Academic Program: UG

Academic Year 2019-20 Syllabus

V & VI Semester B.E.

Electrical & Electronics Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution recognized by AICTE & Affiliated to VTU, Belagavi)

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Department of Electrical & Electronics Engineering

*(**Our motto:** Professional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

VISION

To develop competent professionals with human values

MISSION

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture
- To involve Industrial Expertise for connecting classroom content to real life situations.
- To inculcate Ethics and impart soft-skill leading to overall Personality Development.

QUALITY POLICY:

In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

CORE VALUES:

Competency
Commitment
Equity
Team work and
Trust

DEPARTMENT VISION AND MISSION

Vision:

To develop globally acceptable Electrical and Electronics Engineering professionals with human values.

Mission:

- Adopting the state of the art curricula
- Practicing effective and innovative teaching-learning methodologies
- Initiating complementary learning activities to enhance competence
- Inculcating positive attitude and commitment to society.

Programme Educational Objectives (PEOs)

I. To prepare students for successful careers in industry / Govt. Organizations / PSUs/ MNCs / Entrepreneurs etc.
II. To develop the ability among students to synthesize data and technical concepts for application to product design.
III. To provide opportunity for students to work as part of teams on core and/or multidisciplinary Projects.
IV. To provide students with a strong foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for graduate studies.
V. To promote student awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

POs and PSOs

PO 1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/Development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and Team work:** Function effectively as an individual and as a member or leader in diverse teams and individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12. **Life-long Learning:** long learning: Recognize the need for and have the Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PSO 13. To demonstrate knowledge and handling of Electrical Systems involving Generation, Transmission, Distribution and Utilization.

PSO 14. To be able to maintain electrical and electronic systems involving data acquisition, processing and control.

V Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
15UEEC500	Linear ICs and Applications	3 - 0 - 0	3	50	100	3	-	-
15UEEC501	Electrical Machines - 2 (AC Machines)	4 - 0 - 0	4	50	100	3	-	-
15UEEC502	Power Electronics	4 - 0 - 0	4	50	100	3	-	-
15UEEC503	Electromagnetic Theory	3 - 0 - 0	3	50	100	3	-	-
15UEEC504	Digital Signal Processing	3 - 2 - 0	4	50	100	3	-	-
15UEEC505	Renewable Energy Sources	3 - 0 - 1	3	50	100	3	-	-
15UEEL506	Electrical Machines – 1(DC Machines & Transformers) Lab	0- 0 - 3	1.5	50	-	-	50	3
15UEEL507	Power Electronics Lab	0- 0 - 3	1.5	50	-	-	50	3
Total		**20-2-7**	**24**	**400**	**600**		**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical **S**: Self-study
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

VI Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration in Hrs.
15UHUC600	Management, Entrepreneurship & Protection of Intellectual Property	4 - 0 - 0	4	50	100	3	-	-
15UEEC600	Power System Analysis & Stability	3 - 0 - 0	3	50	100	3	-	-
15UEEC601	High Voltage Engineering	3 - 0 - 0	3	50	100	3	-	-
15UEEC602	Switchgear and Protection	3 - 0 - 0	3	50	100	3	-	-
15UEEC603	Digital System Design using VHDL	3 - 0 - 2	4	50	100	3	-	-
15UEEL604	Electrical Machines – 2 (AC Machines) Lab	0- 0 - 3	2	50	-	-	50	3
15UEEL605	Mini Project	0 - 0 – 6	4	50	-	-	50	3
15UEEE6XX	Elective – 1	3 - 0 - 0	3	50	100	3	-	-
Total		**19-0-11**	**26**	**400**	**600**		**100**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical **S**: Self-study
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Elective (1) Courses

Course Code	Course Title
15UEEE651	Computer Organization
15UEEE652	Object Oriented Programming using C++
15UEEE653	Data structures and Algorithms

Total number of credits offered for the Third year:50

V Semester

15UEEC500	Linear ICs & Applications	(3- 0 - 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn the basic working of Linear IC, design concepts of Linear ICs based circuits and solve relevant problems. They also learn to analyze electronic circuits and fundamental design skills of analog systems using linear ICs which have immediate end application to Engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the working of electronic circuits using Linear ICs and use of PSPICE simulation.		1, 2, 13	5, 12, 14
CO-2	Demonstrate the basic knowledge of designing circuits involving Linear ICs.	1, 2	13, 14,	4
CO-3	Analyze, interpret, solve analog electronic circuits.		1, 2, 13,	4, 5, 14
CO-4	Exhibit acquired skills relating to fundamentals of design.		1, 2, 13	4, 5, 1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	2.25	2.25		1.00	1.00							1.00	2.00	1.00

Prerequisites: Analog Electronics

Contents:

1. **Op-amp Linear Application:** Integrator, Differentiator design, High Z_{in} non-inverting amplifier, voltage follower design and single supply operation of op-amps. **04 Hrs.**
2. **Op-amp frequency response & characteristics:** Circuit Stability requirement, open loop and closed loop frequency response, frequency and phase response, frequency compensating methods, slew rate, stray and capacitance effects. **05 Hrs.**
3. **Wave shaping circuits using Op-amp (Signal processing circuits):** Precision half and full wave rectifiers, clippers, clampers, peak detector, sample hold circuits. **05 Hrs.**

4. **Op-amp Non-linear applications:** Comparators, Schmitt Trigger circuits, Square wave generator, Mono-stable Multivibrator. **05 Hrs.**
5. **Waveform generator:** Oscillator principle, Triangular wave generator, RC Phase shift oscillator, Wein bridge oscillator. **03 Hrs.**
6. **Active filter:** Types of filters & 2^{nd} order LPF, HPF, BPF, BEF (all butter-worth). **03 Hrs.**
7. **Mixed signal Special IC & applications:** Types of ADC's and DAC's, PLL. **05 Hrs.**
8. **MOS Differential amplifier and current mirrors:** Single ended and differential operation, Differential amplifier, quantitative and qualitative analysis (Elementary treatment), Basic current mirrors, cascade current mirrors, active current mirrors. **06 Hrs.**
9. **PSPICE simulation of Op-amp circuits:** PSPICE model i) absolute value output circuit ii) Comparator iii) Schmitt. Trigger. iv) N on-inverting amplifier frequency response and active filter frequency response characteristics. **04 Hrs.**

Reference Books:

1) Ramakanth A. Gayakwad–"Operational Amplifiers and Linear IC's"3/e, Prentice Hall, 2000.
2) David A. Bell - Operation Amplifiers and Linear IC's ,2/e, PHI, 2005.
3) Roy & Choudry–"Operational amplifiers and Linear Integrated circuits", 2/e, New Age International 01-Jan-2003.
4) Behzad Razavi" Design of analog CMOS Integrated circuit ",1/e, Tata McGraw-Hill Education, 01-Oct-2002.
5) Stanley William - Operational Amplifiers with Linear integrated circuits, 4/e, Pearson Education, 2004.

15UEEC501 Electrical Machines-2 (AC Machines) (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the basic principle, construction, operation and performance of Induction machines, the basic principle, construction, operation and performance of synchronous machines, the transient behavior and dynamics of machines.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level(1)**
CO-1	Understand the working of three phase and single phase induction motors, synchronous generator and motors and do draw the phasor diagram of these machines.		1, 2, 13	
CO-2	Predetermine the performance of induction motors using equivalent circuit and circle diagrams and voltage regulation of cylindrical rotor alternator and salient pole alternator.		1, 2,4, 13	
CO-3	Understand different starting methods, braking methods and speed control techniques of induction motors.		1, 2,	4
CO-4	Analyze the operation of synchronous machine on infinite bus and interpret and analyze the dynamic behavior of the machines.		1, 2,4, 13	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	2.00	2.00		2.00									2.00	

Prerequisites: 1.Basic Electrical Engineering 2. Network analysis

Contents:

1. Induction Machines:

Principle of operation of 3 phase induction motor, Phasor diagram, Torque - slip curves, Equivalent circuit and performance calculations. No load and locked rotor tests. Circle diagram. Starting of 3 phase induction motor. Types of starters. Speed control of 3 phase induction motor. Control of rotor slip power of wound rotor induction motors. Electrical braking of induction motors. Induction Generators. Deep bar rotor and double cage induction motors. **20 Hrs.**

2. Single phase Induction Motors:

Construction, Double revolving field theory. Equivalent circuit, Determination of parameters of equivalent Circuit by tests, Methods of starting single phase IM. **06 Hrs.**

3. Synchronous Machines: Generator:

Construction, Advantages of rotating field, construction, emf equation, effects of harmonics on generated emf. Poly-phase armature windings, Phasor diagram of a synchronous generator with cylindrical rotor. Calculation of voltage regulation by emf, mmf, Potier triangle and ASA methods. Voltage regulation of Salient pole synchronous generator. Parallel operation. Operation on Infinite bus. Operating characteristics. Power flow equations. **16 Hrs.**

4. Motors: Principle of operation, Methods of starting, pharos diagram, effect of changing excitation, two reaction model, Synchronous Condensers**.** **06 Hrs.**

5. Electrical transients in synchronous machines:

Effect of damper windings. Effect of D.C. components. Expressions for reactance and time constants. Dynamics of Synchronous machines pull in phenomenon. Oscillations in synchronous machines. **04 Hrs.**

Reference Books:

1) D. P Kothari & I. J. Nagrath, “Electrical Machines”, 3/e, TMH,2010.
2) M. G. Say “Performance and Design of A.C Machines”, 3/e, CBS publications, 2004.
3) P. S. Bimbra“ Electric Machinery”, 3/e, Khanna publishers,2003.
4) Ashfaq Hussain “Electric Machines”, 2/e, Dhanpathrai & Sons, 2004.

15UEEC502	Power Electronics	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs)

The students are expected to learn different types of switching devices, their control, performance characteristics and applications. They also learn about the principle of commutation of SCRs, the working principles of AC-AC, AC-DC, DC-DC and DC-AC converters and to analyze the working of various types of converter circuits with different types of loads connected across them.

Course Outcomes: (COs)

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	State the principle of working of thyristors and underline their effects on power system.		2,3	1,11
CO-2	Describe the switching characteristics of power MOSFET, SCR, Explain the two transistor model of SCR and Derive the	13	2,3	1

	equation for collector current based on the model.			
CO-3	Illustrate the firing and commutation concepts of SCRs.		2,3	11
CO-4	Analyze AC-AC, AC-DC,DC-DC,DC-AC converters working with different loads connected and Evaluate the performance parameters	13	2,3	1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	1.5	2	2								1.00		3.00	

Prerequisites: 1.Basic Electronics

Contents:

1. Power Semiconductor devices:

Applications of Power Electronics, Power semiconductor devices, Control characteristics, Types of Power Electronic circuits, peripheral effect. **04 Hrs.**

2. **Power Transistors:**

Power MOSFET switching characteristics, Power IGBT: switching characteristics, gate drive, di/dt limitations snubbers, heat sinks, MOSFET and IGBT application. **06 Hrs.**

3. Thyristors:

Introduction, working, characteristics, two transistor model, firing circuits using op-amps and digital IC'S, commutation, GTO. **06 Hrs.**

4. Commutation Techniques:

Introduction, Natural commutation, Forced commutation, Self commutation, Impulse commutation, Resonant pulse commutation and complementary commutation. **06 Hrs.**

5. AC Voltage Controllers:

Introduction to TRIAC characteristics and applications, single-phase bi-directional controllers with R, R-L loads, Cyclonverter. **06 Hrs.**

6. Controlled Rectifiers:

Introduction, Single phase semi converters, full converters and dual converters. Three phase half Controlled and full Controlled converters. **08 Hrs.**

7. DC Choppers:

Introduction, Principle of step-down and step-up choppers, step-down chopper with R-L loads, Performance parameters, Chopper classification, Analysis of Impulse commuted thyristor chopper (only qualitative analysis). **08 Hrs.**

8. Inverters:

Introduction, Principle of operation, Performance parameters, single phase bridge inverters, Three phase inverters, Voltage control of single phase inverters, CSI,

PWM techniques. **08 Hrs.**

Reference Books:

1) M. H. Rashid " Power Electronics", 3/e, Prentice Hall of India Pvt. Ltd, Pearson, 1988.
2) G. K. Dubey, S. R. Doradla, A Joshi & Sinha "Thyristorised Power Controllers", 2/e,New Age International (P) Ltd., Publishers, 2003.
3) M. D. Singh and Khanchandani K. B. - Power Electronics, 2/e TMH, 2001.
4) P. C. Sen–"Power Electronics",1/e, Tata McGraw-Hill Education, 1987.

15UEEC503	**Electromagnetic Theory**	**(3- 0- 0) 3**

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn about the vectors, scalars and use of the same for field analysis. They are also learning the concepts of energy and potential. They will come to know the behavioral aspects of conductors, dielectrics and capacitance. Further they will know about the time varying field and wave propagation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the concepts of vectors and scalars and the significance in field analysis.		1, 2, 12	13
CO-2	Use mathematical tools for field analysis.		1, 2, 12, 13	
CO-3	Exhibit the knowledge about the time varying field.		1, 2, 12, 13	
CO-4	Analyze wave propagation in free space and dielectrics.	1,13	2	12

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-13**	**PSO-14**
Mapping Level	2.25	2										1.75	2.00	

Prerequisites: 1.Elementary Physics 2. Mathematics
2. Basic Electrical Engineering

Contents:

1. Vector analysis:

Scalars and vectors, vector algebra, Dot & cross products, Cartesian, cylindrical and spherical coordinate system. **04 Hrs.**

2. Coulomb's law and Electric field Intensity:

Field due to a continuous volume charge distribution, Field of a line charge and of a sheet charge. **04 Hrs.**

3. Electric flux density:

Gauss's law and Divergence, Electric flux density, Divergence, Divergence theorem. **04 Hrs.**

4.Energy and Potential:

Energy expended in a moving point charge in an Electric field. Concept of potential and potential differences. Potential due to point charge and system of charges. Potential gradient, energy density in electric field. **06 Hrs.**

5.Conductors, dielectrics and capacitance:

Continuity of current, conductor property and boundary conditions, Boundary conditions for perfect dielectric materials, capacitance calculations for different configurations. **04 Hrs.**

6.Poisson's and Laplace's equations:

Poisson's and Laplace's equations, Uniqueness theorem, examples of the solution of Laplace & Poisson equations. **04 Hrs.**

7.The steady magnetic field:

Biot-Savart Law, Ampere Circuital Law, Curl, the scalar and vector magnetic potentials. **04 Hrs.**

8.Magnetic forces:

Force on a moving charge, force on a differential current element, Force between differential current elements, magnetic boundary conditions. **03 Hrs.**

9.Time Varying Fields & Maxwell's Equations:

Faraday's Law, Displacement current, Maxwell's equations in point form and integral form. **03 Hrs.**

10.The Uniform Plane wave:

Wave propagation in free space, wave propagation in dielectrics, Poynting Vector and power considerations, propagation in good conductors and skin effect. **03 Hrs.**

Reference Books:

1) William H. Hayt Jr., John A. Buck, "Engineering Electro Magnetics", 7/e TMH,2006.
2) Ganesh Rao, "Engineering Electromagnetics",1/e, Pearson Education India,2011.
3) John Krauss & Daniel A Fleisch,"Electromagnetics with Applications" 5/e , McGraw Hill,2010.

15UEEC504	Digital signal processing	(3- 2 - 0) 4

Contact Hours:52

Course Learning Objectives (CLOs):

The students are expected to learn to analyze sampled data, compare DFT and FFT algorithms in terms of computation burden and memory requirement. Further, they learn to design IIR filters, FIR filters, make use of IIR and FIR filters for different Applications, realize filters in different forms and about the Architecture and capabilities of DSP.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyze and synthesize sampled data by use of DFT and FFT algorithm and compare DFT and FFT algorithms in terms of computation burden and memory requirement			2, 3, 5, 14
CO-2	Realize filters in different forms and design IIR filters for given specifications		2, 3, 4	14
CO-3	Design FIR filters for given specifications		4	3, 14
CO-4	Select Digital signal processor for application under consideration			4, 5, 14

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level		1.5	1.3	2.0	1.0									1.0

Prerequisites: 1.Engineering Mathematics
2. Signal and Systems
3. Network Analysis

Contents:

1. **Discrete Fourier transforms (DFT):**

Definitions, properties-linearity, shift and symmetry etc., circular convolution-periodic convolution, use of tabular arrays, circular arrays, stock ham's methods, linear convolution-two finite duration sequences, one finite & one infinite duration. **8L+2T Hrs.**

2. **Fast Fourier transforms (FFT) algorithms:**
   Introduction, decimation in time algorithm, decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithm. **7L+1T Hrs.**
3. **Realization of digital systems:**
   Introduction, block diagrams & SFGs, matrix representation, realization of IIR systems-direct form, cascade form, parallel form, realization of FIR systems-direct form, cascade form, linear phase realizations. **8L+2T Hrs.**
4. **Design of IIR Digital filters:**
   Introduction, Impulse Invariant & Bilinear Transformations, all pole analog filters – Butterworth & Chebyshev, design of digital Butterworth & Chebyshev filters, frequency transformations. **8L+2T Hrs.**
5. **Design of FIR Digital filters:**
   Introduction, windowing, rectangular, modified rectangular, Hamm, Hamming, generalized hamming windows, Kaiser window, frequency sampling technique. **5L+1T Hrs.**
6. **DSP Processors TMS320 and programming:**
   Architecture of fixed / floating processors. **06 Hrs.**

Reference Books:

1) Proakis - Digital Signal Processing: Principle, Algorithms and Applications, 4/e, Pearson Education, PHI, 2007.
2) Oppenheim - Digital Signal Processing, 2/e, Pearson Education, PHI, 2008.
3) Salivahanan, Vallavaraj, Gnanapriya - Digital Signal Processing,2/e TMH, 2008.
4) Ifeachor & Jervis - Digital Signal Processing,3/e Pearson Education, 2004.
5) A Nagoorkani, “Digital Signal Processing”,2/e Tata McGraw Hill Education Pvt Ltd,2013.

15UEEC505	Renewable Energy Sources	(3- 0 - 1) 3

Contact Hours:39

Course Learning Objectives: (CLOs):

The students are expected to know the world and Indian energy scenario, the energy storage mechanisms. Further, they will be learning the concept of power from solar, wind, biogas, ocean and other renewable energy sources and prevailing technologies.

Course Outcomes: (COs)

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)/ PSO(13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the energy and requirement of energy in the present scenario.		3	1, 13
CO-2	Use the knowledge about renewable energy technologies for solar, wind, biogas implementation.		3	1, 13
CO-3	Test the skills of operation of the renewable based energy systems.		3	1, 13
CO-4	Evaluate the performance of solar, wind and biogas based power generation.		3	1, 13

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	1.00		2.00										1.00	

Prerequisites: 1.Basic Electrical engineering 2. Electrical Power Generation & Transmission 3.Electrical Power Distribution & Utilization

Contents:

1. **Fundamentals of Energy Science and Technology:**
   Introduction, Advantages and Disadvantages of Conventional Energy Sources, Salient Features of Non-conventional Energy Sources, Environmental Aspects of Energy, World Energy Status, Energy Scenario in India. **03 Hrs.**
2. **Energy Storage:**
   Introduction, Necessity of Energy Storage, Energy Storage Methods.
   Numericals on flywheel energy storage. **03 Hrs.**
3. **Solar Energy Basics:**
   Introduction, Extraterrestrial and Terrestrial Radiations, Solar Time, Basic Sun-Earth Angles, Solar Day Length, Estimation of Intensity of Terrestrial Radiation, Solar Radiation on Inclined Plane Surface, Solar Radiation Data, Measurements of Solar Radiation Data. Numericals on solar day length, LST, Solar Geometry. **04 Hrs.**
4. **Solar Thermal Systems:**
   Introduction, Solar Collectors, Solar Water Heater, Solar Thermo-Mechanical Systems. **04 Hrs.**
5. **Solar Photovoltaic Systems:**
   Introduction, Solar Cell Fundamentals, characteristics, classification. Solar Cell, Module, Panel and Array Construction. Maximizing the Solar PV Output

and Load Matching, Maximum Power Point Tracker (MPPT), Balance of System Components, Solar PV Systems & Applications. **07 Hrs.**

6. **Wind Energy:**
   Introduction, Wind Turbine location, applications, types, construction. Wind Energy Conversion Systems, Environmental Aspects, Wind Energy Program in India. Numericals on power available in wind. **07 Hrs.**
7. **Biomass Energy:**
   Introduction, Biofuels, Biomass Resources Biomass Conversion Technologies, Biomass Gasification, Biomass Energy Programme in India. Drum and Dome type digesters, simple calculations regarding drum type digester. **04 Hrs.**
8. **Ocean Energy:**
   Introduction, Tidal Energy, Wave Energy, Ocean Thermal Energy. Numerical on energy and power from tidal plant single effect type. **05 Hrs.**
9. **Emerging Technologies:**
   Introduction, Fuel Cell, Hydrogen Energy. **02 Hrs.**

Reference Books:

1) B. H. Khan, “Non Conventional Energy Resources”, 3/e, TMH, 2008.
2) G. D. Rai, “Non Conventional Sources of Energy”, 2/e, Khanna publishers, 2007.
3) Twiddle, ”Renewable Energy Sources”, 1/e ,ELBS, 1986.
4) Mukherjee D. & Chakraborti S,.“Fundamentals of Renewable Energy Systems”, 2/e New Age International Publishers, 2005.

15UEEL506 Electrical Machines- 1 Lab (DC Machines & Transformers) (0–0–3) 1.5

Contact Hours:36

Course Learning Objectives (CLOs):

The students are expected to learn realization of theoretical concepts and verify practically. They will be learning to conduct experiments on DC machines, single phase and three phase transformers to determine the performance characteristics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Conduct experiments to determine the performance parameters of DC machines	9,14	5	4
CO-2	Conduct experiments to determine the	9,14	5	4

	performance parameters of single phase transformers.			
CO-3	Conduct experiments to determine the performance parameters of three phase transformers.	9,14	5	4
CO-4	Carry out phase conversion	9,14	5	4

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level				1	2				3				3	

Prerequisites: 1. Electrical machines

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

Expt 1) OCC and external characteristics of DC shunt generator.
Expt 2) Speed control of DC shunt motor by a) Rheostat control b) Flux control.
Expt 3) Load test on DC shunt motor.
Expt 4) Field test on DC series machines.
Expt 5) Swinburne test.
Expt 6) Hopkinson test.
Expt 7) Ratio and Polarity test on transformer.
Expt 8) OC and SC tests on 1- Φ transformers.
Expt 9) Sumner's test.
Expt 10) Scott connection.
Expt 11) Parallel operation of 1- Φ transformers.
Expt 12) Load test on 3-phase transformers.

Reference Books:

1. Lab. Manual.
2. D.P. Kothari & I.J. Nagrath- "Electrical Machines", 3/e, TMH,2010.
3. Ashfaq Hussain- "Electric Machines", 2/e, Dhanpatrai &Sons, 2004.

15UEEL507	Power Electronics Lab	(0 - 0 - 3) 1.5

Contact Hours:36

Course Learning Objectives (CLOs):

The students are expected to learn conducting experiments on power semiconductor devices, plot the characteristics and compare the same with the theoretical characteristics. They will learn to rig up different triggering circuits and commutation circuits. They learn to verify for the waveforms and other performance parameters of the converter circuits with different loads.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Draw the characteristics of SCR, MOSFET, IGBT.	9,14	5	4
CO-2	Develop the triggering circuits for SCRs using UJT circuits and commutation circuits.	9,14	5	4
CO-3	Obtain the waveforms of various converter circuits using power semiconductor devices.	9,14	5	4
CO-4	Run a DC motor using a AC-DC, AC-AC converter.	9,14	5	4

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level				1.00	2.00				3.00					3.00

Prerequisites:1) Power Electronics.

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

Expt 1) Static Characteristics of SCR.

Expt 2) Static Characteristics of MOSFET and IGBT.

Expt 3) SCR turn-on circuit using synchronized UJT relaxation oscillator.

Expt 4) SCR turn-off circuits using (i) LC Circuit(ii) auxiliary commutation.

Expt 5) Synchronized UJT firing circuit for HWR circuits.

Expt 6) Generation of firing signals for thyristors using Microprocessor.

Expt 7) AC voltage controller using Triac – Diac combination.

Expt 8) Single phase FWR with R and RL loads.

Expt 9) Voltage (Impulse) commutated chopper – both constant frequency and variable frequency operations.

Expt 10) Speed control of a separately excited DC motor.

Expt 11) Speed control of single phase induction motor.

Expt 12) Parallel/Series Inverters.

Reference Books:

1) Lab. Manual.
2) M. H. Rashid, ”Power Electronics”, 3/e, Prentice Hall of India Pvt. Ltd, Pearson, 1988.
3) G. K. Dubey, S. R. Doradla, A Joshi &Sinha, ”Thyristorised Power Controllers”, New Age International (P) Ltd., Publishers, 2003.

VI Semester

15UHUC600	**Management, Entrepreneurship & Protection of Intellectual Property**	**(4-0-0) 4**

Contact Hours:52

Course Learning Objectives (CLOs):

The students are expected to learn the evolution of Management, the organization structure encompassing planning, organizing, decision making and execution. They will also learn about the concept and scope of entrepreneurship in small, medium, large and Government owned Industries and the issues related to copyright, patents, in all, protection of Intellectual property.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	State Information regarding copyright, patents and IPR	3	8	10
CO-2	Discuss skills required for motivation, process control, deregulation of power etc	3	8	10
CO-3	Demonstrate Management skills pertaining to Planning, Organizing, Forecasting and Decision making	11	3,9	6
CO-4	Assess the skills required to acquire entrepreneurial qualities and their role in economical development of the nation and Analyze skills for identification of opportunities, preparation of proposals for projects, feasibility studies	11	3,9	6

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level			2.5			1.0			2.0	1.0	3.0			

Prerequisites: 1.A course on Humanities (preferred)

Contents:

1. Engineering and Management: Historical Development of Engineering, Management, and synthesis. **03 Hrs.**

2. Planning, Forecasting and Decision Making: Nature of Planning, the foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision-making. **04 Hrs.**

3. Organizing and staffing: Nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation of power, meeting & committees. **04 Hrs.**

4. Motivating: Motivation, leadership, motivating and leading technical professionals. **03 Hrs.**

5. Controlling: process of control, financial controls, non-financial controls. **03 Hrs.**

1. Entrepreneurship:

1. Foundations of Entrepreneurship: Meaning of entrepreneur, functions of entrepreneur, types of entrepreneur, concept of entrepreneurship, role of entrepreneurs in economic development, barriers of entrepreneurship. **04 Hrs.**
2. Small Scale Industry: Definition, characteristics, objects, role of SSI in economic development, advantages of SSI, steps to start a SSI, impact of liberalization, privatization, and globalization on SSI, definition of ancillary and tiny industry. **04 Hrs.**
3. Government and Institutional Support: Nature of support of government, objectives and functions of SISI, SIDBI, DIC, single window agency, KIADB, KSSIDC, KSFC. **04 Hrs.**
4. Preparation of Project: Meaning of project identification, project report, contents and formulation, identification of business opportunities, feasibility studies, types and purpose. **05 Hrs.**

Protection of Intellectual Property:

1. Introduction: Meaning and forms of intellectual property right, competing rationale for protection, international conventions, world court. **02 Hrs.**
2. Copyright: Meaning of copyright, content of copy right, ownership and rights, period of copyright, assignment and relinquishment of copyright, license, infringement of copyright, fair use, offenses and penalties **02 Hrs.**
3. Patents: Concept of patent, patentable inventions, procedure for obtaining patent, rights and obligations of patent holders, infringements and remedies, offenses and penalties. **05 Hrs.**
4. Industrial Designs: Definition of design, procedure for registration, rights conferred by registration, infringements. **04 Hrs.**
5. Trademarks – concept and significance **02 Hrs.**
6. Term Paper on commercializing a hypothetical product/process/software by proper evaluation of relevant existing patents/copy rights. **03 Hrs.**

Reference Books:

1) Thomas W. Zimmerer, “Essentials of Entrepreneurship”,2/e PHI, 2005.
2) Daniel L. Babcock, “Managing Engineering and Technology”, 4/e, PHI,2010.
3) Peter Drucker, “The Practice of Management”1/e, Business & Economics, 26-Jul-2012.

4) N.K.Acharya, "Text book on Intellectual Property Rights", 4/e, Asia Law House,2012.

15UEEC600 Power System Analysis and Stability (3 - 0- 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn

- The importance of per unit computation
- How to draw per unit diagram of a given power system
- How to analyze symmetrical three phase short circuit on an unloaded synchronous generator.
- How the circuit breakers are rated?
- About the symmetrical components of currents and voltages
- How to analyze the unsymmetrical faults in a power system
- About the steady state & transient stability analysis of power system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the power system, single-line diagram, per unit quantities, per unit diagram, different period of analysis, circuit breaker ratings, symmetrical components, sequence impedance of different components of power system, sequence impedance diagrams, symmetrical and unsymmetrical faults and different stability studies.	1		9,14
CO-2	Calculate symmetrical fault current and the interrupting capacity of circuit breakers, power in terms of symmetrical components, the unsymmetrical fault currents and voltages, critical clearing angle and critical clearing time	1	2,13	9,14
CO-3	Analyze symmetrical and unsymmetrical faults in a power system	1	2,13	9,14
CO-4	Derive swing equation for a synchronous machine, power angle equations for a two machine system and apply equal area	1	2,13	9,14

	criterion to determine stability of the system.			

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	3	2							1				2	1

Prerequisites: 1.Network Analysis 2.Switchgear and Protection 3.EPGT 4. Electrical Machines

Contents:

1. Representation of Power system Components:

Standard symbols of power system components, one line diagram, impedance and reactance diagram, per unit quantity-definition, per-unit impedance of three phase components, selection of base value, change of base, equivalent load impedance, per unit impedance of two- winding transformer referred to primary and secondary, method to draw p.u. impedance diagram of a power system and advantages of p.u. computations. **08 Hrs.**

2. Symmetrical 3 - Phase faults:

3-phase short circuit at the terminals of unloaded generator, definition of sub-transient, transient and steady state reactance, examples on sub- transient current calculations in unloaded power systems, internal emfs of loaded machines, selection of circuit breaker ratings- momentary current and interrupting capacity. **06 Hrs.**

3. Symmetrical components:

Definition of symmetrical components as applied to 3-phase unbalanced systems, operator 'a' and its properties, resolution of unbalanced phasors into their symmetrical components, expressions for sequence components, examples on calculations of symmetrical components of unbalanced load against balanced 3-phase supply. Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components. **05 Hrs.**

4. Sequence Networks:

Sequence impedances and sequence networks. Sequence impedance of power system elements, positive, negative and zero sequence networks of 3-phase generator, transmission lines, 3-phase loads and transformers. **05 Hrs.**

5. Unsymmetrical faults:

L-G, L-L, L-L-G faults on an unloaded alternator without and with fault impedance, Derivation of connection of sequence networks, Unsymmetrical faults on power system without and with fault impedance, Derivation of

connection of sequence networks, examples on calculation of unsymmetrical fault currents **10 Hrs.**

6. Power System Stability:

Definition of stability, classification, power angle equation, swing equation, synchronizing power co-efficient, equal area criterion (EAC) of stability and EAC applications to equal area criterion, numerical problems, factors affecting transient stability and recent trends. **05 Hrs.**

Reference Books:

1) W. D. Stevenson, "Elements of Power System Analysis", 4/e, TMH, 1982.
2) I. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", 4th Edition, TMH, 2011.
3) Hadi Saadat, "Power System Analysis", 2nd Edition, TMH, 2005.
4) Stag, G. W. and EI-Abiad A. H., "Computer Methods in Power System Analysis", International Student Edition, McGraw Hill, 1988.

15UEEC601	High voltage Engineering	(3 – 0 – 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn about the voltage levels, advantages high voltage systems, applications and generation of high voltages. They will learn different methods of measuring high voltages, various methods of breakdown mechanism in insulators, selection methods insulators and the high voltage testing of electrical apparatus.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe advantages of transmitting electrical power at high voltages, important applications and comparison of HVAC and HVDC for power transmission	1	13	2, 4,12
CO-2	Explain different types of HVAC and HVDC generation system, and breakdown phenomenon of gases, liquids and solids	1	2,13	
CO-3	Demonstrate different methods of measuring HVAC and HVDC	1	13	2
CO-4	Applying measurement technique to find electrical parameters like dielectric loss,	1	2,13	4

	loss angle, partial discharge with emphasis on electrical apparatus insulators, bushings, cables, circuit breakers, cables, transformers and lightning arrestors			

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	3	1.5		1.0								1.0	2	

Prerequisites:1. Electrical Power Distribution & Utilization
2. Switch Gear and Protection
3. Electrical Measurements

Contents:

1. **Introduction:** Introduction to HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory. Important applications of high voltage. Comparison of HVAC and HVDC transmission systems. **03 Hrs.**
2. **Generation: HV AC:**HV transformer - working of transformer connected in cascade. Series resonant circuit. Tesla coil.
   HVDC: voltage doubler circuit, Cockcroft- Walton type. Calculation of percentage voltage regulation, percentage ripple and optimum number of stages. **06 Hrs**.
3. **Generation of Impulse Voltage and Current:** Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator. Multistage impulse generator working of Marx impulse generator and components. Triggering gap and time sweep circuits for oscillographic records. Generation of switching impulse voltage and high impulse current. **06 Hrs.**
4. **Measurement of high voltages:** Electrostatic voltmeter-principle &construction. Chubb and Fortescue method, Generating voltmeter- Principle of operation & construction. Series resistance micro ammeter, Standard sphere gap measurements; Potential dividers and types Surge current measurement- Klydanograph and magnetic links **08 Hrs.**
5. **Breakdown phenomena:** Classification and Properties of HV insulating media. Gaseous dielectrics, Ionizations, primary and secondary ionization processes. Townsend's theory, Streamer's theory. Corona discharges. Expression for disruptive and visual critical voltages and corona power loss. Breakdown in electro negative gases. Paschen's law. Time lags of Breakdown. Breakdown in solid dielectrics - Intrinsic, avalanche, thermal & electromechanical. Breakdown

of liquid dielectrics- Suspended particle theory, electronic, cavity/bubble's theory and electro convection. **09 Hrs.**

6. **Non-destructive insulation testing techniques:** Dielectric loss and loss angle measurements using HV Schering Bridge, Transformer ratio Arms Bridge. Need for discharge detection and PD measurements aspects. Discharge detection methods-straight and balanced methods. **04 Hrs.**
7. **High voltage testing of Electrical Apparatus –** Insulators, Bushings, Isolators, Circuit breakers, cables, transformers, and surge arrestors**.** **03 Hrs.**

Reference Books:

1) E. Kuffel and W.S. Zaengl, "High voltage engineering fundamentals", 2/e, Elsevier, press, 2005.
2) M.S.Naidu and Kamaraju, "High Voltage Engineering", 3/e, THM, 2007.
3) L. L. Alston, "High Voltage technology", 2/e, BSB Publication, 2007.
4) C.L.Wadhwa, "High voltage engineering", New Age International Private limited, 1995.

15UEEC602 Switchgear and Protection (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected Students to learn the importance of protection schemes in power system and how it will evolve hand in hand with the power system development. They are also learning different types of circuit breakers, the constructions and operations of different circuit breakers and relays. They will learn to select differential and distance protections for overhead lines and differential protections of transmission lines and generator protection.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe fault, types fault, severity of faults, Necessity for protection, Arcing in CBS, AC & DC circuit breaking the concepts of protection and its importance.	3	1,13,14	--
CO-2	Types of CBs their construction working, advantages disadvantages and applications.	1,13	2	14
CO-3	Understanding a relay, plug setting time setting, PSM, stable operation, zones of protection, under reach over reach	13	1	--

	stability ratio.			
CO-4	Protection of transformer, Transmission line, alternator, bus bar with O.C relay, Impedance relay Differential relay.	4	14	1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	2.25	2.0	3.0	2.0	1.0								1.5	1.25

Prerequisites: 1.Mathematics
2. Basic Electrical Engineering
3.Electrical Measurements

Contents:

1. Circuit breakers:

Principle of AC and DC circuit breaking, problems encountered in DC circuit breaking. Initiation, maintenance and interruption of Arc, Arc interruption theories, Arc voltage, restriking voltage and recovery voltage, resistance switching, current chopping interruption of capacitive current. **10 Hrs.**

2. Classification & Introduction:

Air break and Air blast CBs, oil & minimum oil CBs, working of SF6 CBs, vacuum CBs, HVDC CBs, rating of CBs. **06 Hrs.**

1. Protective Relaying:

Introduction to protection, Requirements of good relaying, system transducers CTs, PTs etc., principles of power system protection. **03 Hrs.**

2. Over current relay:

Directional over current relay, characteristics. **04 Hrs.**

3.Differential protection:

Basic principle, zone of protection, percentage differential relay, earth leakage protection and Bus bar protection. **04 Hrs.**

4.Distance protection of transmission lines:

Impedance relay, reactance relay and mho relay. **04 Hrs.**

5.Generator protection:

Stator & rotor faults, abnormal operating conditions. **04 Hrs.**

6.Transformer protection:

Over current & differential protection, differential relay with harmonic restraint, protection against high resistance ground faults, Buchholtz relay. **04 Hrs.**

Reference Books:

1) Badriram & Vishwa Karma –"Power System Protection & Switch Gear"1/e, TMH, 1995.
2) Sunil S. Rao–"Switch Gear & Protection", 1/e, Khanna Publication, 2004.

3) Ravindranath & Chander - Power System Protection & Switch Gear, New Age Publications, 2005.
4) Chakraborthy, Soni, Gupta &Bhatnagar–"A Course in Electrical Power", 3/e, DhanapatRai Publication, 1999.

15UEEC603 Digital System Design using VHDL (3– 0 – 2) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to know the need for HDL, history of HDL development and capabilities of VHDL. They are required to learn the basic elements of the language, different modeling styles used in VHDL. Further, they learn to write code the code for combinational, sequential circuits, and reconfigurable hardware circuits (Programmable Logic Devices) using different styles of modeling.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the need, evolution and capabilities of HDL, basic elements of the language, code structure and styles of modeling			5,14
CO-2	Describe entity, architecture, configuration, package declaration, package body, data types, operators, attributes, component instantiation, concurrent and process statements, functions and procedures.		3, 5	14
CO-3	Write VHDL code for combinational logic like arithmetic circuits, encoders, decoders, multiplexers, demultiplexers ALU, RAM etc. using different styles of modeling.		3, 5	12, 14
CO-4	Write code and simulate simple digital circuits		5	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level			2		2									1.0

Prerequisites: 1. Digital Electronics.

Contents:

1. **Introduction:** Need for HDL, evolution of VHDL and capabilities of the language. Code structure: Fundamental building blocks; library, entity, architecture, package declaration, and package body. **04 Hrs.**
2. **Basic Elements of the Language:** Object types: signal, variable, constants. Data types- Scalar, composite, incomplete and file types and sub types. VHDL operators and attributes. **08 Hrs.**
3. **Concurrent Code: Concurrent statements:** operators, WHEN/ELSE, WITH select WHEN, simple BLOCK and Guarded BLOCK, GENERATE statements. Generics. Time delays allowed in VHDL: Inertial, transport, simulation delta. Example codes for combinational and sequential circuits (Encoder, Mux, Decoder, arithmetic circuits, comparators, ALU, code converters, latches, flip flops, counters, registers etc.) **10 Hrs.**
4. **Sequential Code:** structure of Process**,** Sequential statements: BNF of IF, LOOP, CASE, WAIT, ASSERT, NEXT, EXIT, NULL, POSTPONE**.** Example codes for combinational and sequential circuits (Encoder, Mux, Decoder, arithmetic circuits, comparators, ALU, code converters, latches, flip flops, counters, registers etc.). **10 Hrs.**
5. **Structural Code:** components, port map, generic MAPAND examples (Encoder, Mux, Decoder, arithmetic circuits, comparators etc.). **06 Hrs.**
6. **Packages:** Package declaration and package body. Simple examples. **04 Hrs.**
7. **Sub programs:** Function: syntax, location and examples. Procedures: syntax, location and examples. **06 Hrs.**
8. **Introduction PLDs:** Basic structure of CPLDs and FPGAs. **04 Hrs.**

Reference Books:

1) Volnei A.Pedroni, ”Circuit Design with VHDL”,Reprinted,EEE,PHI,2005.
2) Douglas Perry, ”VHDL Programming by examples”, 4/e, TMH, 2005.
3) Bhasker, ”VHDL Primer”, 3/e, Pearson, 2002.
4) C. H. Roth, ”Digital System Design using VHDL”, 8th reprint,Brooks/Cole Publishing, 2008.

Laboratory Exercise:

1. Mux using structural, concurrent and sequential style of modeling.
2. Carry ripple adder using structural, concurrent and sequential style of modeling.
3. Flip flops using structural, concurrent and sequential style of modeling.
4. Shift register using concurrent and sequential style of modeling.
5. Counters using structural, concurrent and sequential style of modeling.

15UEEL604 Electrical Machines-2 Lab (AC Machines) (0 - 0 - 3) 2

Contact Hours:36

Course Learning Objectives (CLOs):

The students are expected to learn to conduct experiments to measure the line and phase voltages and currents in Star and delta connections. Further, they will be learning to conduct experiments on 3 phase squirrel cage and wound rotor induction motors, single phase induction motors, alternators and synchronous motors and evaluate the performance.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Test and obtain performance characteristics of single phase induction motors.	9,14	5	4
CO-2	Test and obtain performance characteristics three phase induction motors.	9,14	5	4
CO-3	Determine regulation of large capacity alternator by different methods	9,14	5	4
CO-4	Synchronize the alternator with the busbar	9,14	5	4

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level				1	2				3				3	

Prerequisites: 1. Electrical Machines

Contents: Minimum of 10 experiments to be conducted from the list given below.

Prescribed Experiments:

1.Load test on 3-phase induction motor.
2.Load test on 1-phase induction motor.
3.Performance predetermination of 3-phase induction motor by equivalent circuit.
4.Performance predetermination of 3-phase induction motor by Circle diagram.
5.Speed control of wound rotor induction motor.
6.Load test on induction generator.
7.Regulation of alternator by emf and mmf methods.
8.Regulation of alternator by Potier triangle method and ASA methods.

9.Synchronization of alternator.
10.Slip test on alternator.
11.V and inverted V curves of synchronous motor.
12.Study of 3-phase winding and speed change by changing number of poles of induction motor.

Reference Books:

1. Lab. Manual D.P. Kothari & I.J. Nagrath, "Electrical Machines", 3/e,TMH,2010.
2. Ashfaq Hussain,"Electric Machines", 2/e, Dhanpatrai &Sons, 2004.

15UEEL605	Mini Project	(0 - 0 - 6) 4

Contact Hours:60

Course Learning Objectives (CLOs):

The students are expected to learn locating the literature about the work undertaken, define/formulate the problem. Further, they learn to design / develop / simulate / rig up the circuit/ system/model/module and implement the same. They will also be learning the cooperation, commitment , responsibility and discharge the best possible being in a team of the same discipline / interdisciplinary and present, communicate in a convincing way and also to prepare the report.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state of the technology in his Engineering field of interest.	8, 12,13,14	1, 5, 6,7,10	3, 4,9, 11
CO-2	Define/formulate simple problem/work to carry out the for the project.	8, 12,13,14	1, 5, 6,7,10	3, 4,9, 11
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his project work.	8, 12,13,14	1, 5, 6,7,10	3, 4,9, 11
CO-4	Summarize the work in to a project report	8, 12,13,14	1, 5, 6,7,10	3, 4,9, 11

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	2	2	1	1	2	2	1	2			1	3	3	3

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

Contents:

1.The students are expected to locate the state of the art technology in his domain of interest by an extensive literature survey and Select a topic from an emerging area relevant to electrical sciences and/or other relevant branches and define the problem for the project work.
2. Problems requiring interdisciplinary skills.
3. Validation of the concepts studied in their previous semesters.

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet.

15UEEE651 Computer Organization (3 - 0 - 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn the basic structure of computers, machine instruction and simple programs. They will also learn the concept of Instruction Set architecture and machine level instructions, use of resources (registers and memory), the relationship between Instruction set architecture, micro architecture, and system architecture and their roles in the development of the computer.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explore** the basics of computer architecture and analyze the performance issues of a computer system.		2	1, 12,14
CO-2	**Know** the usage of machine instructions, addressing methods, memory structure			1,2

	and its operation			
CO-3	**Demonstrate** data representation formats and analyze processor performance for arithmetic operations		2	1
CO-4	**Understand** pipelining and the functions of the processing unit and approaches to generate control signals for instruction execution.			1, 2,3, 4,12, 14

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level	1	1.5	1	1								1		1

Prerequisites: 1.Digital Electronics preferred

Contents:

1. **Basic Structures of Computers:**
   Computer types, Functional units, Input unit, Memory unit, Arithmetic & logic unit, Output unit, Control unit; Basic Operational Concepts: Bus Structures: Performance: Processor clock, Basic Performance equation, Pipelining & Superscalar operation, Clock rate Some Basic Concepts: Semiconductor RAM Memories: Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories, Memory System Considerations, RAM bus memory; Read-only Memories: ROM, PROM, EPROM, EEPROM, Flash memory; Speed, Size & Cost: Cache Memories, Input /Output organization, Direct Memory Access **12 Hrs.**
2. **Machine Instructions & Programs:**
   Numbers, Arithmetic operations and characters, Memory Locations & Addresses' Byte addressability, Big-endian & Little-endian assignments, Word Alignment, Accessing Numbers, Characters & Character strings; Memory Operation: Instruction & Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Instruction Execution & Straight line sequencing, Branching, Condition Codes, Generating Memory Addresses; Addressing Modes. **06 Hrs.**
3. **Pipelining**
   Basic concepts, data hazards, instruction hazards, influence on instructions sets, performance considerations: effect of instruction hazards, number of pipeline hazards **06 Hrs.**
4. **Arithmetic:**
   Addition & Subtraction of Signed Numbers: Addition/Subtraction Logic Unit; Design of fast adders: Carry-Look ahead addition; Multiplication of Positive

numbers: Signed-Operand Multiplication: Booth Algorithm; Fast Multiplication: Bit-pair Recoding of Multipliers; Integer division. **06 Hrs.**

5. **Processing Unit:**
   Some Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a Word in Memory; Execution of a Complete Instruction: Branch instruction; Multiple-Bus Organization: Hardwired Control: A Complete Processor; Micro-programmed Control: Micro-instruction, Micro-program Sequencing **09 Hrs.**

Reference Books:

1) Carl Hamacher, Z. Vranesic & S Zaky, "Computer Organization", 5/e, TMH, 2002.

2) Morris Mano, "Computer System Architecture", 2/e, PHI, 1986.

3) Heuring& H. Jordan, "Computer System Design & Architecture", 2/e, Addison-Wesley, 1999

15UEEE652 Object Oriented Programming using C++ (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn fundamental key concepts and benefits of 00 programming paradigm, C++ Language features supporting 00 Application Development, Traditional language features and syntax supporting application development using 00 key concepts and realistic application of object-oriented development within a variety of problem domains using 00 principles and standards.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the basic elements of data structures to address the static and dynamically varying data.		14	1, 3
CO-2	Conceptualize the concept of stack, queue, linked lists, trees, linear/ binary search and use them in programming to solve a given problem scenario.		2, 3, 14	1
CO-3	Analyse time/space complexity issues of algorithms and use them for solving problems based on		2,3,14	1

	searching techniques			
CO-4	Develop a code / program using appropriate data structures for a given application.		2, 3, 4,5,14	1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PO-14
Mapping Level	1	2	1.75	2	2									2

Prerequisites: Programming experience in any language is desirable.

Contents:

1. Principles of Object-Oriented Programming Paradigm:

Review of Procedure Oriented Programming, key concepts of Object Oriented Programming – Object, Class, Encapsulation, Inheritance, Polymorphism; Benefits and Applications of OOPS. **04 Hrs.**

2. The Basic Language C++:

Structure of C++ program with Class/Objects, Comments, Data types, IO Preprocessor Directives string, pointer, Constants enumeration, array, complex number; typedef names, type compatibility, type conversion, qualifier – const., volatile; Operators, Function and Parameter Passing. Function Overloading **05 Hrs.**

3. Classes and Objects: I

Introduction: declaration and definition of a Class, defining member functions, C++ program with a Class, Objects – global & local objects, scope & lifetime, memory allocation for objects, dynamically allocated objects, pointers to objects, arrays of objects, function arguments with objects, returning objects; constant member functions. Making an outside function Inline, Nesting of member functions, Arrays within a class, static data members, static member functions Constructors and Destructors: Introduction, Parameterized Constructors, Multiple constructors in a class, Constructors with default arguments, Dynamic initialization of objects, Copy constructor, Constructing two-dimensional arrays, const. Objects, Destructors, **10 Hrs.**

4. Operator Overloading and Type Conversion:

Introduction, Defining operator overloading, Overloading unary operators, Overloading binary operators, Overloading binary operators using Friends, Rules for overloading operators, overloading a comma operator, overloading the output operator, overloading the input operator, Type conversion. **06 Hrs.**

5. Inheritance:

Introduction, Defining derived classes, Single inheritance, Making a private member Inheritable, Multilevel inheritance, multiple inheritance, and

Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Constructors & Destructors in base & derived classes. **05 Hrs.**

6. **Pointer, Virtual Functions and Polymorphism:**
   Introduction, Pointers, Pointers to Objects, this pointer, Pointers to derived classes, type-checking pointers, pointers to members, Virtual functions, Pure virtual functions. **05 Hrs.**
7. **Managing Console I/O and File I/O:**
   C++ streams, C++ stream classes, examples of formatted and unformatted I/O operations, Classes for file stream operations, Opening and Closing a File, Opening file using open(), file modes. **04 Hrs.**

Reference Books:

1) Grady Booch,"Object Oriented Analysis and Design with Applications",3/e, Pearson Education, 2007
2) Balagurusamy. E.,"Object Oriented Programming with C++,"3/e, TMH, 2007.
3) Herbert Schildt, "C++ The Complete Reference", 3/e, TMH, 2006.
4) Bjarne Stroustrup,"The C++ programming language", 3/e, Pearson Education, 2004.

15UEEE653 Data Structures and Algorithms (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn basic features of programming language, a abstract data types and its use in solving given any problem. They will be learning how to use of data structures in application development. They are exposed to standard algorithms and analysis.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO(13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the features of programming language including Data types and their memory allocation, Declaring string and their manipulation, use of arrays, structures, unions and pointers in solving a given problem scenario.		5	11
CO-2	Recite the operations of Stack using pointers and arrays, hence use it in solving a given problem scenario		3,5	11,12
CO-3	Appraise the operations of different types of		3,5	2,11

	queues using pointers and arrays and use it in solving a given problem scenario			
CO-4	Explain the operations of Binary Trees using pointers and use it in solving a given problem scenario.		3,5	2,14

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-13	PSO-14
Mapping Level			2		2						1	1		1

Prerequisites: Programming experience in C/C++.

Contents:

1. **Basic Programming Features:**
   Data types, Memory allocation, arrays, structures, unions, pointers, recursion and file operations. **05 Hrs.**
2. **Abstract Data Types:**
   Conceptualization, Implementation and applications of Stack, Queues and Trees using arrays and pointers(Linked List). **11 Hrs.**
3. **Searching and Sorting Techniques:**
   Conceptualization, Implementation and applications of: Linear and Binary search, Hashing, sorting techniques: bubble sort, insertion sort, selection sort, quick sort, merge sort, heap sort. **08 Hrs.**
4. **Analysis of Algorithms:**
   Time and space complexity issues of algorithms. **05 Hrs.**
5. **Algorithm Design:**
   Divide and Conquer method and applications (Max-Mm), Greedy strategy method and applications (Job sequencing, Optimal merge patterns), Dynamic Programming method and applications (Multistage graphs, travelling sales problem), Backtracking method and applications (Sum of sets) Branch and Bound method and applications (Travelling Sales problem). **10 Hrs.**

Reference Books:

1) Yedidyah, Augenstein and Tenenbaum, "Data Structures Using C and C++',2/e, PHI- India,2011.
2) SartajSahni, "Data Structures, Algorithms and Application in C++", 2/e,University Press, 2005.
3) Thomas H Coreman, Charles E Leiserson & Ronald L Rivest, "Introduction to Algorithms", 1/e, Prentice Hall of India, August 2000.
4) Adam Drozdek, "Data Structures & Algorithms in C++", 2/e, Vikas Publishing House, 2004.

SDM College of Engineering & Technology, Dharwad

Odd Semester 2019-20

Academic Calendar for UG Programmes

Sl. No.	Particulars	Date
1	Registration	27-07-2019 to 31-07-2019
2	Induction program for First Semester (Tentative)	01-08-2019 to 14-08-2019
3	Teaching Commences for odd semester except I Sem	01-08-2019
4	Last date for registration with late fee	06-08-2019
5	Teaching Commences for I semester	16-08-2019
6	Display of attendance	16-09-2019
7	Internal Assessment – IA– I	18-09-2019 to 20-09-2019
8	Communication of performance to the parents	26-09-2019
9	Last date to drop the course	27-09-2019
10	Display of attendance	02-11-2019
11	Internal Assessment –IA– II	04-11-2019 to 06-11-2019
12	Students Feedback	11-11-2019 to 15-11-2019
13	Communication of performance to the parents	13-11-2019
14	Last date to withdraw the course	13-11-2019
15	Teacher – Parents Meet	16-11-2019
16	Internal Assessment –IA– III	27-11-2019 to 29-11-2019
17	Last day of teaching for Odd Semester	30-11-2019
18	Final Lab Assessments	03-12-2019 to 10-12-2019
19	Display of consolidated Continuous Internal Evaluation (CIE) & Attendance	05-12-2019
20	Communication of performance to the parents	05-12-2019
21	Semester End Examination	13-12-2019 to 27-12-2019
22	Inter Semester Recess	28-12-2019 to 12-01-2020
23	Declaration of Results	09-01-2020
24	Communication of performance to the parents by putting on website	10-01-2020
25	Makeup SEE for odd semesters	11-01-2020 to 18-01-2020
Commencement of Even Semester :		**13-01-2020**

Dean (Academic Program) **PRINCIPAL**

Academic Calendar (Tentative) for Even Semester 2019-20
B.E. & M.Tech

Sl. No.	Particulars	Date
1	Registration	09-01-2020 to 11-01-2020
2	Commencement of Teaching	13-01-2020
3	Last date for registration with late fee	18-01-2020
4	Display of attendance	18-02-2020
5	Internal Assessment – IA– I	24-02-2020 to 26-02-2020
6	Communication of performance to the parents	03-03-2020
7	Last date to drop the course	04-03-2020
8	Parents Meet	14-03-2020
9	Insignia – 2020	20-03-2020 & 21-03-2020
10	Display of attendance	30-03-2020
11	Internal Assessment – IA– II	01-04-2020 to 03-04-2020
12	Last date to withdraw the course	08-04-2020
13	Communication of performance to the parents	11-04-2020
14	Feedback by Students	20-04-2020 to 25-04-2020
15	Internal Assessment –IA– III	04-05-2020 to 06-05-2020
16	Last day of teaching for Even Semester	06-05-2020
17	Final Lab Assessments	09-05-2020 to 20-05-2020
18	Display of consolidated Continuous Internal Evaluation (CIE) marks & Attendance for 8th semester	09-05-2020
19	Semester End Examination for 8th semester	11-05-2020 to 19-05-2020
20	Display of consolidated CIE marks & Attendance for 2nd, 4th & 6th semesters (Both for UG & PG)	13-05-2020
21	Communication of performance to the parents	14-05-2020
22	Project exam for 8th semester	21-05-2020 to 26-05-2020
23	Semester End Examination for 2nd, 4th & 6th semesters (Both for UG & PG)	22-05-2020 to 05-06-2020
24	Results for 8th semester	30-05-2020
25	Summer vacation	06-06-2020 to 31-07-2020
26	Announcement of Results for 2nd, 4th & 6th semester (Both for UG & PG)	12-06-2020

Supplementary Semester: 12-06-2020 to 27-07-2020

Commencement of next Academic Year 2020 - 21: 01-08-2020

Dean (Academic Program) **PRINCIPAL**

Supplementary Semester Calendar for B.E./M.Tech/MBA – 2020

Sl. No.	Particulars	VII & VIII Sem (B.E.)	I to VI Sem (B.E.), M.Tech & MBA
1	Registration	01-06-2020 to 03-06-2020	06-06-2020 to 08-06-2020
2	Teaching Commences	01-06-2020	12-06-2020
3	Registration with special permission by Principal	04-06-2020	12-06-2020
4	Internal Assessment (IA) – I	13-06-2020 & 15-06-2020	24-06-2020 & 25-06-2020
5	Internal Assessment (IA) – II	25-06-2020 & 26-06-2020	03-07-2020 & 04-07-2020
6	Internal Assessment (IA) – III	10-07-2020 & 11-07-2020	13-07-2020 & 14-07-2020
7	Display of consolidated Continuous Internal Evaluation (CIE) marks & Attendance	13-07-2020	16-07-2020
8	Supplementary SEE	14-07-2020 to 17-07-2020	18-07-2020 to 23-07-2020
9	Declaration of results	22-07-2020	27-07-2020

Dean (Academic Program) **PRINCIPAL**