFORM GENERATOR 9Hrs.

Square wave generators: 555Timer, Crystal controlled Oscillator Ramp Generator: Triangle generator,

Sawtooth generator Sine wave generator: Requirement for sinusoidal oscillations, Wien-bridge and twin-T oscillators. Function Generators: Multi op-amp function generators.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO 1 Analyze the pe
CO 2 Build circuits u
CO 3 In-depth know
CO 4 Design solutio
CO 5 Design various
CO 6 Design A/D ar

TEXT / REFERENCE BOOKS

1. D.RoyChoudary, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2022.
2. James M . Fiore, Operational amplifier and linear Integrated circuits: Theory and applications,2020
3. Ramakant A.Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015
4. S. Salivahanan, V.S. Kanchana Bhaaskaran, "Linear integrated circuits", 3rd Edition, McGraw-Hill, 2011.
5. William D.Stanely, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
6. Sergio Franco "Design With Operational Amplifiers and Analog Integrated Circuits" 4 th Edition, McGraw-Hill Education, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks **80 Marks**

		L	T	P	EL	Credits	Total Marks
SEEB1501	**POWER SYSTEM ANALYSIS**	**3**	**1**	**0**	**0**	**3**	**100**

Pre requisite: Nil **Co**

Requisite: SEEB2601

COURSE OBJECTIVES

- To impart knowledge in modelling of power system elements.
- To implement Numerical methods in power flow problem.
- To analyze the system in various fault conditions.
- To have a knowledge in stability of power systems.

UNIT1 POWER SYSTEM MODELING 9Hrs.

Need for system analysis in planning and operation of power system – - Per unit representation – Single Phase and Three Phase System–-Reactance Diagram - bus admittance by analytical method and direct inspection method – Bus Impedance Matrix

UNIT 2 POWER FLOW ANALYSIS9 Hrs.

Problem definition - bus classification - derivation of power flow equation - solution by Gauss Seidel and Newton Raphson methods by polar form - P V bus adjustments for both methods - computation of slack bus power, line flow and transmission loss.

UNIT3 SYMMETRICAL COMPONENETS9Hrs.

Introduction of symmetrical components - Positive, Negative and Zero sequence - Symmetrical component transformation matrices used in resolution of unbalanced voltages and currents- Sequence Impedances and Network - Positive, Negative and Zero sequence networks of power system components like Generator, transformers, transmission lines, loads.

UNIT4 Symmetrical and Unsymmetrical Fault Analysis9Hrs.

Symmetrical fault analysis - Need for short circuit study - Symmetrical short circuit analysis using Z-bus. - computations of short circuit capacity, post fault voltage and current - unsymmetrical short circuit analysis for single line fault, line to line fault and double line to ground fault using unloaded generator and fault through impedance.

UNIT 5 STABILITY & SECURITY ANALYSIS 9 Hrs.

Distinction between steady state and transient state - Concepts of Stability & Security - Swing equation-solution to swing equation - step by step method - power angle equation - equal area criterion - critical clearing angle and time. Stability analysis of single machine connected to infinite bus by modified Euler's method - Multi-machine stability analysis using Runge Kutta method.

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Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1Model Reactance networks for the given power system Network and formulate bus admittance and Bus Impedance matrix.

CO2 - Analyze Y Bus in load flow analysis and examine the power flows and voltages in a power grid.

CO3 - Analyze the concepts of Symmetrical components and sequence networks of power system components.

CO4 - Analyze symmetrical and unsymmetrical faults and solve for the fault voltages and currents for various types of faults.

CO5 - Analyze the transient and steady state stabilityCondition

CO6 - Solve transient stability problems.

TEXT / REFERENCE BOOKS

2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", Tata McGraw Hill, 2017.
3. Kothari .D.P and Nagarath.I.J., "Power system Engineering", 2nd Edition, Tata McGraw Hill, 2011.
4. Pai. M.A," Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
5. Nagarath, I.J. and Kothari, D.P., "Modern Power System Analysis", 4th Edition, Tata

McGraw Hill Publishing Company, 2011.

6. Hadi Saadat, "Power system Analysis", Tata McGraw Hill Publishing Company, 3rd Edition, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks **80 Marks**

SEEB1502	ELECTRICAL MACHINE DESIGN	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SEEB1202, SEEB1301

Co Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge about engineering materials, calculation of mmf for air and iron path for rotating machines.
- To impart knowledge in design of armature and field system of DC machines.
- To impart knowledge in design of core, yoke, windings and cooling systems of transformer.
- To impart knowledge in design of stator and rotor of induction machines.
- To impart knowledge in design of stator and rotor of synchronous machines.

UNIT1 INTRODUCTION9 Hrs.

Major considerations in Machine design - Limitations in design - Standard specifications - Electrical Engineering materials - High conductivity materials - Insulating materials - Magnetic circuit calculations - mmf for air gap and iron path - real and apparent flux densities in rotating machines - Choice of specific electric and magnetic loadings.

UNIT2 DC MACHINES 9 Hrs.

Output equation - Main Dimensions - Choice of number of poles - Armature design - Estimation of number of conductors / turns - Coils armature slots- Conductor dimensions - Slot dimension - Design of field poles and field coil (shunt field) - Design of Commutators and Brushes.

UNIT3 TRANSFORMERS9 Hrs.

Output equation - Design of core and winding of single phase shell and core type transformer and three phase transformers

-Temperature rise in transformers - Design of tank, cooling tubes and Ducts.

UNIT 4 INDUCTION MOTORS 9 Hrs.

Output equation, Main dimensions, Design of stator, Choice of L/D ratio - Air gap length - Design of rotor - Squirrel cage and Slip ring rotor.

UNIT5 SYNCHRONOUS MACHINES 9 Hrs.

Output equation - Design of salient pole rotor machine - Dimensions - Short circuit ratio - Effect of Short Circuit ratio - Air gap length-Armature design –Slot dimensions-Rotor design-Design of damper winding –Design of cylindrical rotors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1Determine the mmf for rotating machines based on the major considerations. CO2 - Analyze and apply the design procedure for DC machines.

CO3 - Analyze and apply the design procedure for core, yoke, winding and cooling systems of transformer. CO4 - Analyze and apply the design procedure for stator and rotor of induction machines.

CO5 - Analyze and apply the design procedure for stator and rotor of synchronous machines. CO6 - Select optimized design based on the requirement.

TEXT / REFERENCE BOOKS

1. A.K.Sawhney, A.Chakrabarti, “A course in Electrical machine Design”, Dhanpat Rai and Sons, New Delhi, 6th Edition, 2010.

2. Albert E. Clayton and NN Hancock, "The performance and Design of Direct Current Machines", Oxford and IBH Publishing Co. Pvt.Ltd., New Delhi, Edition2004.
3. A.Nagoorkani, "Electrical Machine Design", RBA Publications, 2nd Edition,2014.
4. R.K.Agarwal, "Principles of Electrical Machine Design", 5th Edition, S.K.Kataria & Sons.2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each –No choice **20 Marks**

PARTB:2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

S13BLH52	MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre Requisite: Nil

Co Requisite: Nil

COURSE OBJECTIVES

- To impart the knowledge of 8085, 8086 processor and 8051 Controller.
- To develop assembly language program in 8085/8086 processor and 8051 Controller.
- To introduce the peripheral devices.
- To acquire the knowledge of interfacing and hardware implementation using ARDUINO UNO.

UNIT 1 INTRODUCTION TO MICROPROCESSORS9 Hrs.

Introduction, 8085 Architecture, Pin Diagram and signals, Timing Diagram, Interrupts and its types, Addressing Modes of 8085, time delay calculation..

Practice Programming:

1. To develop assembly language program for the addition, subtraction, multiplication and Division of two 8 bit numbers.
2. To develop assembly language program for data transfer in various memory locations using stack pointer instructions

UNIT 2 8086 MICROPROCESSOR
9 Hrs.

8086 Architecture-Maximum and Minimum Mode-Memory Banks-Memory Segmentation-Programming Model –Instruction Set

Practice Programming:

1. To develop assembly language program for the 32 bit and 64 bit numbers addition.
2. To develop assembly language program for counting and swapping of N numbers.
3. To develop assembly language program for Code conversion (BCD TO ASCII, ASCII TO BCD)

UNIT 3 8051 MICRO CONTROLLER 9 Hrs.

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

Practice Programming:

1. To develop assembly language program to perform arithmetic operations and store the results onto the stack ,ports, registers and internal RAM locations.
2. To develop assembly language program to perform the following 1) Keep monitoring the p1.2 bit until it becomes high 2) When p1.2 becomes high , write the value 45h to port 0. 3) Send a high to low (H to L) pulse to p2.3

UNIT 4 PERIPHERAL INTERFACING 9 Hrs.

Study on need, Architecture, configuration and interfacing, with ICs: 8255,8257,8259, 8254- A/D and D/A converters &Interfacing with 8086 & 8051.

Practice Programming:

1. To develop assembly language program for creation of square wave of 66% duty cycle on bit 3 of port 1
2. To interface LED and switch with 8051 microcontroller and to toggle output depending on the switch using timers..
3. To interface DC Motor / Stepper Motor with Atmel AT89C51 / 8086 and to rotate in clockwise or anticlockwise direction based on the status of the switch.

UNIT 5 ADVANCED MICRO CONTROLLER
PROGRAMMING & APPLICATIONS

9 Hrs.

Architecture of ARDUINO UNO – Introduction to embedded C programming, key board and display interface for temperature monitoring system –Control of servo motor- stepper motor control- Application to automation systems.

Practice Programming:

1. To develop a embedded C coding for LED Blinking using Arduino
2. To develop a embedded C coding for DS3231 RTC (Real Time Clock) Interfacing with Arduino to build DIY Digital Clock.

To develop a embedded C coding for Home Automation System.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Apply the basics of 8 bit processor to do real time automation programming.

CO2Analyze the 16-bit processors with memory segmentation technique for better programming technique.

C03 – Examine the performance enhancement of microcontroller by comparing 8085 programming technique.

CO4 – Investigate the operation of various peripheral devices interfacing with 8085 and 8051

CO5 - Design the interfacing circuits for real time applications.

CO6 – Develop the control circuits for various Peripherals controlled by 8051 / Arduino UNO.

TEXT / REFERENCE BOOKS

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and applications with 8085”, 6th Edition, Penram International Publishing Pvt. Ltd., 2014.
2. Douglas V. Hall, “Microprocessor and its Interfacing”, Tata McGraw Hill, Edited second Version, 2006.
3. Nagoor Kani A, “Microprocessor (8085) and its Applications”, 2nd Edition, RBA publications, 2013.
4. Mathur A.P, “Introduction to Microprocessor”, Tata McGraw Hill, 3rd Edition 2002.
5. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.
6. Simon Monk, Programming Arduino: Getting Started with Sketches (Tab), 2nd Edition, Kindle Edition,June 2016.
7. Damon Parker, Arduino Programming: The ultimate guide for making the best of your Arduino Programming Projects Kindle Edition, April 2020.

ENDS EMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100		**Exam Duration: 3 Hrs**
PART A	**MCQ Questions**	**20 Marks**
PART B	**Laboratory Practical**	**80 Marks**

SECB2501	INTEGRATED CIRCUITS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre Requisite: SECB1401 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To study the basic principles, configurations and practical limitations of op-amp.
- To understand the various linear and non-linear applications of op-amp.
- To analyze and deign op-amp oscillators, single chip oscillators and frequency generators.
- To analyze, design and explain the characteristics and applications of active filters, including the switched capacitor filter.
- To understand the operation of the most commonly used D/A and A/D converter types and its applications.

SUGGESTED LIST OF EXPERIMENTS ANALOG INTEGRATED CIRCUITS

1. Design and construct using IC741 a).Inverting
b). Non-inverting c). Adder
d). Schmitt Trigger e). Differentiator
2. Waveform Generators usingIC741 a). Triangular wave generator
b). Square wave generator c). Sine Wave generator
3. Design and construct PWM using IC 555timer
4. Design a 3 bit DAC in R-2R ladder Configuration
5. Design, construct the filters using PSPICE (a). Low pass filter
(b). High pass filter (c). Band pass filter (d). Band reject filter

DIGITAL INTEGRATED CIRCUITS

6. Verify the Basic gates / Boolean function using logic gates.
7. To Construct and verify the full and half adder using logic gates.
8. To Verify 2x4 Decoder and 4x2 Encoder functionally.
9. To construct and study the working of RS flip-flop, D flip-flop, T flip-flop, JK flip-flop
10. To verify various shift register
(a).SISO
(b) .SIPO (c). PISO (d).PIPO
11. Design a counter using suitable flip-flop (a). MOD Counter
(b). Ripple Counter (c). Up- Down Counter

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Discuss the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp.

CO Facilitate analysis and design of circuits to study the operation registers, flip flop counter.

CO 3 Analyze and deign basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators and data converters.

CO4Examine the basic configuration of IC741, IC555 and various counter operation. CO Verify the logic gates and combinational circuit using the suitable IC.
CO6 Find the various characteristics of the filter circuits using Orcad PSPICE.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100			Exam Duration:3 Hrs
CAE	Evaluation of Regular Lab class	30 Marks	50 Marks
	Model practical exam	20 Marks	
ESE	University Practical exam		50 Marks

SEEB1601	POWER SYSTEM OPERATION AND CONTROL	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SEEB1501 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand electric power system operation.

- To understand electric power system steady state control.
- To understand economic and technical feasible operating state.
- To study the economic operation of power system.
- To teach about SCADA and its application for real time operation and control of power Systems

UNIT1 INTRODUCTION TO POWER SYSTEM OPERATION AND CONTROL 9 Hrs.

Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - Power system security- Factors affecting system security - necessity of voltage and frequency regulation - P-F and Q-V control structure- - Different operating states of power Systems - Energy control system: Function-monitoring, Data Acquisition and Control, System Hardware Configuration- SCADA

UNIT 2 LOAD FORECASTING AND UNIT COMMITMENT9 Hrs.

System load variation and Load Characteristics -Economics of Generation - load curves and load duration curve - Reserve Requirements - Overview of system operation: Load Forecasting. Statement of unit commitment (UC) problem-constraints in UC: Spinning Reserve, Thermal unit Constraints, Hydro Constraints, Fuel Constraints and other Constraints - UC solution methods: Priority -List Methods, Forward Dynamic Programming Approach

UNIT3 Economic Operation of Power System 9Hrs.

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - Optimal Dispatch Problem – coordination Equation without losses – Solution by lambda iteration method - co-ordination equations with loss included - solution of co-ordination equations using Bmn co-efficient - Base point and participation factors.

UNIT 4 REAL POWER - FREQUENCY CONTROL 9 Hrs.

Fundamentals of Speed Governing Mechanism and Modeling – Regulation of Alternators - Fundamentals of automatic generation control - Implementation of AGC - Under Frequency Load Shedding. Load Frequency Control (LFC) of single area system-static and dynamic analysis (uncontrolled case).

UNIT 5 REACTIVE POWER AND VOLTAGE CONTROL 9 Hrs.

Production and Absorption of Reactive Power - Methods of Voltage Control - shunt Reactors, Shunt Capacitors, Series Capacitors, Synchronous Condensers, Static VAR Systems-Principles of Transmission System Compensation – Modelling of Reactive Compensation Devices - Application of Tap-Changing Transformers to Transmission Systems - Distribution System Voltage Regulation - Modelling of Transformer ULTC Control System.

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Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the significance of monitoring and control of a power system.

CO2 - Examine the load forecast and unit commitment.

CO3 -Analyze the economic operation of power system..

CO4 - Predetermine the Fundamentals of Speed Governing and control of generating unit power output and Implement AGC and Load Shedding.

CO5 - Analyze power system operation, stability, control and protection and Modelling of Reactive compensation device
CO6 - Select Optimised design based on the requirement.

TEXT / REFERENCE BOOKS

7. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016..
8. D. P. Kothari and I. J. Nagrath, "Modern power system analysis", 4th Edition, Tata McGraw hill publishing company limited, New Delhi, 2011.
9. Leonard L.Grigsby, "The Electric Power Engineering Handbook", CRC press, 3rd edition 2012.
10. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each –No choice **20 Marks**

PARTB:2 Questions from each unit of internal choice ; each carrying 16 marks **80 Marks**

SEEB1602	Electrical Drives and Control	L	T	P	EL	Credits	Total Marks

		3	0	0	0	3	100

Pre Requisite: SEEB1202, SEEB1301

Co Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge in modeling of power converters.
- Understand the dynamics of mechanical system found in industrial application.
- Characterize the operation of motor, drive, sensor and mechanical power within the drive.
- Understand the operation of DC and AC Motor drive.
- Understand the method of starting and braking of electric motor.
- To have a knowledge of various motor drive applications.

UNIT1 DRIVESCHARACTERISTICS 8Hrs.

Electric drives - Advantages - Choice of electric drive, Speed/Torque Characteristics of various types of loads and drive motors, Classes of motor duty- Selection of power rating for drive motors with regard to duty. Thermal model of motor for heating and cooling, Overloading and load variation factors- load equalization.

UNIT2 DCDRIVE10 Hrs.

Starting and braking operations of DC motor drive-Speed control of DC motors - Ward Leonard scheme - Drawbacks - Ward Leonard Ilgener scheme - Thyristor converter fed DC Drives: single, two and four quadrant operations. Chopper fed DC Drives: control strategies - single, two and four quadrant operation.

UNIT3 THREE PHASE INDUCTIONMOTORDRIVES 10Hrs.

Speed control of three phase induction motors: Stator control - Stator voltage, frequency and voltage/frequency control - VSI,CSI and Cyclo converter fed induction motor drives. Rotor control : Rotor resistance control- Static control of rotor resistance using DC Chopper, slip power recovery schemes -Kramer and Scherbius drives.

UNIT4 THREE PHASE SYNCHRONOUSMOTORDRIVES10 Hrs.

Speed control of three phase synchronous motors - types of control , Voltage source and current source converter fed synchronous motors –Cyclo converter fed synchronous motors – Commutator less DC motor- Effects of harmonics on the performance of AC motors -Closed loop control of drive motors, Marginal angle control and power factor control.

UNIT5 DRIVEAPPLICATIONS 7Hrs.

Selection of drives and control schemes for steel rolling mills, Paper mills, textile mills and cranes - Traction- conventional DC and AC Traction drives-DC Traction using Chopper Controlled Drives-Polyphase AC motors for Traction Motors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 Select suitable drives for a specific application.

CO2 - Analyze the construction, characteristics and application of D.C. motor. CO3 - Design the converter for AC and DC drives.

CO Analyze the performance of speed control of three phase synchronous motor drive.

CODesign solutions by using drives in traction unit in railways.

CO6Design torque, speed and position controller of motor drives Control schemes for steel rolling mills, Paper mills, lifts and crane.

TEXT / REFERENCE BOOKS

1. Gopal K. Dubey, “Fundamentals of Electrical Drives”, Alpha Science International Ltd,2019.
2. Vedam.Subrahmanyam “Electric Drives” Mcgraw hill, 7thEdition2018.
3. Rashid M.H., “Power Electronics circuits Devices and Applications”, Prentice Hall, 9thEdition, New Delhi,2019.
4. Juha Pyrhonen, Valeria Hrabovcova & R.ScottSemken, “ElectricalMachine DrivesControl: An Introduction”,2016.
5. B.K.Bose, “Power Electronic & AC drives”, Prentice Hall,2017.
6. Control of Electrical Drives by Ws. Leonhard (Springer2001).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each –No choice **20 Marks**

PARTB: 2 Questions from each unit of internal choice ; each carrying 16 marks **80 Marks**

S14BLH61	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre Requisite: : SMBT1401 **Co**

Requisite: Nil

COURSE OBJECTIVES

- To impart basic ideas in discrete signals and systems.
- To gain knowledge of Analog and Digital filter design with various structural realizations.
- To learn DSP controller pertaining to Power Electronics via programming.

UNIT1 INTRODUCTION TO DISCRETE TIME SIGNALS, SYSTEMS ANDZ–TRANSFORM 9Hrs.

Introduction to concept of signal, noise and frequency. Sampling theorem, Quantization, Quantization error, Aliasing-
mathematical representation of discrete signals, Classifications of discrete Signals and Systems - Review of Z transform
& Inverse Z Transform-ROC–Time response analysis using standard test signals (step and ramp) – linear convolution-
Correlation.

Practice Problems using MATLAB / EQUIVALENT SOFTWARE PACKAGE (Scilab/Octave) :

1. Generation of elementary Discrete-Time sequences
2. Linear convolution
3. Auto correlation and Cross Correlation

UNIT2 DISCRETE FOURIER TRANSFORM AND COMPUTATION 9Hrs.

Discrete Time Fourier Transform analysis(DTFT), Discrete Fourier Transform (DFT)- Properties of DFT- frequency
response analysis-magnitude and phase response, circular convolution, FFT computations using radix-2 Decimation in
Time (DIT) and Decimation in frequency(DIF) algorithms.

Practice Problems using MATLAB / EQUIVALENT SOFTWARE PACKAGE (Scilab/Octave) :

1. Compute the DFT for a discrete signal and verification of its properties.
2. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum using DIT-FFT.

UNIT3 DESIGN OF INFINITE IMPULSE RESPONSE FILTER (IIR)

9Hrs.

Design of IIR filters using Impulse invariant and Bilinear transformation method- Prewarping. Review of Butterworth and
Chebyshev approximations- Frequency transformation in analog domain- Filter design using Butterwoth and Chebyshev-
Realization of recursive structures-Direct form-I-Direct form-II-Cascade-Parallel Forms.

Practice Problems using MATLAB / EQUIVALENT SOFTWARE PACKAGE (Scilab/Octave) :

1. Design and implementation of a digital IIR filter (Low pass, High pass, Band pass and Band reject filters) to meet given
specifications and test with an audio file. Plot the spectrum of audio signal before and after filtering.

UNIT4 DESIGN OF FINITE IMPULSE RESPONSE (FIR)FILTER

9Hrs.

Properties of IIR and FIR filters - Filter design using windowing techniques - Hamming, Hanning, Blackman, Rectangular,
Triangular windows- Digital filter design using Frequency sampling technique- Realization of Structures for FIR and
Linear phase FIR filter- Direct form-Transposed form- Cascaded form, Elementary Ideas of Finite Word Length effects in
Digital Filters.

Practice Problems using MATLAB / EQUIVALENT SOFTWARE PACKAGE (Scilab/Octave) :

1. Design and implementation of Low pass, High pass, Band pass and Band reject FIR filters to meet the desired
specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal
before and after filtering.

UNIT 5 DSP APPLICATIONS

9Hrs.

DSP Hardware and Software Tools, Overview of DSP processors and architectures, Introduction to DSP development boards
and tools, Emerging Applications of DSP in Machine learning, deep learning, Internet of Things (IoT) and sensor networks.
Future trends and advancements in DSP.

Practice Problems using MATLAB / EQUIVALENT SOFTWARE PACKAGE (Scilab/Octave):

1. Students will work on a DSP application project of their choice which includes Project selection, development, and
presentation

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze various signals, systems and transforms.

CO2 - Apply Discrete-Fourier Transform and Fast Fourier Transform on discrete time signals.

CO3 - Design IIR digital filters for suitable applications.

CO4 - Design and analyze FIR digital filters.

CO5 - Comprehend the architecture of digital signal processing controller (TMS320CX2407).

CO6 - Develop ALP for motor control application using TMS320CX2407.

TEXT / REFERENCE BOOKS

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing - Principles, Algorithms & Applications”, 4th Edition, Pearson education / Prentice Hall, 2007.

2. Emmanuel C..Ifeachor, & Barrie.W.Jervis, “Digital Signal Processing”, 2nd Edition, Pearson Education / Prentice Hall, 2002.

3. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, “Discrete Time Signal Processing”, Pearson Education, 2ndEdition,2005.

4. Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill,2001.

5. Kuo, Sen M., et al. Real-Time Digital Signal Processing: Fundamentals, Implementations and Applications. United Kingdom, Wiley, 2013.

6. Santra, Avik, Souvik Hazra, Lorenzo Servadei, Thomas Stadelmayer, Michael Stephan, and Anand Dubey. & quot; Signal Processing with Deep Learning. & quot; (2023): 181-200.

7. Li, Yuanqing, Kai Keng Ang, and Cuntai Guan. & quot;Digital signal processing and machine learning." Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction (2010): 305-330.

8. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.

ENDS EMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

PART A **MCQ Questions** **20 Marks**

PART B **Laboratory Practical** **80 Marks**

SEEB2601	POWER SYSTEMS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

Pre requisite: SEEB1501 **Co**

Requisite: Nil

COURSE OBJECTIVES

- To have hands on experience on various system studies and different techniques used

for system planning using Software packages.
- To gain Knowledge in designing of automation problem.

SUGGESTED LIST OF EXPERIMENTS

1. Computation of Power System Components in Per Unit.
2. Formulation of the bus admittance matrix by Direct inspection method.
3. Formulation of the bus admittance matrix by Singular transformation method.
4. Formation of bus impedance matrix.
5. Analysis of Daily Load Curve.
6. Automatic Generation Control.
7. Determination of Transmission line parameters.
8. Numerical Integration of Swing equation.
9. Load flow solution using Gauss – Seidal method.
10. Load flow solution using Newton – Rapson method.
11. Fault analysis.
12. Characteristics of Microcontroller based Frequency relay.
13. Construction of simple ladder program for Logic gates.
14. Applications of Delay Timers in PLC.
15. Applications of Counters in PLC.

COURSE OUTCOMES:

On completion of the course, student will be able to
CO1 Create bus impedance and admittance matrix and compute P.U power system model.
CO2 - Estimate the various fault currents in power system and compute inductance in Transmission lines. CO3 - Solve the power flow analysis using Gauss Seidel and N-R method.
CO4 - Analyze the daily load curve and automatic generation control. CO5 - Identify the stability of system and characteristics of various relay. CO6 - Design ladder diagram for different automation problem using PLC.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. marks: 100 Exam Duration:3 Hrs

CAE	Evaluation of Regular Lab class	30 Marks	50 Marks
	Model practical exam	20 Marks	
ESE	University Practical exam		50 Marks

S14BLH71	PRINCIPLES OF EMBEDDED SYSTEM DESIGN	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

Pre Requisite: S13BLH52 **Co Requisite:** Nil

.**COURSE OBJECTIVES**

- Architecture of PIC Microcontroller
- Simple IoT Systems using Arduino
- Implementation of ARM processor
- To learn automation using scheduling algorithms and Real time operating system.

UNIT 1 RISC EMBEDDED CONTROLLER 9 Hrs.

Definition – Features– Design Metrics – Design Flow – Example Embedded Systems-Comparison of CISC and RISC controllers - PIC 16F877 architecture - Memory organization - Addressing modes - Assembly language instructions.

Practice Problems:

1.To write an assembly language program to perform arithmetic operation of PIC16F877 using MPLAB IDE
2.To write an assembly language program to perform logical operation of PIC16F877 using MPLAB IDE.
3.To interface LED with PIC16F877 microcontroller and to toggle output depending on the delay.

UNIT 2 ARDUINO 9 Hrs.

Introduction to ARDUINO, Architecture, overview of its I/O Ports, Serial Ports, PWM, ADC, Interfacing with different type of Sensors and Communication modules, Hardware timers, watchdogs and interrupt handling in Arduino. Controlling embedded system based devices using Arduino.

Practice Problems:

1.To interface 16x2 LCD with Arduino Uno and to display WELCOME TO EEE SATHYABAMA.
2.To interface sensor with Arduino Uno and to display the data using LCD display.

UNIT 3 ARM PROCESSOR BASED SoC and SoM 9 Hrs.

Overview of ARM 7 Architecture- Overview of Intel ARM based hard processor System on Chip (SoC) with an on chip FPGA - Overview of System on Module (SoM) using ARM based SoC- Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction

Practice Problems:

Using ARM Processor
1.Program to interface relay card
2.Interface 4-digit seven-segment display to display any four-letter word
3.Interface 2-line LCD module to output a moving message on it.

UNIT 4 EMBEDDED NETWORKING 9 Hrs.

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard–RS485–USB–Inter Integrated Circuits (I2C)- Serial Peripheral Interface (SPI) -CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers-Distributed Embedded system

Practice Problems:

1. Design of Temperature Monitoring System Using RF Modem
2.Implementing Zigbee protocol with ARM.
3.Interfacing real time clock and serial port with ARM.

UNIT 5 EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND REAL TIME OPERATING SYSTEM 9Hrs.

Introduction to assembler - Compiler -Cross compilers -Linker/ Locators - Simulators - RToS - Desktop OS versus RTOs - Software architectures - Round Robin, Round-Robin with Interrupts, Function Queue Scheduling architecture - ISRs and Scheduling -Task management - Task scheduling - Race conditions - Priority Inversion –– Inter task Communication-Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

Practice Problems:

1,To interface SEVEN SEGMENT DISPLAY with PIC16F877 microcontroller and to
display numbers from 0-9 with a delay generated in between by TIMER. Generate the hex code in MPLAB IDE and interface using Proteus
2.To interface LDR with PIC16F877 microcontroller and to display the output using LED Generate the hex code in MPLAB IDE and interface using Proteus.
3.Temperature and humidity values are measured successfully by interfacing DHT11sensor withArduino Uno and the measured values are displayed using 16*2 LCD. Generate the hex code inArduino IDE and interface using Proteus.

Max. 45 Hrs.

COURSE OUTCOMES :

On completion of the course, student will be able to
CO1 - Analyze the architecture, functionalities of PIC 16F877A Microcontroller and apply for addressing the Engineering problems.
CO2 – Develop knowledge and skills required to develop an real time embedded system using ARDUINO for addressing Engineering problems
CO3 – Analyze the architecture of ARM processor and concepts of SoC and SoM.
CO4 - Analyse the various standards and protocols used for embedded interfaces.
CO5 - Analyze various embedded software development tools.
CO6 - Evaluate the concept of RTOS in real time embedded system.

TEXT / REFERENCE BOOKS

1. Muhammed Ali Mazidi, Rolin D.Mckinlay, Dannycauscy, “PIC microcontrollers and embedded systems using assembly and C”, 1st edition, Pearson, 2007.
2. Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury,” Arduino-Based Embedded Systems,CRC Press; 1 edition, November 2017.
3. Ashwin Pajankar, ARDUINO MADE SIMPLE: With Interactive Projects, BPB Publications, 2018.
4. Raj Kamal, “Embedded system-Architecture, Programming, Design”, Tata McGraw Hill, 2011.
2. Sriram. V. Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, 2004 Tata McGraw

Hill Publishing Company Limited, 2006.
3. Frank Vahid, Tony Givargis, 'Embedded system Design - A unified Hardware / software Introduction', John Wiley and Sons, 2002.
4. Todd D Morton, 'Embedded Microcontrollers', Reprint by 2005, Low Price Edition.
5. Muhammed Ali Mazidi, Janice GillispieMazidi, 'The 8051 Microcontroller and Embedded Systems', Low Price Edition, Second Impression 2006.
6.
7. https://www.arm.com/resources/guide/designing-soc-with-cortex-m
8. https://www.microchip.com/design-centers/32-bit-mpus/sip-som/system-on-module.

ENDS EMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100		**Exam Duration: 3 Hrs**
PART A	**MCQ Questions**	**20 Marks**
PART B	**Laboratory Practical**	**80 Marks**

SEEB1701	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SEEB1501, SEEB1601

Co Requisite: Nil

COURSE OBJECTIVES

- To discuss the cause and effect of abnormal operating conditions in a power system and the protective schemes along with the problems associated with circuit interruptions.
- To understand construction, operation and characteristics of various electromagnetic and static relays.
- To introduce apparatus protection for transformer, alternator, induction motor, transmission line and bus bar.
- To understand the arc quenching theories and operations of various types of circuit breakers and their ratings.

UNIT1 INTRODUCTION8Hrs.

Essential requirements of protection - Nature and causes of faults - Types of faults - Effects of faults - Zones of protection - Protection schemes - CTs and PTs and their applications - Basic relay terminology.

UNIT2 PROTECTIVE RELAYS 10Hrs.

Electromagnetic relays - Operating principle - Torque equation - Relay characteristics - Over current relay, Directional relay, Distance relay, Differential relay, Negative sequence relay, Amplitude and Phase comparator of over current static relays, Duality between comparators - Microprocessor based over current relay.

UNIT3 APPARATUS PROTECTION 9Hrs.

Protection of Generator - Stator & Rotor protection - Large Motor protection - Transformer protection - Bus bar Protection - Transmission line protection.

UNIT4 THEORY OFARC QUENCHING 9Hrs.

Arcing phenomena - Theory and methods of arc quenching - Recovery voltage - Restriking voltage - RRRV - Resistance switching - Current chopping - Capacitive current breaking - Characteristics of fuses - HRC fuse.

UNIT5 CIRCUIT BREAKERS 9Hrs.

Classification of circuit breakers - Air circuit breakers - Oil circuit breakers - Vacuum circuit breaker - SF6 circuit Breakers - Selection of circuit breakers - Rating of circuit breakers - Testing of circuit breakers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Comprehend the basic protective relaying terminologies and zones of protection. CO2- Distinguish the construction, operation and characteristics of various relays. CO3 - Design protection schemes of various apparatus used in power system. CO4- Examine the various methods of arc quenching. CO5 - Analyze the problems that occur in circuit breakers. CO6 -Analyze the rating and also test the circuit breakers.

TEXT / REFERENCE BOOKS

1. L.G.Hewitson, Mark Brown, Ben Ramesh and Ramesh Balakrishnan,"Practical Power System Protection", Newnes Publications, Oxford,2005.
2. Sunil S.Rao "Switchgear and protection", Khanna Publishers, New Delhi,2008.

3. Badri Ram and D.N.Vishwakarma “Power System Protection and Switchgear”, Tata McGraw Hill Publishing, New Delhi, 2005.
4. Soni, Gupta and Bhatnagar “A Course in Electrical power”, Dhanpat Rai & Sons, New Delhi,2010.
5. TSM Rao, “Digital Numerical Relays”, Tata McGraw Hill publishing, New Delhi,2005.
6. B.Ravindranath and N.Chander, “Power System Protection and Switchgear”, New Age International (P) Ltd,2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice
20 Marks

PART B: **2 Questions from each unit of internal choice, each carrying 16 marks**
80 Marks

SEEB3001	POWER SYSTEM RESTRUCTURING AND DEREGULATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SEEB1402, SEEB1501
Co Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge in Deregulation and Restructuring of power systems.
- To understand different trading and pricing in deregulated market.

UNIT 1 INTRODUCTION TO DEREGULATION AND RESTRUCTURING 9 Hrs.

Gencos, Transcos, Discos, Customers, ISO, Market operators. Privatization, An overview of the Restructured Power System, Difference between Integrated Power System and Restructured Power System, Transmission Open Access, Wheeling, Power Systems Operation – Old Vs New, Key issues associated with the Restructuring of ESIs, Advantages of Competitive System.

UNIT 2 DEREGULATION OF POWER SECTOR 9 Hrs.

Separation of ownership and operation, Deregulated models – Pool Model, Pool and Bilateral Trades Model, Multilateral Trade Model.

UNIT 3 COMPETITIVE ELECTRICITY MARKET 9 Hrs.

Independent System Operator activities in Pool Market, wholesale Electricity Market Characteristics, C Auction, Single Auction Power Pool, Double Auction Power Pool, Market Clearing And Pricing, Market Power a Mitigation Techniques, Bilateral Trading, Ancillary Services.

UNIT 4 TRANSMISSION PRICING9 Hrs.

Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, postage stamp method, control path method, boundary flow method, MW-mile method, MVA-mile method,

comparison of different methods.

UNIT 5 CONGESTION MANAGEMENT 9 Hrs.

Total Transfer Capability – Limitations – Margins – Available Transfer Capability(ATC) – Procedure – methods to compute ATC – Static and Dynamic ATC – Bid, Zonal and Node Congestion Principles – Inter and Intra zonal congestion – Generation Rescheduling – Transmission Congestion Contracts.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the need for restructuring of Power Systems, discuss different market models, different stakeholders and market power.

CO2-Examine the functioning and planning activities of ISO.

CO3 -Analyze transmission open access pricing issues and congestion management.

CO4 - Estimate the transfer capability of small power systems.

CO5 - Design of power markets and market architectural aspects, the changes in operational aspects with new operational challenges like congestion management.

CO6- Design of efficient pricing of transmission network usage operation.

TEXT / REFERENCE BOOKS

1. Loi Lei Loi, “Power System Restructuring and Deregulation – Trading, performance& information technology”, John Wiley sons, 2001.
2. Kankar Bhattarcharya, et al., “Operation of restructured power systems”, Springer US, 2012.
3. S. A. Khaparde and A. R. Abhyankar, “Restructured Power Systems”, Alpha Science Intl. Ltd, 2013.
4. Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, “Market Operations in Electric Power Systems: Forecasting, Scheduling, and Risk Management”, Wiley-Blackwell, March 2012.
5. Mohammad Shahidehpour and Muwaffaq Almoush, “Restructured Electrical Power Systems Operation, Trading and Volatility,” Marcel Dekkar, Inc, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3002	ELECTRICAL POWER QUALITY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on sources and characteristics of power quality.
- To study the measurement and analysis of power quality indices.
- To understand the various power quality improvement techniques.
- To get acquainted with the high power applications.

UNIT 1 CHARACTERISATION OF ELECTRIC POWER QUALITY 9Hrs.

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – General power quality problems: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage.

UNIT 2 SOURCE OF POWER QUALITY PROBLEMS 9 Hrs.

Static power converter-DC/AC pulse width modulated drives-Switched mode power supplies-AC voltage regulators-Cycloconverter-Arc furnaces-Static VAR compensator-Inverters for Dispersed generation-Electronic phase control.

UNIT 3 MEASUREMENT OF POWER QUALITY INDICES 9 Hrs.

Measurement-General, Basic Equipment used for the analysis of non-sinusoidal voltages and currents, requirements of instrument response, Presentation of harmonic data, Transducers for harmonic measurements, Distortion factor, Crest factor.

UNIT 4 ANALYSIS OF POWER QUALITY INDICES 9 Hrs.

Analysis methods-Harmonic current calculation, System frequency response calculations, Modelling Guide lines for Harmonic Analysis, Telephonic Interference, Line notching Calculations, Total Harmonic

distortion, Displacement power factor improvement calculation.

UNIT 5 POWER QUALITY IMPROVEMENT TECHNIQUES 9 Hrs.

Power factor corrector-Harmonic filter-passive, Active and Hybrid filters –Static compensator-Distribution static compensator-Dynamic voltage restorer- Protecting sensitive loads using DVR - Use of PWM techniques in power quality improvement.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the characterization of electric power quality.
CO2 - Evaluate the various source of power quality problems.
CO3 - Analyze different types of power quality indices.
CO4 - Design various methods for power quality measurements.
CO5 - Analyze the various power quality improvement techniques.
CO6 - Select optimized design based on high power applications.

TEXT / REFERENCE BOOKS

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academics Publishers, 2002.
2. G.T Heydt, “Electric Power Quality”, Stars in Circle Publications, 1994, (2nd Edition).
3. J.Arilliga, N.R.Watson and S.Chen, “Power System Quality Assessment”, John wiley & Sons, England, 2000.
4. Robert W. Erickson &Dragon Maksimovic, “Fundamentals of Power electronics” second edition, 2001 spring and Business media.
5. IEEE Recommended practices and requirements for Harmonic control in Electrical power systems, IEEE Std. 519-1992.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3003	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre Requisite: SEEB1402, SEEB1403, SEEB1501 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To attain detailed knowledge in various reactive power compensators.
- To understand Thyristor Controlled Series Capacitor concepts.
- To attain the knowledge of series and shunt compensation.
- To analyze the behavior of STATCOM, UPFC and IPFC.
- To understand the implementation of FACTS controllers in improvement of power system performance.

UNIT 1 INTRODUCTION9 Hrs.

Electrical Transmission Network, Emerging Transmission Network, Concept of Reactive Power, Load and System Compensation, Midpoint Voltage, Passive Compensation, Synchronous Condenser, Saturated Reactor, Classification of FACTS controllers.

UNIT 2 SHUNT COMPENSATION9 Hrs.

Thyristor Controlled Reactor (TCR), Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC), Fixed Capacitor- Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor-Thyristor Controlled Reactor (TSC -TCR), V-I Characteristics of Static Var Compensator (SVC), Advantages of slope in dynamic Characteristic, Voltage control by SVC.

UNIT 3 THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)9 Hrs.

Fixed Series Compensation, Need for Variable Series Compensation, TCSC: Basic principle, Modes of Operation, Advantages, Capability Characteristic, Variable Reactance Model, Application: Open loop & Closed loop Control.

UNIT 4 EMERGING FACTS CONTROLLER 9 Hrs.

Static Synchronous Compensator (STATCOM): Introduction, Principle of Operation, V-I Characteristic, Multilevel VSC based STATCOM, SSSC: Principle of Operation, Unified Power Flow Controller (UPFC): Principle of Operation, Interline Power Flow Controller (IPFC): Principle of Operation, Hybrid Power Flow Controller (HPFC): Principle of Operation.

UNIT 5 SUB SYNCHRONOUS RESONANCE (SSR)9 Hrs.

Concept of SSR, NGH-SSR Damping scheme: basic concept, design and operation aspect, Thyristor Controlled Braking Resistor (TCBR), Static Phase Shifting Transformer (SPST), Advanced Series Capacitor (ASC): Basic concept, Design and operation aspect.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Analyze different types of FACTS Controllers.

CO2- Examine the performance of various Shunt Compensators.

CO3- Analyze the impact of Thyristor Controlled Series Capacitor for open loop and closed loop applications.

CO4 - Analyze the functional operation and control of Emerging FACTS controllers with voltage source and current source inverters.

CO5- Analyze the significance of SSR in Power System network. CO6 - Design Advanced Series Capacitor.

TEXT / REFERENCE BOOKS

2. R. Mohan Mathur and Rajiv K. Varma, “Thyristor based FACTS controllers for electrical transmission systems”, IEEE Press John Wiley & Sons Inc. Publication, 2002.
3. Narin G.Hingorani and Laszlo Gyugi, “Understanding FACTS”, IEEE Press Standard Publishers Distributors, 2001.
4. K.R.Padiyar, “FACTS controllers in power transmission and distribution”, New Age International Publishers, 2009.
5. Xiao-Ping Zhang, Chrisytian Rehtanz and Bikash Pal, “Flexible AC Transmission Systems Modelling and Control”, Springer International Publishers, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3004	HIGH VOLTAGE ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on the concepts of over voltages.
- To analyze the dielectric breakdown mechanisms.
- To measure and test High voltages and currents.

UNIT 1 OVERVOLTAGES IN ELECTRICAL POWER SYSTEMS 9 Hrs.

Causes of Over voltages Theory and Mechanism of Lightning phenomenon - Overvoltage due to Switching Surges - Protection against over voltages - Reflection and Refraction of Travelling waves - Insulation Coordination.

UNIT 2 CONDUCTION AND BREAKDOWN IN DIELECTRICS 9 Hrs.

Lonization of gases and current growth - Townsend's criterion for breakdown -Streamer theory of breakdown in gases. Paschen's Law - Vaccum breakdown - Various mechanisms of breakdown in liquid dielectrics -Various processes of breakdown in solid dielectrics.

UNIT 3 GENERATION OF HIGH VOLTAGES AND CURRENTS 9 Hrs.

Generation of high DC voltages: Rectifier, Voltage doubler circuits, Cockroft Walton voltage multiplier circuit, Van de Graffe generator - Generation of high AC voltage: cascaded transformers, resonant transformers- Generation of high frequency a.c. high voltage - Generation of impulse voltages: Standard impulse wave shapes, Marx Circuit - generation of switching surges
- generation of impulse current - tripping and control of impulse generators.

UNIT 4 MEASUREMENT OF HIGH VOLTAGES AND CURRENTS9 Hrs.

High Resistance with series ammeter -Potential Divider - Generating Voltmeters - Capacitance Voltage Transformer, Electrostatic Voltmeters - Sphere Gaps - Hall generator - Resistive Shunts -Rogowski coils - Cathode Ray Oscillographs for impulse measurement.

UNIT 5 TESTING OF ELECTRICAL APPARATUS9 Hrs.

Testing of Insulators and Bushings - Testing of Isolators and Circuit Breakers - Testing of Cables - Testing of Transformers - Testing of Surge arresters - Radio Interference Measurements - Standards and Specifications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Examine the over voltage phenomenon and to suggest the suitable protection method. CO2 - Analyze different dielectrics in High voltage application.

CO3- Design the various methods of generating high DC, AC voltages and currents. CO4 - Estimate the techniques used to measure high voltage and currents.

CO5- Analyze the different electrical apparatus used in high voltage application. CO6- Modeling of generation set ups for high impulse voltage.

TEXT / REFERENCE BOOKS

1. M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', 5th Edition Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2013.
2. C.L.Wadhwa, "High Voltage Engineering" - New Age International (P) Ltd, Publishers, 2007.
3. E.Kuffel and W.S. Zaengal, "High Voltage Engineering Fundamentals", 2nd Edition, Butterworth Heinemann, 2000.
4. H.M.Ryam, "High voltage Engineering and testing", 2nd Edition, 2001, IEEE Power and Energy Series 32.
5. Farouk A.M.Rizk and Giao N.Trinh, "High voltage Engineering", CRC Press,1st Edition,17 April 2014.
6. Dr.A.Haddad and D.F.Warne, "Advances in High voltage Engineering", Institution of Engineering and Technology, 22 October 2004.
7. Prof.D.V.Razevig, "High voltage Engineering", Khanna Publisher, 2nd Edition, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3005	FACTS and HVDC	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- To attain detailed knowledge in various reactive power compensators.
- To analyze the behavior of STATCOM, SVC and TCR.
- To attain the knowledge of series compensation.
- To explain advantages of HVDC power transmission, overview of HVDC system.
- To describe the basic components of a converter, the methods for compensating the reactive power demanded by the converter.

UNIT 1 INTRODUCTION 9 Hrs.

Electrical Transmission Network, Emerging Transmission Network, Concept of Reactive Power, Load and System Compensation, Midpoint Voltage, Passive Compensation, Synchronous Condenser, Saturated Reactor, Classification of FACTS controllers.

UNIT 2 SHUNT COMPENSATION 9 Hrs.

Thyristor Controlled Reactor (TCR), Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC), Fixed Capacitor- Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor-Thyristor Controlled Reactor (TSC -TCR), V-I Characteristics of Static Var Compensator (SVC), Advantages of slope in dynamic Characteristic, Static Synchronous Compensator (STATCOM): Principle of Operation, V-I Characteristic.

UNIT 3 SERIES COMPENSATION 9 Hrs.

TCSC: Basic principle, Modes of Operation, Advantages, Capability Characteristic, Variable Reactance Model, Application: Open loop & Closed loop Control, SSSC: Principle of Operation.

UNIT 4 DEVELOPMENT OF HVDC TECHNOLOGY 9 Hrs.

High Voltage Direct current Transmission (HVDC) - Terminal Equipment for HVDC Systems - Classifications, Advantages, Limitations - Economic Distance for HVDC - Comparison of EHVAC and HVDC Transmission.

UNIT 5 CONTROL OF HVDC CONVERTER AND SYSTEM 9 Hrs.

Converter Control for an HVDC System, Commutation Failure, HVDC Control and Design, HVDC Control Functions, Reactive Power and Voltage Stability.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic principles, characteristics of different types of FACTS Controllers.
CO2 - Examine the concept of Shunt Compensation.
CO3 - Analyze Thyristor Controlled Series Capacitor for open loop and closed loop applications..
CO4 - Examine advantages of HVDC power transmission, overview and organization of HVDC system.
CO5 - Evaluate the methods for compensating the reactive power demanded by the converter.
CO6 - Experimenting converter control for HVDC systems, commutation failure, control functions.

TEXT / REFERENCE BOOKS

1. R. Mohan Mathur and Rajiv K. Varma, “Thyristor based FACTS controllers for electrical transmission systems”, IEEE Press John Wiley & Sons Inc. Publication, 2002.
2. Narin G.Hingorani and Laszlo Gyugi, “Understanding FACTS”, IEEE Press Standard Publishers Distributors, 2001.
3. K.R.Padiyar, “FACTS controllers in power transmission and distribution”, New Age International Publishers, 2009.
4. Xiao-Ping Zhang, Chrisytian Rehtanz and Bikash Pal, “Flexible AC Transmission Systems Modelling and Control”, Springer International Publishers, 2015.
5. HVDC Transmission: Power Conversion Applicationsin Power Systems Chan-Ki Kim et al Wiley 1st Edition, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice. **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks. **80 Marks**

SEEB3006	HIGH VOLTAGE ENGINEERING AND HVDC TRANSMISSION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on different types of dielectrics.
- To comprehend the basic concept of High Voltage and Current generation and their measurements and testing.
- To study the operation of HVDC conversion technology and power control techniques
- To comprehend the different issues related to Power frequency voltage control.
- .To understand the basic concepts of EHV AC and HVDC transmission.

UNIT 1 CONDUCTION AND BREAKDOWN IN DIELECTRICS 9 Hrs.

Ionization of gases and current growth - Townsend's criterion for breakdown -Streamer theory of breakdown in gases. Paschen's Law - Vaccum breakdown - Various mechanisms of breakdown in liquid dielectrics -Various processes of breakdown in solid dielectrics..

UNIT 2 GENERATION AND MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 9 Hrs.

Generation of high DC voltages: Rectifier, Voltage doubler circuits, Cockroft Walton voltage multiplier circuit, Van de Graffe generator - Generation of high AC voltage: cascaded transformers, resonant transformers- Generation of high frequency a.c. high voltage - Generation of impulse voltages: Standard impulse wave shapes, Marx Circuit - generation of switching surges - generation of impulse

current - tripping and control of impulse generators. High Resistance with series ammeter -Potential Divider - Generating Voltmeters - Capacitance Voltage Transformer, Electrostatic Voltmeters - Sphere Gaps - Hall generator - Resistive Shunts -Rogowski coils - Cathode Ray Oscillographs for impulse measurement. Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, and surge diverters.

UNIT 3 HVDC Transmission System 9 Hrs.

DC Power Transmission Technology: Introduction, Comparison of AC and DC Transmission, Application. Analysis of HVDC Converters: Choice of converter configuration, Converter and HVDC system control, Converter faults and protection, Smoothing reactor and DC line, Reactive power control.

UNIT 4 FACTS Devices in HVDC Transmission 9 Hrs.

DC link controls, faults and abnormal operation and protection; Mechanism of active and reactive power flow control; Basic FACTS controllers: SVC, STATCOM, TCSC, TCPAR, UPFC; Modeling of FACTS Controllers; System static performance improvement with FACTS controllers; System dynamic performance improvement with FACTS controllers.

UNIT 5 EHVAC and HVDC Power Transmission Systems 9 Hrs.

Overview: Comparison of EHV AC and DC transmission, DC transmission systems, modern trends in AC and DC transmission. Overhead Transmission Line Parameter and Insulators: Bundled conductors, Resistance, Inductance and capacitance calculations of EHV line, Computation of surface voltage gradient on conductors, Insulator performance in polluted environments, mitigation of pollution induced flashover.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic concepts and properties of Solid, Liquid and Gaseous insulation.
CO2 - Justify the suitable dielectric for high voltage applications.
CO3 - Evaluate the performance of high DC,AC voltages and currents generators .
CO4 - Analyze the degree of adequacy level in HVDC transmission.
CO5 - Evaluate HVDC conversion technology.
CO6 - Analyze factors affecting AC-DC transmission.

TEXT / REFERENCE BOOKS

1. J. Kuffel and W. S. Zaengl, High Voltage Engineering: Fundamentals, Newnes , 2000.
2. J. Arrillaga, HVDC Transmission, IET, peter pereginver Ltd., London, U.K , 1998.
3. M.S. Naidu and V. Kamaraju, ‘High Voltage Engineering’, 5th Edition Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2013.
4. Farouk A.M.Rizk and Giao N.Trinh, “High voltage Engineering”, CRC Press,1st Edition,17 April 2014.
5. Dr.A.Haddad and D.F.Warne, “Advances in High voltage Engineering“, Institution of Engineering and Technology, 22 October 2004.
6. Padiyar, K.R., HVDC Power Transmission System, New Age International (P) Limited, Publishers 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration: 3Hrs.

PART A: 10 Question of 2 marks each – No choice. **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks. **80 Marks**

SEEB3007	EHVAC TRANSMISSION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand the basic concepts of EHV AC transmission.
- To impart knowledge about the Electrostatic field of AC lines.
- To identify corona effects on transmission lines.

UNIT 1 INTRODUCTION 9 Hrs.

EHVAC Transmission line trends and preliminary aspect - standard transmission voltages – Estimation at line and ground parameters-Bundle conductors: Properties -Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT 2 ELECTROSTATIC FIELDS AND TRAVELLING WAVE THEORY 9 Hrs.

Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines – Effect of high electrostatic field on biological organisms and human beings - Surface voltage gradients and Maximum gradients of actual transmission lines – Voltage gradients on sub conductor.

UNIT 3 POWER CONTROL 9 Hrs.

Electrostatic induction in unenergized lines – Measurement of field and voltage gradients for three

phase single and double circuit lines – Un energized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage – Charging currents at power frequency-Voltage control – Shunt and Series compensation – Static VAR compensation.

UNIT 4 CORONA EFFECTS AND RADIO INTERFERENCE 9 Hrs.

Corona Effects – I: Power loss and audible noise (AN) – corona loss formulae – charge voltage diagram – generation, characteristics - limits and measurements of AN – relation between 1-phase and 3-phase AN levels – Examples.

Corona Effects – II: Radio interference (RI) - corona pulses generation, properties, limits –frequency spectrum – modes of propagation – excitation function – measurement of RI, RIV and excitation functions – Examples.

UNIT 5 STEADY STATE AND TRANSIENT LIMITS 9 Hrs.

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics- Introduction six phase transmission – UHV.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic concepts of EHV AC transmission.
CO2 - Analyze the Electrostatic field of AC lines.
CO3 - Evaluate the compensation methods.
CO4 - Analyze the corona effects on E.H.V. lines.
CO5 - Analyze the EHV cables.
CO6 - Analyze the steady state and transient limits.

TEXT / REFERENCE BOOKS

1. Rokosh Das Begamudre, ”Extra High Voltage AC Transmission Engineering”– Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, “HVAC and HVDC Transmission, Engineering and Practice” Khanna Publisher, Delhi, 1990.
3. Subir Ray, “An Introduction to High Voltage Engineering”, Prentice Hall of India Private Limited, 2013.
4. RD Begamudre, “Extra High Voltage AC Transmission Engineering”– New Academic Science Ltd; 4 edition 2011.
5. Edison,” EHV Transmission line”- Electric Institution, GEC, 1968

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3008	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge about distributed generation technologies.
- To understand relevance of power electronics in DG.
- Obtain knowledge of different energy storage devices.
- To understand concept of microgrid.

UNIT 1 INTRODUCTION TO DISTRIBUTED GENERATION 9 Hrs.

Distributed generation (DG) overview and technology trend. Working principle, architecture and application of renewable DG technologies: Solar PV, bioenergy, wind energy, hydroelectricity, tidal power, wave energy, geothermal energy etc. Non-conventional technology based DGs: Fuel cells, CHP based microturbine, IC engines, etc. Storage based DGs: Storage technology: Battery, super capacitor, flywheel etc., Need for Distributed generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT 2 INTERCONNECTION ISSUES AND STANDARDS OF DGs. 9 Hrs.

Distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities,

regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system.

UNIT 3 IMPACT OF GRID INTEGRATION 9 Hrs.

Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.

UNIT 4 POWER ELECTRONICS AND DG SYSTEMS 9 Hrs.

Relevance of power electronics in DG applications, Power quality requirements and source switching using SCR based static switches, Distribution system loading, line drop model, series voltage regulators and on-line tap changers, power converter topologies, model and specifications for DG applications, issues filter designs, harmonic reduction, Control of DG inverters, phase locked loops, current control and DC voltage control for stand-alone and grid parallel operations. Protection of converters, power quality implication, acceptable ranges of voltage and frequency, reactive power compensation and active filtering.

UNIT 5 OPERATION AND CONTROL OF MICROGRID 9 Hrs.

Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic concepts of Distributed Generation
CO2 - Analyze the interconnection issues and standards of DGs.
CO3 - Analyze the impact of grid integration.
CO4 - Design Power Electronics circuits for DG systems.
CO5 - Analyze operation and control of micro grid.
CO6 - Develop the Control techniques for micro grid system.

TEXT / REFERENCE BOOKS

1. Renewable Energy- Power for a sustainable future, third edition, Edited by Godfrey Boyle, Oxford University Press, 2013.
2. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.
3. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006. New Delhi.
4. J.F. Manwell, J.G “Wind Energy Explained, Theory Design and Applications,”. McGowan Wiley publication, 2nd Edition, 2009.
5. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.
6. John Twidell and Tony Weir, “Renewable Energy Resources”, Taylor and Francis Publications,

Second Edition, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3009	POWER GENERATION AND UTILIZATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: SEEB1601 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand the general power generation concepts.
- To understand the general electrical utilization concepts.
- To study the performance and efficiency of power generation.

UNIT 1 CONVENTIONAL POWER PLANTS10 Hrs.

Layout and working of diesel, steam, low and high head power plants-pumped storage plants-principle of nuclear power generation - types and layouts of nuclear reactors- boiling water reactor- advanced gas cooled reactor- fast breeder reactor - reactor control - waste disposal.

UNIT 2 ECONOMICS OF GENERATION8 Hrs.

Introduction-Definitions-Load Duration Curve-Number and size of Generator Units-Base Load and Peak Load Plants-Cost of Electrical Energy-Fixed cost-Running Cost of Energy-Tariff or Charge to Consumer.

UNIT 3 ILLUMINATION 10 Hrs.

Nature of radiation - definition-laws-lighting calculations-polar curves-Rousseau construction-design of Illumination Systems-Flood Lighting and Calculations-Street Lighting-Classification of Light Sources-Incandescent lamps- gas discharge lamps- sodium vapour, mercury vapour, Fluorescent Lamps and LED lamps.

UNIT 4 HEATING AND WELDING8 Hrs.

Introduction - methods of heating - design of heating element- resistance, inductance, arc furnaces- high freq. dielectric heating- welding - types- resistance, arc welding- construction and its characteristics.

UNIT 5 ELECTRIC TRACTION 9 Hrs.

Introduction - requirements of an ideal traction Train Movement-Speed-Time Curve- mechanics of train movement - tractive effort calculations- Power and energy output from driving axles-Traction motors and its Characteristics-Traction motor control-Current collection systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 - Analyze conventional power generation methods.
CO2 - Evaluate the number and size of generator units and base load and peak load. CO3 - Design of Illumination systems and working of types of Lighting.
CO4 - Examine various methods of Heating and Welding. CO5 - Analyze the Concept of Electric traction systems.
CO6 - Analyze the principle of a Traction motor.

TEXT / REFERENCE BOOKS

1. C.L.Wadhwa, “Generation, Distribution & Utilisation of Electrical Energy”, New Age International Publishers, New Delhi, Reprint 2016.
2. Uppal.S.L. “Electrical Power”, Khanna Publishers, 9th Edition, 2001.
3. J.B. Gupta, “Utilization of Electric Power and Electric Traction”, Kataria & Sons publishers, Delhi,9th Edition, 2004.
4. B.R.Gupta, “Generation of Electrical Energy”, S. Chand Limited, 2009.
5. R.K.Rajput, “Utilization of Electrical power”, Laxmi Publications, 2006.
6. Leonard L.Grigsby,”Electric power generation, transmission and Distribution”, CRC Press, Taylor and Francis Group, 2012.
7. S.Sivanagaraju, M.Balasubba Reddy and D.Srilatha, “Electric Energy-Generation, Utilization and Conservation” Pearson, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3010	ENERGY MANAGEMENT AND SCADA	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To enable the students to understand the concept of energy management and energy management opportunities.
- To understand the different methods used to control peak demand.
- To understand the different methods used to control peak demand.
- To Study the concept of Energy management opportunities in electrical systems.
- To Study the SCADA Architecture and its Applications.

UNIT 1 INTRODUCTION 9 Hrs.

General principles of Energy management and Energy management planning. Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load scheduling.

UNIT 2 Energy management opportunities in Drives 9 Hrs.

Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies.

UNIT 3 Energy management opportunities in HVAC systems 9 Hrs.

HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of waste heat recovery for Energy saving opportunities.

UNIT4 SCADA Architecture 9 Hrs.

Introduction to SCADA, Typical SCADA architecture, System Hardware Configuration- SCADA and EMS Function: Network Topology Determination, Steady State Estimate, Security Analysis and Control, Benefits of SCADA, Various operating states in SCADA**.**

UNIT 5 APPLICATIONS OF SCADA 9 Hrs.

Interfacing SCADA system with PLC, Typical connection diagram, Object linking and embedding for Process Control (OPC) architecture. Applications - traffic Light Control, Water Distribution, Pipeline control, Motor Drive Control.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the concept of Energy Management.
CO2 - Analyze the Energy Saving in Electrical Drives.
CO3 - Analyze the Energy management in Electrical System.
CO4 - Develop the Architecture of SCADA.
CO5 - Design the Interfacing SCADA system with PLC.
CO6 - Develop SCADA application for real time operation.

TEXT / REFERENCE BOOKS

1. Charles M. Gottschalk, Industrial energy conservation, John Wiley & Sons, 1996.
2. Craig B. Smith, Energy management principles, Pergamon Press.
3. D. Yogi Goswami, Frank Kreith, Energy Management and Conservation Handbook, CRC Press, 2007
4. G.G. Rajan, Optimizing energy efficiencies in industry -, Tata McGraw Hill, Pub. Co., 2001.
5. IEEE recommended practice for energy management in industrial and commercial facilities.
6. Boyar.S.A," Supervisory Control and Data Acquisition", ISA Publication, New Delhi , Fourth Edition, ISBN 978-1936007097

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice. **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks. **80 Marks**

SEEB3011	MEASUREMENTS AND INSTRUMENTATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To learn about various measurement concepts.
- To learn about signal generators and signal analyzers.
- To know about the data acquisition systems.
- To know about the measurement in optical domain.

UNIT 1 BASIC MEASUREMENT 9 Hrs.

Measurement systems – Static and dynamic characteristics – units and standards of measurements – error - accuracy and precision, types, statistical analysis – moving coil, moving iron meters – Electrodynamo meter type wattmeter- Energy meter multimeters – Bridge measurements – Maxwell, Hay, Schering, Anderson and Wien bridge.

UNIT 2 BASIC ELECTRONIC MEASUREMENTS 9 Hrs.

Electronic multimeters – Cathode ray oscilloscopes – block schematic – applications – special oscilloscopes – delayed time base oscilloscopes, analog and digital storage oscilloscope, sampling oscilloscope – Q meters – Vector meters – RF voltage and power measurements – True RMS meters.

UNIT 3 SIGNAL GENERATORS AND ANALYZERS 9 Hrs

Function generators – pulse and square wave generators, RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer - digital spectrum analyzer, Vector Network Analyzer – Digital L,C,R measurements, Digital RLC meters.

UNIT 4 DIGITAL INSTRUMENTS 9 Hrs.

Comparison of analog and digital techniques – digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval – extension of frequency range – Automation in digital instruments, Automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments, Computer controlled test systems, Virtual instruments.

UNIT 5 ACQUISITION MEASUREMENT SYSTEMS AND FIBER OPTIC DATA 9 Hrs.

Elements of a digital data acquisition system – interfacing of transducers – multiplexing – data loggers – computer controlled instrumentation – IEEE 488 bus – fiber optic measurements for power and system loss – optical time domains reflect meter.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basics of measurement systems.
CO2 - Design a measuring instrument and study about various oscilloscopes.
CO3 - Select proper method for analyzing the signals using signal generators.
CO4 - Examine the latest technology for modern digital instruments.
CO5 - Evaluate the various digital measurement techniques.
CO6 - Develop a data acquisition system and measurement system.

TEXT / REFERENCE BOOKS

1. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Pearson / Prentice Hall of India, 2007.
2. Ernest O. Doebelin, Measurement Systems- Application and Design, TMH, 2007.
3. Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, Pearson Education, 2003.
4. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.
5. David A. Bell, Electronic Instrumentation and measurements, Prentice Hall of India Pvt Ltd, 2003.
6. B.C. Nakra and K.K. Choudhry, Instrumentation, Meaurement and Analysis, 2nd Edition, TMH, 2004.
7. James W. Dally, William F. Riley, Kenneth G. McConnell, Instrumentation for Engineering Measurements, 2nd Edition, John Wiley, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3012	POWER PLANT INSTRUMENTATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To familiarize about different power generation process, various measurements & analysis in power plants, types of controls and control loops in boilers.
- To provide in-depth understanding of nuclear power plant.

UNIT 1 INTRODUCTION 9 Hrs.

Brief survey methods of power generation - hydro, thermal, nuclear, solar and wind power - Importance of instrumentation in power generation - Piping and instrumentation diagram of a thermal power plant - Boiler types - water tube - fire tube - fluidized bed - Fuels - coal, fuel oil, natural and petroleum gas, synthetic fuels and biomass - Combustion process - Combustion of solid fuel, Combustion of fuel oil, combustion of gas – Cogeneration.

UNIT 2 MEASUREMENTS IN POWER PLANTS 9 Hrs.

Metal temperature measurement in boilers, piping system for pressure measuring devices, Flow of feed

water - fuel, air and steam with correction factor for temperature and pressure - smoke and dust monitor, flame monitoring. Drum level measurement - Radiation detector - Introduction to turbine supervising system - pedestal vibration - shaft vibration - eccentricity measurement. Installation of non-contracting transducers for speed measurement - rotor and casing movement and expansion measurement.

UNIT 3 CONTROL LOOPS IN BOILER 9 Hrs.

Combustion Control -air/fuel ratio control - furnace draft control - drum level control- main stream and reheat steam temp control - super heater control - attemperator - de-aerator control - distributed control system in power plants - interlocks in boiler operation- Problems associated with control of multiple pulverizers - Fan drives and control.

UNIT 4 ANALYZERS IN POWER PLANTS 9 Hrs.

Coal analyzer- thermo-gravimetri - gross calorific value - total sulphur analysis - ash analyzer - online monitor - air quality monitoring - Sampling of ambient air - general air sampling system - Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - pH Meter - pollution monitoring instruments.

UNIT 5 NUCLEAR POWER PLANT INSTRUMENTATION 9 Hrs.

Introduction - Energy from nuclear reaction - Nuclear fission and fusion - Neutron flux and reaction rate - Types of reactor - pressurized water reactor - boiling water reactor - Nuclear waste disposal - Piping and instrumentation diagram of different types of nuclear power plant - Nuclear reactor control loops - reactor dynamics - excess reactivity - pulse channel and logarithmic instrumentation - control and safety instrumentation - reliability aspects.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Summarize the methods of power generation and combustion process.
CO2 - Illustrate the measurement of various parameters in a power plant and working of Nuclear power plant.
CO3 - Select the appropriate control techniques for boilers.
CO4 - Compare the different analyzers used in power plant.
CO5 - Analyze the various measurements in different types of power plants.
CO6 - Select optimized measurement and control techniques in power plants.

TEXT / REFERENCE BOOKS

1. Gill A.B, “Power Plant Performance”, 6th Edition, Butterworth, London, 1984.
2. Liptak. B.G, Analytical Instrumentation, Vol 1 & Vol 2, Chilton Book Company, 1994.
3. Nag P.K ?Power Plant Engineering? , 2nd Edition, Tata McGraw Hill, 2001.
4. Sam Dukelow. G “The control of Boilers”, 2nd Edition, Instrument society of America, 1991.
5. Elonka S.M, Kohan A.L, “Standard Boilers Operations”, McGraw Hill, New Delhi, 1994.
6. Wakil. E.A Power Plant Engineering, Tata McGraw Hill, 1984,
7. David Lindsley, “Boiler Control Systems”, McGraw Hill, New York, 1991.
8. Jain. R.K, “Mechanical and industrial Measurements”, Khanna Publishers, New Delhi, 1995.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3013	INDUSTRIAL INSTRUMENTATION AND AUTOMATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To study the various Components in the Industrial Automation.
- To have an adequate knowledge about different industrial instrumentation
- To get the Knowledge in PLC for various Applications
- To Study the various components in SCADA.

UNIT 1 INTRODUCTION 9 Hrs.

Need and benefits of Industrial Automation, Automation Hierarchy, Basic components of automation system, description of each component, Types of automation system: - Fixed, programmable, flexible.

UNIT 2 SENSORS AND TRANSDUCER 9 Hrs.

Piezoelectric, Photovoltaic, Hall Effect, Magneto strictive, Radio-Active Absorption, Ionic Conduction Transducers, Digital Transducers - Digital Displacement Transducer, Shaft Angle Encoder, Optical

Encoders, Magnetic Encoders -Digital Speed Transducers -Variable Reluctance Type, Smart Sensors - SQUID Sensors - Film Sensors – MEMS - Basic Concept of MEMS

UNIT 3 INTRODUCTION TO PLC 9 Hrs.

Introduction to Sequence Control, PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming- realization of AND, OR logic, concept of latching.

UNIT 4 PLC AND ITS APPLICATIONS 9 Hrs.

Introduction to Timer/Counters, ON Delay Timer, OFF Delay Timer - Exercises based on Timers, Counters - Up Counters, Down Counters. Logical Instructions, Comparison Instruction, Arithmetic Instructions, Data Handling Instructions. PLC based applications: Motor sequence control, Traffic light control, elevator control, Tank level control, conveyor system, Stepper motor control.

UNIT 5 SCADA 9 Hrs.

Introduction to SCADA, typical SCADA block diagram, - Common System Components Supervision and Control- HMI, RTU and Supervisory Stations- Trends in SCADA, benefits of SCADA. Interfacing SCADA system with PLC: Typical connection diagram, Object linking and embedding for Process Control (OPC) architecture.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the different components of an Automation System.
CO2 - Analyze the New sensors and Transducer for the applications
CO3 - Interface the given I/O Device with appropriate PLC Module.
CO4 - Design a PLC Ladder Program for the given applications.
CO5 - Develop a simple SCADA Applications.
CO6 - Design the Interfacing SCADA system with PLC

TEXT / REFERENCE BOOKS

1. Stenerson, Jon," Industrial Automation and Process Control", PHI Learning, New Delhi, ISBN 9780130618900.
2. D. Patra Nabis, 'Sensors and Transducers', Prentice Hall of India, 1999.
3. Dr. S. Renganathan, "Transducer Engineering" -Allied Publishers Limited.
4. Jadhav, V. R.," Programmable Logic Controller", Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
5. Petruzella,F.D," Programmable Logic Controller", Tata — McGraw Hill India, New Delhi, Fourth edition,20l0, ISBN: 9780071067386.
6. Mitra, Madhu Chandra, Sengupta, Samarjit," Programmable Logic Controllers and Industrial Automation an Introduction", Penram International Publication, New Delhi 2015,Fifth Reprint, ISBN 9788187972174.
7. Boyar.S.A," Supervisory Control and Data Acquisition", ISA Publication, New Delhi , Fourth Edition, ISBN 978-1936007097.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3014	TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To undertake installation, commissioning and maintenance of various electrical equipment.
- To impart knowledge on maintenance schedule of different equipment and machines.
- To trouble shoot various electrical equipment, machines and domestic appliances.
- To have familiar about electrical safety regulations and rules during maintenance.

UNIT 1 SAFETY MANAGEMENT 9Hrs.

Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure - Building installation, Domestic appliances, Industrial premises, Earthing of substation, generating station and overhead line.

UNIT 2 TESTING OF TRANSFORMER, PLANT AND EQUIPMENT 9 Hrs.

Measurement of winding resistance, voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation 13 28 resistance; Dielectric tests; Temperature-rise, insulation and HV test, dielectric absorption, switching impulse test. Drying out procedure for transformer. PI index, Commissioning steps for transformer, Troubleshooting & Maintenance of transformer.

UNIT 3 INSTALLATION AND COMMISSIONING OF ROTATING ELECTRICAL MACHINES 9 Hrs.

Degree of protection, cooling system, degree of cooling with IP- IC code (brief discussion), enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of rotating electric machine, drying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors.

UNIT 4 TRANSMISSION LINE 9 Hrs.

Commissioning of A.C transmission line and HVDC transmission, galvanize steel structure, towers and insulator for transmission and distribution line, tower footing resistance, substation equipment, bus bar system, power cable, low power control cable, Contactor, GIS (gas insulated substation).

UNIT 5 SWITCH GEAR & PROTECTIVE DEVICES 9 Hrs.

Standards, Classification, specification, rating and duties of CB, installation, commissioning tests, maintenance schedule, type & routine tests. Operation of s/s (steps) for line Circuit breaker maintenance. Location of lightening arrester with reasons.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend different types of earthing for different types of electrical installations.
CO2 - Examine the maintenance schedule of the transformers.
CO3 - Analyze and trouble shoot various types of rotating electrical machines.
CO4 – Estimate the commissioning of AC transmission line and HVDC transmission.
CO5 – Develop a maintenance schedule for switch gear and protective devices.
CO6 – Design a lightening arrester for appropriate locations..

TEXT / REFERENCES BOOKS

1. Rao, S., “Testing, commissioning, operation and maintenance of electrical equipment”, 6/E., Khanna Publishers, New Delhi
2. Paul Gill, “Electrical power equipment maintenance and testing”, CRC Press, 2008.
3. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
4. Philip Kiameh, “Electrical Equipment Handbook: Troubleshooting and Maintenance”, McGrawHill, 2003.
5. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipments/machines.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SECB3015	ROBOTICS AND AUTOMATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To study the fundamental concepts of robotics and automation.
- To impart knowledge on various drive system, sensors & machine vision system.
- To learn the various manipulators, grippers as well as the various dynamic process.
- To acquire the concept of kinematics and inverse kinematics.
- To understand the programming and specific industrial applications and applications in Machine Learning

UNIT 1 BASIC CONCEPTS 9 Hrs.

Origin & various generation of Robots - Robot definition - Robotics system components - Robot classification Coordinate frames - Asimov's laws of robotics - degree of freedom - dynamic stabilization

of robots. work volume. Need for Automation - types of automation - fixed, programmable and flexible automation

UNIT 2 DRIVES, SENSORS AND MACHINE VISION 9 Hrs.

Hydraulic, Pneumatic and Electric drives - Machine vision - Sensing - Range, Proximity, Position, Velocity, Acceleration, Tactile, Acoustic, Force, Torque, Optical & laser sensors. Machine vision - Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, Image processing and analysis – Image data reduction – Segmentation feature extraction – Object recognition- Case study on choice of sensors and actuators for maze solving robot and self-driving cars

UNIT 3 MANIPULATORS, GRIPPERS AND ROBOT DYNAMICS AND KINEMATICS 9 Hrs.

Construction of manipulators - Manipulator dynamics and force control - Electronic and Pneumatic manipulator control circuits - End effectors - Various types of grippers - Design considerations. Introduction to Robot Dynamics - Lagrange formulation - Newton Euler formulation - Properties of robot dynamic equations. Forward Kinematics - Denavit Hartenberg Representation. Multiple solution jacobian work envelop, Inverse Kinematics - Geometric approach. Hill climbing techniques.

UNIT 4 PROGRAMMING LANGUAGES 9 Hrs.

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Implementation of Robots in industries-Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non-manufacturing applications - Robots for nuclear and chemical plants.

UNIT 5 APPLICATIONS OF MACHINE LEARNING 9 Hrs.

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine basic concepts of robotic system
CO2 - Analyze the function of sensors and machine vision system in the robot.
CO3 - Categorize the drives, manipulators and grippers.
CO4 - Develop the qualitative knowledge of. Robot dynamics and kinematics.
CO5 - Evaluate the recent trends and application of robotics in various fields and its applications of Machine Learning in Robotics
CO6 - Propose the theoretical concepts through specific experimental tasks.

TEXT / REFERENCE BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., “Industrial Robotics”, McGraw-Hill Singapore, 1996.
2. Ghosh, “Control in Robotics and Automation: Sensor Based Integration”, Allied Publishers, Chennai, 1998.

3. Asfahl C.R., "Robots and Manufacturing Automation", John Wiley, USA 1992.
4. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994.
5. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", TATA McGraw-Hill Publishing Company, New Delhi, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3016	ADVANCED POWER ELECTRONICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: SEEB1403 **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on different types of power semiconductor devices and its switching characteristics.
- To study the operation, characteristics and performance parameters of controlled rectifiers.
- To understand the operations of choppers and inverters.
- To get acquainted with the applications of power electronics converters.

UNIT 1 SWITCHING VOLTAGE REGULATORS 9 Hrs.

Introduction - Linear power supply (Voltage regulators) - Switching voltage regulators - Review of basic DC-DC voltage regulator configurations - Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode - Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuk converter, Sepic Converter - Design criteria for SMPS - Multi-output switch mode regulator.

UNIT 2 RESONANT CONVERTERS 9 Hrs.

Introduction - Need of resonant converters - Classification of resonant converters - Load resonant converters - Resonant switch converters - Zero- voltage switching DC-DC converters - Zero current switching DC-DC converters - Clamped voltage topologies.

UNIT 3 MULTI-LEVEL CONVERTERS 9 Hrs.

Need for Multi-level inverters - Concept of multi-level - Topologies for multi-level - Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations - Features and relative comparison of these configurations applications - Introduction to carrier based PWM technique for multi-level converters.

UNIT 4 MULTIPULSE CONVERTERS 9 Hrs.

Concept of multi-pulse - Configurations for m-pulse (m=12,18,24 ….)converters - Different phase shifting transformer (Y-Δ1, Y-Δ2, Y-Z1 and Y-Z2) configurations for Multi-pulse converters - Applications

UNIT 5 HVDC TRANSMISSION 9 Hrs.

Introduction - Operation of 12-pulse converter as receiving and sending terminals of HVDC system - Equipment required for HVDC System and their significance - Comparison of AC and DC transmission - Control of HVDC transmission

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the Characteristics of various Switching Voltage Regulators.
CO2 - Evaluate the various performances of Resonant Converters.
CO3 - Analyze different Multi-level converter Circuits.
CO4 - Design various Multi-pulse Converters based on real time applications.
CO5 - Analyze the HVDC Transmission applications.
CO6 - Select an Optimized Power Electronic Converters to meet industrial requirements.

TEXT / REFERENCE BOOKS

1. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics – Converters, Applications and Design”, John Willey & sons, Inc., 4th ed., 2007.
2. Muhammad H. Rashid, “Power Electronics - Circuits, Devices and Applications”, Prentice Hall of India, 4th ed., 2014.
3. Bin Wu, “High Power Converters and AC Drives”, John Willey & sons, Inc., 2006.
4. Derek A. Paice “Power Electronic Converter Harmonics – Multi-pulse Methods for Clean Power”, IEEE Press, 1999.
5. Muhammad H. Rashid , “Power Electronics Handbook”, Elsevier, 4th ed., 2021.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 Exam Duration:3Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3017	ADVANCED CONTROL SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: SEE1401
Co Requisite: Nil

COURSE OBJECTIVES

- To gain knowledge in the designing of state space analysis.
- To obtain the state transition matrices and the solution of state equations.
- To design a state observer using the concept of controllability and observability.
- To have a clear understanding in Digital Data Systems.
- To have an exposure in different stability analysis of Nonlinear Systems.

UNIT 1 STATE SPACE MODEL 9 Hrs.

Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen

Values and Eigen vectors Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function.

UNIT 2 MATHEMATICAL ANALYSIS 9 Hrs.

Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem-Solution of State Equation.

UNIT 3 STATE FEEDBACK AND OBSERVERS 9 Hrs.

Concepts of Controllability and Observability - Design of State Space Feedback using Pole Placement Technique-State Observers.

UNIT 4 SAMPLED DATA SYSTEMS 9 Hrs.

Reconstruction of Sampled Signals using Hold Circuits - Zero Order Hold - its Representation - Bode Plot of Hold Circuit - Z
- Transform of Sampled Signals - Theorems on Z- Transform - Inverse Z-transform - Mapping between s and z Planes - Pulse Transfer Function Impulse Response - Closed Loop Operation - Characteristic Equations - Jury's Stability Criterion

UNIT 5 NONLINEAR SYSTEMS 9 Hrs.

General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearities - Determination of Limit Cycle by Describing Function - Stability of Limit Cycle - System Stability in the Sense of Lyapunov - Lyapunov's Direct Method - Stability and Instability Theorems - Application of Lyapunov Method for Linear Systems - Basic Concepts of Phase Plane Method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the state model of any linear time invariant system.
CO2 - Analyze the state transition matrices and their solutions.
CO3 - Evaluate the controllability and observability.
CO4 - Design a state observer using pole placement technique.
CO5 - Analyze any discrete systems.
CO6 - Determine the stability of any Nonlinear systems.

TEXT / REFERENCE BOOKS

1. K.Ogata, "Modern control Engineering", 5th Edition. Prentice Hall India, New Delhi. 2010.
2. B.C.Kuo, "Automatic Control Systems", Phi learning Pvt Ltd, 9th Edition, 2009.
3. Philips C.L., & John Parr "Feedback Control Systems" 5th Edition, Prentice Hall International. 2010.
4. Naresh K. Sinha, "Control Systems'', New Age International Ltd., Reprint 2004.
5. Stanley M.Shinners, "Modern Control System Theory and Design", 3rd Edition, John Wiley & Sons.2004.
6. M.Gopal, "Digital Control and State Variable Methods", 4th Edition, Tata McGraw Hill Ltd., New Delhi, 2012.
7. Roy Choudhry, "Modern Control Engineering" Phi Learning, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3018	MODERN POWER CONVERTERS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on different types of Switched mode power supplies.
- To study the operation, characteristics and performance parameters of Matrix Converter.
- To understand the operations of Soft switched converters.
- To get acquainted with the applications of modern power electronics converters.

UNIT 1 SWITCHED MODE POWER SUPPLIES (SMPS) 9 Hrs.

DC Power supplies and Classification - Switched mode dc power supplies with and without isolation -

single and multiple outputs - Closed loop control and regulation - Design examples on converter and closed loop performance.

UNIT 2 AC-DC CONVERTERS 9 Hrs.

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 design examples.

UNIT 3 DC-AC CONVERTERS 9 Hrs.

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.

UNIT 4 AC-AC CONVERTERS WITH AND WITHOUT DC LINK 9 Hrs.

Matrix converters - Basic topology of matrix converter - Commutation - current path - Modulation techniques - Scalar modulation - Indirect modulation - Matrix converter as only AC-DC converter - AC-AC converter with DC link - Topologies and operation - With and Without resonance link - Converter with DC link converter - Performance comparison with matrix converter with DC link converters.

UNIT 5 SOFT-SWITCHING POWER CONVERTERS 9 Hrs.

Soft switching techniques - ZVS, ZCS, quasi resonance operation – Performance comparison hard switched and soft switched converters - AC-DC converter - DC-DC converter – DC-AC converter - Resonant DC power supplies.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine the classification and operation of Switched Mode Power Supplies.
CO2 - Evaluate the various performance parameters of different converters.
CO3 - Analyze different types of multilevel inverters circuits.
CO4 - Design various converters based on real time applications.
CO5 - Analyze the AC-AC Converters with and without DC Link.
CO6 - Select optimized Power Electronic Converters to perform soft switching techniques.

TEXT / REFERENCE BOOKS

1. Power Electronics Handbook, M.H.Rashid, Academic press, New York, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, New York, 2005.
3. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2006.
4. Krein Philip T, Elements of Power Electronics, Oxford University press, 2nd 2012.
5. Agarwal, Power Electronics: Converters, Applications, and Design, 4th edition, Jai P, Prentice Hall, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3019	**RENEWABLE ENERGY SYSTEMS**	**L**	**T**	**P**	**EL**	**Credits**	**Total Marks**
		3	**0**	**0**	**0**	**3**	**100**

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To gain knowledge on world energy scenario.
- To impact knowledge on generation of Solar, wind, Geo thermal energy and fuel cells.
- To analyze the types of renewable energy power generation.
- To have a knowledge on the applications of renewable energies.

UNIT 1 INTRODUCTION9 Hrs.

Classification of Energy Resources - Importance of Non-Conventional Energy Resources - Advantages and Disadvantages of Non-Conventional Energy Resources - Environmental Aspects of Energy - World Energy status - Energy scenario in India
- Principles of Energy Conservation – Cogeneration.

UNIT 2 SOLAR ENERGY9 Hrs.

Theory of solar cells - VI and PV curves - Equivalent circuit. Concept of solar PV module, Panel, Array, Maximum Power Point tracking - Solar PV systems - Solar PV Applications. Solar Thermal Systems-Solar Collector's Classifications- Flat plate collectors - Focus type collectors – Solar Refrigeration and Air-Conditioning System - Solar Pond Power Plant - Solar Thermal Power Plant.

UNIT 3 WIND ENERGY 9 Hrs.

Wind Power and its Sources-Energy from Wind - Horizontal axis Wind Turbine - Vertical Axis Wind Turbine - Wind Energy Conversion Systems - Cp Vs Speed Curve.

UNIT 4 GEOTHERMAL, BIOMASS, TIDAL ENERGY 9 Hrs.

Geothermal Energy:-Resources of geothermal energy- environmental considerations. Bio-mass-Availability of bio-mass and its conversion technologies-Biogas production from Bio-mass. Tidal energy-tidal range power-ocean tidal energy conversion-Ocean Thermal Energy Conversion technology (OTEC).

UNIT 5 FUEL CELL AND MISCELLANEOUS NON- CONVENTIONAL TEACHNOLOGIES9 Hrs.

Fuel Cells - Principle of Working - Classification of Fuel Cells - Construction, Working and Performance of Phosphoric Acid Fuel Cell and Alkaline Fuel Cell - VI Characteristics of Fuel Cell - Fuel Cell Power Plant - MHD Power Conversion- Thermo Electric Power Conversion - Thermionic Power Conversion.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine world and Indian energy scenario and the need of renewable energy.CO2 - Analyze the use of solar energy and its various applications.

CO3 - Analyze the need of Wind Energy and the various components used in energy generation.

CO4 - Examine geothermal, Biomass energy resources, tidal power and OTEC.

CO5 - Analyze the concept of fuel cells and their classifications.

CO6 - Examine MHD, Thermo Electric and Thermionic Power Conversion.

TEXT / REFERENCE BOOKS

1. B Khan ,"Non-conventional Energy resources", Tata McGraw Hill, 2nd Edition 2009.
2. Mukund R. Patel, "Wind & Solar Power Systems- Design, Analysis and Operation", Taylor and Francis, 2nd Edition 2005.
3. James Larminie & Andrew Dicks, "Fuel Cell Systems Explained", John Wiely & Sons, 2nd Edition, 2003.
4. John Twideu and Tony Weir, "Renewal Energy Resources", BSP Publications, 2006.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners", PHI Learning,

2008.
6. Eric Jeffs, "Green Energy: Sustainable Electricity Supply with Low Environmental Impact", CRC Press, USA 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3020	ENERGY STORAGE SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- To develop the ability to understand / analyze the various types of energy storage.
- To study the various applications of energy storage systems.
- To analyze various types of energy storage devices and perform the selection based on techno-

economic view point.

UNIT 1 INTRODUCTION 8 Hrs.

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT 2 ELECTRICAL ENERGY STORAGE 10 Hrs.

Fundamental concept of batteries – measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide and modern batteries for example zinc-Air, Nickel Hydride, Lithium Battery.

UNIT 3 FUEL CELL 9 Hrs.

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantage and drawback of each type.

UNIT 4 THERMAL STORAGE SYSTEM 9 Hrs.

Thermal storage – Types – Modelling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of Transys.

UNIT 5 ALTERNATE ENERGY STORAGE TECHNOLOGIES 9 Hrs.

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the different energy storage technology
CO2 - Analyze the technical aspects of battery storage system
CO3 - Examine the performance of fuel cell storage system
CO4 - Evaluate the performance of different thermal storage system
CO5 - Criticize the different alternate energy storage technology
CO6 - Design suitable alternate energy storage technology for real world application

TEXT / REFERENCE BOOKS

1. Ru-shiliu, Leizhang and Xueliang sun, “Electrochemical technologies for energy storage and conversion”, Wiley publications, 2012 Ibrahim Dincer and Mark A. Rosen, “Thermal Energy Storage Systems and Applications”, John Wiley & Sons 2002.
2. James Larminie and Andrew Dicks,”Fuel cell systems Explained”, Wiley publications, 2003.
3. Lunardini.V.J, Heat Transfer in Cold Climates, John Wiley and Sons 1981.
4. Schmidt.F.W and Willmott.A.J, Thermal Storage and Regeneration, Hemisphere Publishing Corporation, 1981.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3021	ELECTRICAL ESTIMATION AND ENERGY AUDITING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- To make key decision in the area of energy management.

- To maximize the profits on energy utilization (minimize cost).
- To convey knowledge on necessity to study energy auditing methods and energy saving opportunities in electrical system.

UNIT 1 SYSTEMS OF INTERNAL WIRING AND EARTHING9 Hrs.

Systems of Internal Wiring and Earthling Conventional symbols for various wiring items, accessories - Indian Electricity Rules (1956) on installation and earthing - Systems of Internal wiring Wiring systems - Types of wiring - points to be considered for selection of wiring - comparison - Looping back system and Joint box system and tree system – Earthing.

UNIT 2 DOMESTIC, COMMERCIAL AND INDUSTRIAL INSTALLATION ESTIMATE 9 Hrs.

Conditions and Requirements for Domestic, Commercial and Industrial Installation - steps to be followed in preparing electrical estimate (domestic, industrial and agricultural installation) Estimate the quantity of material required for house and industrial wiring.

UNIT 3 ENERGY AUDITING AND ENERGY MANAGEMENT IN ELECTRICAL SYSTEM 9 Hrs.

Energy Audit- Definition, Need, Types of Energy Auditing - Energy management approach understanding energy costs- bench marking – energy performance – power factor correction and maximum demand control.

UNIT 4 ENERGY CONSERVATION IN MOTORS, TRANSFORMERS MOTORS OPERATION

OF INDUCTION MOTOR 9 Hrs.

Special Design feature for high efficiency motor - Torque - Speed Characteristics – Operating parameters of motor - Losses

- Measurement of efficiency - Determination of energy saving - determination of Load – Assessment of economic feasibility - Transformers Introduction - Transformer Losses - Fixed Losses – Load Losses.

UNIT 5 ENERGY CONSERVATION IN LIGHTING SYSTEM, PUMPING SYSTEM AND

DIESEL GENERATING SYSTEM LIGHTING SYSTEM 9 Hrs.

Light source – choice of lighting – luminance requirement – Energy saving potential of electronic ballasts – Energy saving potential of Occupancy sensors - Fluorescent tube lights - CFL lamps – Energy efficient lighting control - Energy conservation avenues in Lighting system. Pumping Systems Pumping System characteristics –Factors affecting pump performance - Efficient pumping system operation – Energy performance assessment of Diesel conservation avenues.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Draw the conventional symbols for various electrical installations. To quote the relevant IE rules for a given electrical installation, earthing and clearance of

service lines. Familiarize the types of wiring. ·

CO2 - List the points to be considered for selection wiring. Determine the size of wire for internal wiring, Explain the necessity and types of earthing. ·CO3 - Estimate the quantity of materials required for earthing, Differentiate between neutral, earth wire, and domestic and industrial wiring. ·

CO4 - Evaluate the types of energy audit, the energy saving opportunities in Transformer, Induction motor, lighting and DG system.

CO5 - Examine the role of power factor controller in energy saving system.

CO6 - Examine the role of sensors in energy saving system, Explain the energy efficient technologies in electrical system.

TEXT / REFERENCE BOOKS

2. K.B. Raina,S.K. Bhattacharya, "Electrical Design: Estimating and Costing" New Age International (P) Limited, 2018.
3. Dr. Subhash Gadhave Anup Goel Siddu S. Laxmikant D. Jathar, "Energy Audit and Management for SPPU" Technical Publications; 1st Edition (2018).
4. Sonal Desai, "Handbook of Energy Audit " McGraw Hill Education (1 July 2017).
5. Amlan Chakrabarti, "Energy Engineering And Management" Kindle Edition PHI (30 January 2011).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Question of 2 marks each – No choice **20 Marks**

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3022	COMPUTER CONTROL OF ELECTRIC DRIVES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- To understand fundamentals of microcontroller and power electronic devices.
- To develop comprehensive approach towards building an industrial drive system.
- To apply drive system to real world application scenarios.

UNIT 1 REVIEW OF MICRO CONTROLLERS AND POWER ELECTRONICS DEVICES 9 Hrs.

Typical Micro controller's 8bit 16 bit (only block diagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors. Power semiconductors devices used for drives control, GTO, BJT, power MOSFET, IGBT, MCT and IGCT structures, Ratings, comparison and their applications. Block diagram of power integrated circuit for D C motor drives.

UNIT 2 A C MACHINE DRIVES 9 Hrs.

General classification and National Electrical Manufacturer Association (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics. Principle of Vector Control of A C Drives, Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control, synchronous motor control with compensation.

UNIT 3 SYNCHRONOUS MACHINE DRIVES 9 Hrs.

Wound field machine, comparison of Induction and wound field synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM), variable reluctance machines (VRM).Series Hybrid Electric Drive Train Design-Sizing of the Major Components- The Hybrid Electric Vehicle-Energy Use in Conventional Vehicles-Energy Savings Potential of Hybrid Drive trains-HEV Configurations-Series Hybrid System-Parallel Hybrid System-Series-Parallel System-Complex Hybrid System.

UNIT 4 PHASE CONTROLLED CONVERTERS AND SLIP POWER RECOVERY SCHEMES 9 Hrs.

Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle, Electrro magnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers, Current fed converters.Static Kramer's drive system, block schematic diagram, phasor diagram and limitations, Static Scherbins scheme system using D.C link converters with cyclo converter modes of operation, modified Scherbins Drive for variable source, constant frequency (VSCF) generation.

UNIT 5 CASE STUDIES: APPLICATION TO DRIVES 9 Hrs.

Expert system shell, Design methodology, ES based P-I tuning of vector controlled drives system, Fuzzy logic control for speed controller in vector control drives, structure of fuzzy control in feedback system. Introduction to Solar and battery powered Drives; Introduction to traction Drives; Servo motor drive requirement – control and implementation.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic concepts of microcontroller and power electronic devices pertaining to drive system.

CO2 - Analyze the vector control method for AC drives.

CO3 - Examine synchronous motor drives.
CO4 - Comprehend Phase Controlled Converters and Slip Power Recovery Schemes.
CO5 - Implement drives system using fuzzy logic controllers.
CO6 - Solve the given societal challenge using drive system.

TEXT / REFERENCE BOOKS

1. Werner Leonhard, Control of Electrical Drives, 3e, Springer 2006.
2. Gopal K. Dubey, Fundamentals of Electrical Drives, Wiley2010.
3. Robbins Mohan, Power Electronics: Converters Applications and Design, Media Enhanced, 3ed, Wiley 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3023	COMPUTER AIDED ELECTRICAL DRAWING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To discuss the basic terminology of DC and AC armature windings.
- To discuss design and procedure to draw armature winding diagrams for Transformers, DC and AC machines.
- To explain development of sectional views of Transformers, DC machine and alternators using the design data.

UNIT 1 WINDING DIAGRAMS 9 Hrs.

Winding Diagrams of D.C. Machines: Simplex Double Layer Lap and Wave Windings. Winding Diagrams of AC .Machines. Integral and Fractional Slot Double Layer Three Phase Lap and Wave Windings. Single Layer Windings – Un-Bifurcated 2 and 3 Tier Windings, Mush Windings, Bifurcated 3 Tier Windings.

UNIT 2 SINGLE LINE DIAGRAMS 9 Hrs.

Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Single, Sectionalized Single, Main and Transfer, Double Bus Double Breaker, Sectionalised Double Bus, One and a Half Circuit Breaker Arrangement, Ring Main),Power Transformers, Circuit Breakers, Isolators, Earthing Switches, Instrument Transformers, Surge or Lightning Arresters, Communication Devices (Power-Line Carrier) and Line Trap.

UNIT 3 TRANSFORMERS ASSEMBLY DRAWINGS 9 Hrs.

Transformers - Sectional Views of Single and Three Phase Core And Shell Type Transformers.

UNIT 4 D.C. MACHINE ASSEMBLY DRAWINGS 9 Hrs.

D.C. Machine - Sectional Views of Yoke with Poles, Armature and Commutator dealt separately.

UNIT 5 ALTERNATOR ASSEMBLY DRAWINGS 9 Hrs.

Alternator – sectional views of stator and rotor dealt separately battery storage and charging.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend the basic concepts of DC and AC armature windings.
CO2 - Develop a layout for substation using the standard symbols for substation.
CO3 - Draw sectional views of core and shell types transformers using the design data.
CO4 - Draw sectional views of assembled DC machine using the design data or the sketches.
CO5 - Draw sectional views of assembled alternator using the design data or the sketches
CO6 - Design of an electrical machine using the aid of computer.

TEXT / REFERENCE BOOKS

1. Yogesh, M., Nagaraja, B., & Nandan, N. (2014). *Computer Aided Electrical Drawing*. PHI Learning Pvt. Ltd.

2. M. G. Say, Performance & Design of Alternating Current machines,CBS publishers,E-Edition,2017.
3. A.E Clayton & N.N.Hancock, The Performance & Design of DC machines, CBS Publication,E-Edition,2018.
4. Manuals of Auto – CAD.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3024	INDUSTRIAL DRIVES AND AUTOMATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**

Requisite: Nil

COURSE OBJECTIVES

- Provide strong foundation to solve control and instrumentation problems in continuous or batch problems.
- Technical competence through hands-on experience with industrial hardware and software.
- Systematic design approach to engineering projects through solving tutorial problems and completing the major assignment.
- To introduce basic concepts of load and drive interaction, speed control concepts of ac and dc drives, speed reversal, regenerative braking aspects, design methodology.

UNIT 1 INTRODUCTION TO ELECTRIC DRIVES AND SELECTION OF CONVERTERS 9 Hrs.

Fundamentals of Electric Drive dynamics- Stator and Rotor-Power and Torque-Efficiency-Typical Operating Conditions-Speed Control of Electrical Motors-Reversing-Torque Control-Dynamic Braking-Motor heating and Thermal monitoring. Direct Converters-Converters with Intermediate Circuit-Inverter Modulation Principles-Converter, Rating from Motor Specification-Overload Capacity-Control Range-Derating factor- Regenerative Energy.

UNIT 2 CONTROL OF DC DRIVES 9 Hrs.

Conventional methods of DC motor speed control, single phase and three phase-controlled DC drives-four quadrant operation-Chopper fed DC drives-Braking and speed reversal-Closed-loop control of DC Drives-Design of controllers.

UNIT 3 SCALAR AND VECTOR CONTROL OF AC DRIVES 9 Hrs.

Scalar Control with Compensation - Servo Control – Voltage Vector Control - Standards and Legislations. Space Vector Control-Flux Vector Control – Direct torque control – Sensor less control.

UNIT 4 INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLERS AND ITS PROGRAMMING METHODS 9 Hrs.

Advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC. Ladder diagram, STL, functional block diagram, SFC, Instruction List. Creating ladder diagram from process control descriptions, Introduction to IEC61131 international standard for PLC.

UNIT 5 INTRODUCTION TO SCADA AND DISTRIBUTED CONTROL SYSTEM 9 Hrs.

Data acquisition system, Evolution of SCADA, Communication Technologies, Monitoring and Supervisory Functions. DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC support, Security and Access Control etc. Performance Criteria for DCS and other automation tools.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the suitable power converters and fix its rating based on requirement.
CO2 - Examine the different types of DC drives and construct its controller.
CO3 - Examine scalar and vector control of AC drives
CO4 - Select and interface hardware for an automatic control system and Use PLC for an automatic control system confining to standards.
CO5 - Design the hardware and software component required to constitute a SCADA system..
CO6 - Develop code and configure DCS to handle local and distributed automation tasks

TEXT / REFERENCE BOOKS

1. Rokosh Das Begamudre, "Extra High Voltage AC Transmission Engineering"– Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, "HVAC and HVDC Transmission, Engineering and Practice" Khanna Publisher, Delhi, 1990.
3. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, "Extra High Voltage AC Transmission Engineering"– New Academic Science Ltd; 4 edition 2011.
3. Edison," EHV Transmission line"- Electric Institution, GEC, 1968.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3025	SPECIAL ELECTRICAL MACHINES AND CONTROL	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To review the basic concepts of stepper motors and its applications.
- To understand the concept of the operating principle and characteristics of switched reluctance motors.
- To impart knowledge on the fundamental concepts and control of permanent magnet brushless DC motors.
- To introduce the concepts and control methods of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To impart knowledge on the microprocessor based control of special machines.

UNIT 1 STEPPING MOTORS 9 Hrs.

Constructional features, principle of operation, types, modes of excitation, Torque production in Variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Introduction to Drive circuits for stepper motor, suppressor circuits, Closed loop control of stepper motor- Applications.

UNIT 2 SWITCHED RELUCTANCE MOTORS 9 Hrs.

Principle of Operation, Constructional features, Torque equation, Power Semi-Conductor Switching Circuits, frequency of variation of inductance of each phase winding - Control circuits of SRM-Torque - Speed Characteristics, Microprocessor based control of SRM Drive, Applications.

UNIT 3 SYNCHRONOUS RELUCTANCE MOTORS 8 Hrs.

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, Speed torque characteristics, Applications.

UNIT 4 PERMANENT MAGNET BRUSHLESS DC MOTORS 9 Hrs.

Commutation in DC motors, Electronic Commutation- Difference between mechanical and electronic commutators- Hall sensors, Optical sensors, Construction and principle of PMBL DC Motor, Torque and E.M.F equation, Torque-speed characteristics, Power Controllers-Drive Circuits, Applications.

UNIT 5 PERMANENT MAGNET SYNCHRONOUS MOTORS 10 Hrs.

Construction and types, Principle of operation, EMF and Torque equation, Phasor diagram- Torque Speed Characteristics, Power controllers- Self-control, Vector control, Microprocessor based Control, Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the reluctance concept to operation of various types of stepper motors.
CO2 - Analyze the operation and characteristics of switched reluctance motors.
CO3 - Evaluate the performance of synchronous reluctance motors.
CO4 - Examine power controllers and driver circuits for permanent magnet brushless DC motor.
CO5 - Evaluate best speed control for permanent magnet synchronous motor.
CO6 - Develop control methods for Permanent magnet synchronous motor on real time applications.

TEXT / REFERENCE BOOKS

1. Miller T.J.E., “Brushless permanent magnet and reluctance motor drives”, Clarendon Press, Oxford, 1989.
2. KenjoT., “Stepping motors and their microprocessor control”, Oxford University Press, 2000.
3. R.Krishnan, “Electric Motor Drives - Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2015.
4. Kenjo T. and Naganori, S “Permanent Magnet and Brushless DC motors”, Clarendon Press, Oxford, 1985.
5. B.K. Bose, “Modern Power Electronics & AC drives”, Dorling Kindersley India, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3026	INDUSTRY 4.0 FOR ELECTRICAL	L	T	P	EL	Credits	Total Marks

	ENGINEERS	**3**	**0**	**0**	**0**	**3**	**100**

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application.
- Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular applications.

UNIT 1 INTRODUCTION TO INDUSTRY 4.0 9 Hrs.

Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT 2 INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM 9 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation. Case study: Application of CPS in health care domain.

UNIT 3 SMART ENERGY SOURCES 9 Hrs.

Energy Storage for Mitigating the Variability of Renewable Electricity Sources- Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation.

UNIT 4 SMARTGRID 9 Hrs.

Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0, Building the Smart Grid-Case study.

UNIT 5 SMART APPLICATIONS 9 Hrs.

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google's Self-Driving Car, Intellectual Property Rights.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Comprehend concepts of Industry 4.0 and the other related fields.
CO2 - Examine cyber physical system and the emerging applications.
CO3 - Analyze the different energy storage systems
CO4 - Analyze a smart grid system.
CO5 - Implement the industry 4.0 to solve engineering problems.
CO6 - Design of smart vehicle and analyze its performance.

TEXT / REFERENCE BOOKS

1. Jean-Claude André, ―Industry 4.0‖, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020.
3. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
4. Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition, ISBN-13: 978-0128100714.
5. Hossam A. Gabbar, ―Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978-0-12- 805343-0.
6. Mini S. Thomas, John Douglas McDonald, ―Power System SCADA and Smart Grids‖, CRC Press,2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3027	EMBEDDED SYSTEMS AND IoT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling.
- To develop comprehensive approach towards building small low cost embedded IoT system.
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies

UNIT 1 INTRODUCTION TO EMBEDDED SYSTEM AND IOT 9 Hrs.

Introduction to embedded systems, Application Areas ,Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Introduction to ARM processor and its architecture. Internet Of Things Promises–Definition– Scope–Sensors, IoT Applications–Structure of IoT– IoT Map Device **;** IoT Sensors/Actuators-IEEE 802.15.4-Characteristics-types. IoT Issues and Challenges, Application driven Selection of Microcontrollers .

UNIT 2 EMBEDDED IoT PLATFORM DESIGN METHODOLOGY 9Hrs.

Microcontroller units and Architecture, Interfaces (serial port, SPI, I2C, UART) ADC, Timers, RTC, Interrupts, Polling, DMA Memory architecture and handling (stack, heap, cache),Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development.

UNIT 3 PILLARS OF EMBEDDED IoT AND PHYSICAL DEVICES 9 Hrs.

The internet of devices, The internet of objects, The internet of transducer, o The internet of controllers, Device to Connect and Manage, talk, Connect. Network, Basic building blocks of and IoT device, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Interface sensor and Actuator with Raspberry Pi, Beagle board and other IoT Devices.

UNIT 4 WEB OF THINGS AND CLOUD OF THINGS 9 Hrs.

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture, Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT

UNIT 5 IoT CLOUD OFFERINGS AND IoT CASE STUDIES 9 Hrs.

Introduction to Cloud Storage Models, Communication API, Amazon Web Services for IoT, Skynet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation, Energy Harvesting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply the basic concepts of embedded systems and IoT.
CO2 - Apply the design methodology for embedded IoT Platform.
CO3 - Develop programs using Python for Raspberry Pi.
CO4 - Analyze the significance of real world problems of web of things and cloud of things.
CO5 - Implement IoT Cloud Offerings for real world problems.
CO6 - Develop the solutions to solve the given societal challenge using IoT.

TEXT / REFERENCE BOOKS

1. Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John Wiley and Sons Ltd, UK, 2014.
2. Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things‖, Springer, New York, 2011.
4. John H. Davies, ―MSP430 Microcontroller Basics‖, First Edition, Newnes Publication. 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SECB3028	MACHINE LEARNING ALGORITHMS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To recognize different key paradigms for machine learning concepts
- To familiarize with various classifiers used for machine learning
- To understand and differentiate among various supervised learning concepts
- To become familiarize with data reduction and feature extraction methods
- To apply suitable machine learning algorithms for simple engineering problems

UNIT 1 INTRODUCTION TO MACHINE LEARNING 9 Hrs.

Machine Learning vs Statistical Modelling, Applications of Machine Learning, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning Classification, Python libraries suitable for Machine Learning

UNIT 2 CLASSIFIERS 9 Hrs.

Classification, K- nearest neighbour, Decision Trees, Implementing Decision Tree, building a Tree, Random Forests - Working of Random Forest, Pros and Cons of Random Forest, Naiver Bayes, building model Using Naiver Bayes

UNIT 3 SUPERVISED LEARNING 9 Hrs.

Regression, Types of Regression model, Building a Regressor in Python, Types of ML Algorithm, Linear Regression, Multiple Linear Regression, Non-linear Regression, Model evaluation methods.

UNIT 4 K-MEANS CLUSTERING 9 Hrs.

Working of K-Means Clustering Algorithm, Advantages and Disadvantages, Applications of K-Means Clustering Algorithm, Hierarchical Clustering, Steps to Perform Agglomerative Hierarchical Clustering, Role of Dendrograms Agglomerative Hierarchical Clustering, Density-Based Clustering.

UNIT 5 DIMENSIONALITY REDUCTIONS & COLLABORATIVE FILTERING 9 Hrs.

Dimensionality Reduction, Feature Extraction & Selection, Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Least Squares Optimization, Collaborative Filtering & Its Challenges.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze supervised and unsupervised learning
CO2 - Select appropriate machine learning strategy for any given problem
CO3 - Select optimized learning algorithms for any given problem
CO4 - Implement Bayesian concepts to machine learning
CO5 - Evaluate existing machine learning algorithms
CO6 - Develop an appropriate machine learning approaches for various challenges.

TEXT / REFERENCE BOOKS

1. Chris Albon : Machine Learning with Python Cookbook , O ‟Reilly Media, Inc.2018
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014
3. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
4. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
5. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press.
6. T. Hastie, R. Tibshirani and J. Friedman, “Elements of Statistical Learning”, Springer Series , 2nd edition
7. Sebastian Raschka, "Python Machine Learning", Second Edition. Packt Publication

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3029	FUNDAMENTALS OF FUZZY LOGIC AND NEURAL NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To impart knowledge on signal transmission in human al system.
- To understand the various artificial neural architectures based on human neural network.
- To study and analyze the principles of fuzzy logic.
- To implement Fuzzy logic based controllers for different applications.

UNIT 1 FUNDAMENTALS OF ANN 9 Hrs.

Introduction - Biological Neuron structure, ANN - Definition – Topology - Models - Learning strategies. Characteristics of ANN - Different Learning Rules - Activation dynamics - Synaptic dynamics - Perceptron Model (Both Single & Multi-Layer) - Training Algorithm - Linear Separability Limitation and Its Over Comings, Problems in perceptron weight adjustments.

UNIT 2 MULTI LAYER NETWORKS 9 Hrs.

BPN - Training - Architecture-Algorithm, Counter Propagation Network - Training - Architecture, BAM - Training-stability analysis, Hop Field Network - Energy Function - Discrete - Continuous - Algorithm - Application – TSP.

UNIT 3 ART & SPECIAL NETWORKS 9 Hrs.

Adaptive Resonance Theory - ART1- ART2 – Architecture -Training SOM-Introduction - Kohonan SOM - Linear vector quantization, Probabilistic neural network Cascade correlation, General Regression neural network, Cognitron - Application of ANN - Texture classification - Character recognition.

UNIT 4 INTRODUCTION TO FUZZY LOGIC 9 Hrs.

Classical set - Operations and properties - Fuzzy Set - Operations and properties - Problems, Classical Relations - Operations and Properties, Fuzzy Relations - Operations and Properties - Compositions Membership function -FLCS - Need for FLC- Fuzzification - Defuzzification.

UNIT 5 FUZZY LOGIC CLASSIFICATION & APPLICATIONS 9 Hrs.

Fuzzy decision making -Types, Fuzzy Rule Based System, Knowledge Based System, Non linear Fuzzy Control system - Fuzzy Classification - Hard C Means - Fuzzy C Means. Applications of fuzzy - Water level controller, Fuzzy image Classification, Speed control of motor.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze various topologies of artificial neural networks.
CO2 - Interpret training and learning of neural systems using supervised and unsupervised methodologies.
CO3 - Illustrate the usage of multi-layer and special networks for different case studies.
CO4 - Evaluate the behavior of Fuzzy Logic control system.
CO5 - Relate the Defuzzification, fuzzy decision systems.
CO6 - Implement Fuzzy based controller for motor speed control, image processing etc.

TEXT / REFERENCE BOOKS

1. Timothy Ross, “Fuzzy Logic with Engineering Application”, McGraw Hill, Edition 1997.
2. James A. Freeman & Skapura, “Neural Networks”, Pearson Education, 2007.
3. B.Yegnanarayana, “Artificial Neural Networks” Prentice Hall, September 2007.
4. Simon Haykin, “Artificial Neural Networks”, 2nd Edition, Pearson Education.
5. Drainkov, H.Hallendoor and M.Reinfrank, “An Introduction to Fuzzy Control”, Edition 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SEEB3030	BIOMEDICAL INSTRUMENTATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co**
Requisite: Nil

COURSE OBJECTIVES

- To familiarize use and requirements of medical instruments.
- To give knowledge of the principle of operation and design of biomedical instruments.
- To give an introductory idea about human physiology system.

UNIT 1 ELECTRO PHYSIOLOGY 8 Hrs.

Cell and Its Structure - Electrical, Mechanical and Chemical Activities - Action and Resting Potential- Organization of Nervous System - CNS - PNS - Neurons - Axons- Synapse - Propagation of Electrical Impulses along the Nerve-Sodium Pump - Cardio Pulmonary System- Physiology of Heart, Lung, Kidney.

UNIT 2 BIO POTENTIAL ELECTRODES AND TRANSDUCERS 8 Hrs.

.Design of Medical Instruments - Components of Biomedical Instrument System - Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes -Instrumentation amplifier - Biomedical Measurements Like pH, PCO2, PO2 of Blood, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier.

UNIT 3 INSTRUMENTS USED FOR DIAGNOSIS 10 Hrs.

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement - Oximeter, , Patient Monitoring System, ICCU, Bone Density Measurement.

UNIT 4 RECENT TRENDS & INSTRUMENTS FOR THERAPY 9 Hrs.

Dialysers - Surgical Diathermy - Electro Anaesthetic and Surgical Techniques , Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications, Stem Cell Therapy.

UNIT 5 MODERN IMAGING SYSTEM 10 Hrs.

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis- Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, DXA, Radiographic & Fluoroscopic Techniques - Image Intensifiers- Computer Aided Tomography, PET, SPECT- Laser Applications- Echocardiography-CT Scan -MRI/ NMR-Endoscopy.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recall the structure of cell, physiology of different biological systems and their functions.
CO2 - Illustrate the types of electrodes and measurements of biological parameters.
CO3 - Explain the working of diagnostic instruments, therapeutic instruments and imaging systems.
CO4 - Analyze the different methods of measurements of biological parameters.
CO5 - Compare the different techniques of measurement.
CO6 - Evaluate the performances of measuring instruments.

TEXT /REFERENCE BOOKS

1. Khandpur, “Handbook of Biomedical Instrumentation” 2nd Edition, Tata McGraw Hill, 2003.
2. Arumugam M, “Biomedical Instrumentation”, Anuradha Publications, Reprint 2009.
3. Tompkins W J and Webster J.G., "Design of Microcomputer Based Medical Instrumentation", Prentice Hall, 1991.
4. Geddes L A and Baker L E, "Principle of Applied Biomedical Instrumentation" 3rd Edition, Wiley, 1989.
5. Khandpur, Raghbir Singh, ”Biomedical instrumentation: Technology and Applications”. 2nd Edition, McGraw Hill, 2005.
6. Anandanatarajan, R., “Biomedical Instrumentation and Measurements”, 2nd Edition, PHI Learning Pvt. Ltd., 2011.
7. Jog, NandiniK., ”Electronics in Medicine and Biomedical Instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd., 2013.
8. Singh, Mandeep, “Introduction to biomedical instrumentation”, 2nd Edition, PHI Learning Pvt. Ltd., 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 10 Question of 2 marks each – No choice **20 Marks**
PART B: 2 Questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SBAB4001	PRINCIPLES AND PRACTICES OF MANAGEMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Pre requisite: Nil **Co requisite:** Nil

COURSE OBJECTIVES

- To analyse how the field of Management has evolved and its significant contributions
- To analyse and apply the critical role of managers in modern organizational settings.
- To illustrate and evaluate the importance of planning, organizing, directing and controlling in decision making.

UNIT 1 INTRODUCTION 9 Hrs.

Definition, Functions, Process, Scope and Significance of Management. Nature of Management, Managerial Roles, Managerial Skills and Activities, Difference between Management and Administration. Significance of Values and Ethics in Management.

UNIT 2 SCHOOLS OF MANAGEMENT 9 Hrs.

Evolution of Management Thought - Contributions of F.W. Taylor, Henry Fayol, Elton Mayo, Approaches of Management Thought (including MBO & MBE) Functions of Management. Concept of Leadership- Theories and Styles.

UNIT 3 PLANNING AND ORGANIZING 9 Hrs.

Nature, Scope, Objective and Significance of Planning, Elements and Steps of Planning, Decision Making Organizing Principles, Span of Control, Line and Staff Relationship, Authority, Delegation and Decentralization. Effective Organizing, Organizational Structures, Formal and Informal Organizations, Staffing.

UNIT 4 DIRECTING 9 Hrs.

Effective Directing, Supervision**, Motivation**: Different Theories of Motivation - Maslow, Herzberg, Mc Clelland, Vroom, Porter and Lawler, Job Satisfaction. **Communication** Process, Channels and Barriers, Effective Communication.

UNIT 5 CONTROLLING AND COORDINATING 9 Hrs.

Elements of Managerial Control, Control Systems, Management Control Techniques, Effective Control Systems. Coordination Concept, Importance, Principles and Techniques of Coordination, Concept of Managerial Effectiveness.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - To provide an understanding of basic management concepts, principles, and practices.
CO2 - To develop planning and decision-making strategies in an organization.
CO3 - To summarize the concept and complete the process of organizing.
CO4 - To develop an understanding of staffing, leadership, directing and motivation in an organization.
CO5 - To predict the dynamics of controlling and its emerging issues in management.
CO6 - Assess managerial practices and choices relative to ethical principles and

standards

TEXT / REFERENCE BOOKS

1. Stephen P. Robbins, David A. Decenzo, Fundamentals of Management, Pearson Education, 9th Edition.
2. Harold Koontz, O'Donnell and Heinz Weihrich, Essentials of Management. New Delhi, 9th edition, Tata McGraw Hill.
3. Management Fundamentals: Concepts, Applications, & Skill Development, 6th edition, Sage.
4. Richard L. Daft, Principles Of Management, Cengage Learning.
5. Prasad, L.M. Principles and Practice of Management, Sultan Chand.
6. Jhunjhunwala J Mohanty, Management Principles and Applications, Himalaya Publishing House.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A	10 Questions of 2 marks each-No choice	**20 Marks**
PART B	2 Questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S41BPB41	VENTURE CREATION	L	T	P	EL	Credits	Total Marks
		2	0	0	3	3	100

Pre requisite: Nil **Co requisite:** Nil

COURSE OBJECTIVE

- To develop an entrepreneurial mindset, understand the concept of entrepreneurship and identify personal strengths and weaknesses.
- To understand the design thinking process and apply design thinking to real-world problems.
- To identify problems and opportunities and develop ideas for new ventures by assessing market potential.
- To develop a value proposition, business model canvas, build MVP to create sustainable differentiation for the venture with a well-structured business plan, unit economics, go-to-market strategiesand funding plan for managing business growth.
- To build an idea pitch and deliver it with confidence to potential stakeholders.

UNIT 1 INTRODUCTION TO ENTREPRENEURSHIP 9 Hrs.

Defining Entrepreneurship, evolution the concept & Emerging Trends in Entrepreneurship (Domain specific), understanding the unique opportunities; Why be an Entrepreneur? Entrepreneurship in Indian Scenario & Its role in economic development; Success stories of Entrepreneur (Domain specific);Entrepreneurial style assessment tool; Developing the Entrepreneurial mindset- Attributes & skills, recognizing your sweet spot for starting up; Principles of Effectuation; Myths about Entrepreneurship; Types of Entrepreneurs; Entrepreneur vs Intrapreneur; Role of Entrepreneurial Teams.

UNIT 2 DESIGN THINKING &OPPORTUNITY DISCOVERY 9 Hrs.

Introduction to Design Thinking for startups; Design Thinking principles & process; Define the problem using Design thinking principles and validate Problem; Generation of ideas, Idea generation techniques and evaluating creative ideas; Identify problem worth solving; Sharpen your Problem Pitch.

UNIT 3 CUSTOMER, MARKETS AND CREATING A SUSTAINABLE DIFFERENTIATION 9 Hrs.

Differentiate between a customer and a consumer; Who is your customer and what is your segment ; Customer Job, Pains, and Gains using Value proposition Canvas; Build solution using Value Proposition Canvas; Market Estimation-TAM,SAM,SOM; Competitive analysis; Minimum viable product – what is MVP: Build - Measure - Learn, differentiate between solution Demo & MVP; How to validate MVP- Achieve a Product – Market fit.

UNIT 4 BUSINESS MODEL, BUSINESS PLANNING AND GO TO MARKET STRATEGIES 9 Hrs.

Introduction to Business model, Business plan ; Lean approach 9 block lean canvas model; Financial feasibility: Costs, revenue streams, Pricing, Financial Projections, Key Financial Metrics using financial template, Managing growth & targeting scale, Unit economics; Selecting the Right Channel; Introduction to Digital Marketing and tools; Branding strategy

UNIT 5 FUNDING STRATEGY 9 Hrs.

Sources of funds: Debt & Equity ; Map the Start-up Lifecycle to Funding Options; Build an Investor ready pitch deck.

Total 45 Hrs.

COURSE OUTCOMES

CO1 - To define entrepreneurship and explain emerging trends in entrepreneurship.
CO2 - To identify and evaluate business opportunities and assess market potential.
CO3 - To conduct customer discovery, market research, build a lean canvas, develop a business plan and marketing strategies.
CO4 - To identify sources of funding and develop a funding strategy, understand basic legal requirement for starting and running a business.
CO5 - To build an idea pitch and deliver it with confidence to various stakeholdersTo develop planning and decision-making strategies in an organization.

TEXT / REFERENCE BOOKS

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). Entrepreneurship (10th ed.). McGraw-Hill Education.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
3. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch.
4. Roy, R. (2017). Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press.
5. Chandan, J. S., & Rana, S. S. (2019). Entrepreneurship Development and Management. New Delhi: McGraw Hill Education.
6. Sinek, S. (2011). Start with Why: How Great Leaders Inspire Everyone to Take Action. Portfolio.
7. Choudhary, R., & Mehta, N. (2019). From Zero to One: How to Build a Successful Startup in India. Notion Press.
8. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.
9. Mitra, P., & Banerjee, A. (2019). Startup Minds: The Entrepreneur's Journey from Idea to Success. SAGE Publications India.
10. Thiel, P. (2014). Zero to One: Notes on Startups, or How to Build the Future. Crown Business.
11. Zappos, T. (2010). Delivering Happiness: A Path to Profits, Passion, and Purpose. Business Plus.