# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

## Course Contents (Syllabus) for

## Second Year B. Tech.
## (Electrical Engineering)
## Sem - III to IV

## AY 2020-21

| **Title of the Course: Probability and Statistics**<br>**Course Code: 5MA201** | L | T | P | Cr |
|---|---|---|---|---|
| | 2 | - | - | 2 |

**Pre-Requisite Courses:** Mathematics course at Higher Secondary Junior College

**Textbooks:**

1. Fundamental of Mathematical Statistics by Gupta and Kapoor.
2. An Introduction to probability and statistics by Vijay Rohatgi.

**References:**

1. Probability and Statistics for Engineers and Scientists by S.Ross.

**Course Objectives :**

Familiarize the students with techniques in multivariate integration and statistics. .

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | Apply computational tools to solve mathematical and statistical problems. | III | Applying |
| **CO2** | Solve problems in probability, statistics and multivariable calculus. | III | Applying |

**CO-PO Mapping**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | | | |
| **CO2** | 2 | 3 | | | | | | | | | | | | |

**Assessments :**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Module 1: Random Variable:**<br>Discrete random variable, Continuous random variable, probability mass function, cumulative distribution function, bivariate discrete random variable, joint probability distribution, joint distribution function of two dimensional discrete random variable. | **4Hrs.** |
| **Module 2: Probability Distribution:**<br>Gaussian distribution, Exponential distribution, Uniform distribution. | **4Hrs.** |
| **Module 3: Statistical Methods:**<br>Measure of Central tendency, Measure of dispersion, Range, Quartile deviation, Mean deviation, variance, Standard deviation, Coefficient of variance, moments, Symmetry, Skewness, Kurtosis, and Types of Kurtosis. | **5Hrs.** |

| | |
|---|---|
| **Module 4: Population and Sample:**<br>Introduction, Types of Characteristics: Attributes and variables, Collection and Organization of data, Population and sample, Methods of sampling. | **3 Hrs.** |
| **Module 5: Exact Sampling Distribution:**<br>Chi- square distribution: definition and its properties, Student t- distribution: definition and its properties. | **4 Hrs.** |
| **Module 6: Test of Hypothesis:**<br>Random samples, parameter, statistic, standard error of statistic, null and alternative hypothesis, critical region, level of significance, Types of error, large sample test, Small sample test. | **7Hrs.** |

**Module wise measurable students learning outcome:**

After the completion of the course the student should be able to

**Module 1: Random Variable**

Explain and solve the integral of physical phenomena when it depends on several variables

**Module 2: Probability Distribution**

Solve various problems in probability theory

**Module 3: Statistical Methods:**

Solve different numerical methods of ordinary differential equation of first order and first degree.

**Module 4: Population and Sample:**

Solve different Methods of sampling

**Module 5: Exact Sampling Distribution:**

Solve various problems in probability distribution.

**Module 6: Test of Hypothesis:**

Explain and solve hypothesis

| **Title of the Course: DC Machines and Transformers**<br>**Course Code: 5EL 201** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:**

**Textbooks:**

1. A.E.Clayton and Hancock, "*The Performance and Design of Direct Current Machines",* CBS Publishers, 1st Edition, 2004.
2. M. G. Say. *"The Performance and Design of Alternating Current Machines",* CBS Publishers, 3rd Edition, 2004.
3. O. E. Taylor, *"Performance Design of AC commutator motors",* Wheeler Publisher, 15th Reprint.

**References:**

1. PurkaitandBandyopadhyay *"Electrical Machines"*, Oxford University Press, 1st Edition, 2017.
2. J. B. Gupta, *"Theory and Performance of Electrical Machines"*, S.K.Kataria and Sons, 1st Edition, 2013.
3. Fitzerald and Kingsley, *"Electric Machines"*, Tata McGraw Hill, 7th Edition, 2007.
4. Kothari and Nagrath, *"Electric Machines"*, McGraw Hill, 5th Edition, 2018.

**Course Objectives:**

1. This course intends to provide basic concept of DC machines and transformers.
2. It intends to develop skills to evaluate ratings of DC machines and transformers for various applications.
3. It intends to solve problems on DC machines and transformers.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive level | Bloom's Cognitive Descriptor |
|---|---|---|---|
| **CO1** | **Explain** the working principles, construction, operation and applications of DC machines, universal motor and transformers. | 2 | understanding |
| **CO2** | **Discuss** numerical problems on DC machines, transformers and universal motor. | 3 | applying |
| **CO3** | **Analyze** the performance of DC machines, transformers and universal motor. | 4 | analyzing |

**CO-PO Mapping: (Use 1, 2, 3 as correlation strengths)**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | | 3 | | | | | | | | | | | | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: DC Machines** | **Hrs.** |
|---|---|
| **Constructional Details:** Construction of D.C. machines, magnetic circuit of DC machines, commutator and brush arrangement, EMF equation, torque equation, power flow diagram of D.C. machines.<br>**Armature Winding:** Simple lap winding and wave winding, winding diagram and tables, brush position, dummy coils.<br>**Armature Reaction:** MMF due to armature winding, flux distribution due to armature current and resultant flux distribution in a machine. Demagnetization and cross magnetization ampere turns, principle of compensation, compensating winding and its use in machines. | **8** |
| **Module 2: D.C. Motors** | **Hrs.** |
| Concept of back e.m.f., characteristics of D.C. motors, Method of speed controls, electro braking, parallel and series operation of motor.<br>**Testing of D.C. Machines:** Losses and efficiency, Break test, Swinburn's test, Hopkinson's test, Redardation test, Field test on D.C. series motor. | **8** |
| **Module 3: Single Phase Transformer** | **Hrs.** |
| Construction and type, EMF equation phasor diagram, equivalent circuit, efficiency, losses, regulation, Experimental determination of equivalent circuit parameters and calculation of efficiency and regulation, parallel operation, auto transformer principle and connections. | **8** |
| **Module 4: Poly Phase Transformer** | **Hrs.** |
| Construction, single phase bank, polarity test, transformer winding, v-v connection and scottconnection,Vector Grouping YD1, YD11, DY1, DY11, DZ0, DZ 6, YZ1, YZ11. | **5** |
| **Module 5: Performance of Transformers** | **Hrs.** |
| Switching inrush current, on load and off load tap changing, Harmonics in exciting current causes and effects, Harmonics with different transformer connections, tertiary winding, oscillating neutral, Testing of transformer as per IS, heat run test, Sumpner's testandequivalent delta test. | **6** |
| **Module 6: Universal Motor** | **Hrs.** |
| Development of torque & power, rotational and transformer emf in commutator winding, commutation in universal motor, complexor diagram, circle diagram, operation on A.C. and D.C. supply, compensated winding, applications. | **4** |

**Module wise Measurable Students Learning Outcomes:**

After the completion of the course the students should be able to:

1. Explain performance and operation of DC machines.
2. Evaluate losses and efficiency by testing DC machines.
3. Apply skills to determine parameters and efficiency of transformer.
4. Apply engineering skills to determine performance in various types of transformer connection.
5. Study of harmonics in various connections of 3 phase transformer.
6. Determine parameters and performance of universal motor using circle diagram.

| **Title of the Course: Electrical Circuits**<br>**Course Code: 5EL 202** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:** Engineering Mathematics I

**Textbooks:**

1. C.K. Alexandar and M.O. Sadiku, *"Fundamentals of Electric Circuits",* MH, 6th Edition,2018.
2. Hayt, Kemmerly, Durbin, *"Engineering Circuit Analysis",* TMH, 8th Edition, 2012.

**References:**

1. James W. Nilsson and Susan A. Riedel "*Electric Circuits*" Prentice Hall, 10th Edition, 2015.
2. L.P. Huelsman, *"Basic Circuit Theory",* PHI Publication, 3rd Edition, 2009.

**Course Objectives:**

1. This course intends to provide basic concepts to evaluate the various parameters of electrical circuit.
2. It is aimed to impart skills to identify the transient and steady state response of electrical circuit.
3. Imparting basic knowledge and application of two port electrical networks.

**Course Learning Outcomes:-**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive level | Bloom's Cognitive Descriptor |
|---|---|---|---|
| **CO1** | **Find** voltages, currents, and powers, equivalent circuits of a.c. and d.c. circuits using electrical circuit theorems. | 1 | Remembering |
| **CO2** | **Determine** the transient and steady state response of first and second order circuits. | 2 | Understanding |
| **CO3** | **Calculate** the parameters of two port electrical networks and electrical circuits. | 3 | Applying |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | | 3 | | | | | | | | | | | | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: DC Circuits** | **Hrs.** |
|---|---|
| Ohm's law, Kirchhoff's law, dependent and independent sources, nodes, branches, loops, voltage and current division, Wye Delta transformations, nodal analysis, mesh analysis, linearity property, superposition theorem, source transformation, Thevenin's and Norton's | **8** |

| | |
|---|---|
| theorem, maximum power transfer. | |
| **Module 2: First order circuits** | **Hrs.** |
| Capacitors, Series and Parallel Capacitors, Inductors, Series and Parallel Inductors, Source free RC, RL circuits, step response of RC, RL, circuits. | **5** |
| **Module 3: Second order circuits** | **Hrs.** |
| Finding initial and final values, source free series and parallel RLC circuits, step response of series and parallel RLC circuits, general second order circuits. | **6** |
| **Module 4: AC circuits** | **Hrs.** |
| Sinusoids, phasors, impedance and admittance, sinusoidal steady state analysis, nodal and mesh analysis, superposition theorem, source transformation, Thevenin's and Norton's equivalent circuit. | **8** |
| **Module 5: Power in AC Circuits** | **Hrs.** |
| Instantaneous and Average Power, Maximum Average Power, RMS Value, Apparent Power and Power factor, Complex Power, mutual inductance, dot convention, energy in coupled circuits. | **6** |
| **Module 6: Two Port Network** | **Hrs.** |
| Impedance parameters, admittance parameters, hybrid parameters, transmission parameters, interconnection of network. | **6** |

**Module wise Measurable Students Learning Outcomes:**

After the completion of the course the students should be able to:

1. Grasp basic knowledge of D.C. circuit theorems.
2. Establish concepts of transient and steady state response of first order circuits.
3. Establish transient and steady state response of second order circuits.
4. Grasp basic knowledge of A.C. circuit theorems.
5. Classify various powers in A.C. circuits.
6. Compute parameters of two port electrical networks.

| **Title of the Course: Analog and Digital Circuits** | L | T | P | Cr |
|---|---|---|---|---|
| **Course Code: 5EL 203** | 3 | -- | -- | 3 |

**Desirable Requisite:** Basic Electronics Engineering

**Textbooks:**

1. Sergio Franco, "*Design with Op-Amps and analog Integrated Circuits*", Tata McGraw-Hill Publication, Third Edition, 2001.
2. Allen Mottershead, "*Electronic Devices &Circuits: An Introduction*", Prentice Hall India, 2010
3. A. Anand Kumar, "*Fundamentals of Digital Circuits"*, Prentice Hall India, Fourth Edition, 2014

**References:**

1. R.A. Gayakwad, "*Op-Amps & Linear Integrated Circuits*", Prentice Hall India, Fourth Edition, 2012.
2. R. L. Boylestad and Louis Nashelsky, "*Electronic Devices & Circuit Theory*", Pearson Publications, Tenth Edition, 2009.
3. M. Moris Mano and Michael Ciletti, "*Digital Design"*, Pearson Publications, Fifth Edition, 2013

**Course Objectives:**

1. This course aims to introduce students the basic features of operational amplifier.
2. It intends to provide knowledge and experience for implementing simple electronic circuits to meet or exceed design specifications.
3. It is aimed to enable students for implementing combinational logic circuits for various applications.
4. It intends to provide knowledge for implementation of sequential circuits using flip-flops.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student will be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Summarize** various analog and digital circuits. | 2 | Understanding |
| **CO2** | **Implement** analog and digital circuits to meet stated applications | 3 | Applying |
| **CO3** | **Construct** basic analog filters, combinational and sequential circuits | 3 | Applying |
| **CO4** | **Analyze** the performance of electronic circuits | 4 | Analyzing |

**CO-PO Mapping :**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | | | 3 | | | | | | | | | | | |
| **CO3** | | | 3 | | | | | | | | | | | |
| **CO4** | | 3 | | | | | | | | | | | | |

**Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Fundamentals of Op-Amps** | **Hrs.** |
|---|---|
| Differential Amplifier(1st stage of OP-AMP), Ideal Operational Amplifiers, Block Diagram, Characteristics, op-amp powering, feedback in op-amp circuits, inverting, non-inverting amplifiers, adder, subtractor, voltage comparator, difference amplifier, op-amp parameters & ratings. | **6** |
| **Module 2: Applications of Opamps** | **Hrs.** |
| Instrumentation amplifier, Integrator, Differentiator, Schmitt trigger, Active filters-Low pass, high pass, band pass, all pass, band reject (notch) filters, Current to voltage convertor, voltage to current convertor, precision rectifier, peak detector, sample & hold circuit, Logarithmic Amplifier,Multivibrators: IC 555Astable, Monostable and Bistable | **7** |
| **Module 3:Transistor Amplifiers and Voltage Regulators** | **Hrs.** |
| Introduction, Types of Configuration: common base, common emitter and common collector configurations, operating point, stability and biasing circuits, Design of Amplifier : Common Emitter mode<br>Voltage regulators, short circuit protection, fixed voltage regulators (± 5 V, ± 12 V). | **5** |
| **Module 4:Combinational Circuits and Sequential Circuits** | **Hrs.** |
| Review of k-map minimization technique for multiple outputs, static & dynamic hazards, multiplexer, de-multiplexer, priority encoder, comparator, half & full adders, tri-state buffers. Latches – S-R latch, D latch, flip-flops- D F/F, J-K F/F,T F/F, master slave J-K F/F, conversion of one F/F to another F/F. | **7** |
| **Module 5:Applications of Sequential circuits** | **Hrs.** |
| Counters:Modulus of Counter, Synchronous and Asynchronous counters, Ripple counters, drawbacks of ripple counters, Ring counters, Twisted Ring Counters, Shift registers, types of shift registers, design using D, J-K & T F/Fs. | **6** |
| **Module 6:Digital to Analog and Analog to Digital Converters** | **Hrs.** |
| Binary weighted DAC, R-2R ladder DAC, Ramp ADC, dual slope ADC, successive approximation technique, flash ADC, voltage, current and phase angle measurement (block level treatment only). | **5** |

**Module wise Measurable Students Learning Outcomes :**

After completion of the course students will be able to:

1. Summarize fundamental concepts of Op-Amps and apply them for simple Op-Amp based circuits.
2. Demonstrate op-amp based applications like oscillators, filters, filters and regulators, etc.
3. Interpret the performance of amplifiers and voltage regulators.
4. Construct basic logical gates for design of digital circuits.
5. Implement basic sequential circuits using flip flops.
6. Classify different types of Digital to Analog and Analog to Digital Converters.

| **Title of the Course: Electrical Measurement**<br>**Course Code: 5EL 204** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Pre-Requisite Courses:** Basic Electrical Engineering

**Textbooks:**

1. Alan Morris "Principles of measurement and instrumentation", Prentice Hall- India, 2004.
2. Albert D. Helfric, "Modern Electronics measurement & instruments", PHI Ltd, 2003.

**References:**

1. Robert B. Northop, "Instrumentation and measurement", 2nd Edition. CRC press, 2005
2. A. K. Sawhney, "Measurement and instruments", Dhanpat Rai, 2002.

**Course Objectives :**

1. This course intends to provide basic concepts of errors in measurements and basic fundamentals of measuring systems, formal representation, computational methods, notation, and vocabulary of linear models.
2. It is aimedto impart skillsto classify bridges, measuring instruments and equipment's and also demonstrate digital instruments, advance instruments.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student willbe able to** | Bloom's Cognitive level | Descriptor |
|---|---|---|---|
| **CO1** | **Grasp** fundamental concepts of measurement and identify errors in measurement and its statistics. | 2 | Understanding |
| **CO2** | **Explain** working principle and mechanism of measuring instrument. | 2 | Understanding |
| **CO3** | **Use** a proper measuring instrument for given application. | 3 | Applying |
| **CO4** | **Identify** conventional and modern techniques for measurement of electrical parameters. | 4 | Analyzing |

**CO-PO Mapping :**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | 3 | | | | | | | | | |
| **CO2** | | | | | 2 | | | | | | | | | |
| **CO3** | | | | | | | | | | | 2 | | | |
| **CO4** | | | | | | | | | | | 3 | | | |

**Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Structure of Measurement System** | **Hrs.** |
|---|---|

| | |
|---|---|
| Units, Dimensions and Standards, Structure of Measurement Systems, Instrument Types-Active, Passive, Examples of Laboratory Instruments. | **4** |
| **Module 2:Characteristics of Measuring Instruments and Errors** | **Hrs.** |
| Static Characteristics of Instruments, Dynamic Characteristics of Instruments, Measurement Errors. | **4** |
| **Module 3:Measuring Instruments** | **Hrs.** |
| Absolute and secondary instruments, types of Secondary Instruments: indicating, integrating, and recording, analog & digital Ammeter and Voltmeter theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) (attraction and repulsion), Permanent Magnet Moving Coil (PMMC) and Dynamometer type instruments. | **5** |
| **Module 4:Measurement of Power and Energy** | **Hrs.** |
| Active and reactive power measurement in three phase system for balanced and unbalanced load using two wattmeter method & one wattmeter method. Construction, working principle, torque equation of single phase conventional (induction type) energy meter, Calibration of energy meter, digital Energy Meter, block diagram and operation of electronic energy meter. | **5** |
| **Module 5:Measurement of Resistance, Inductance and Capacitance** | **Hrs.** |
| Measurement of low, medium and high resistance, Wheatstone Bridge, Kelvin's Double Bridge, Ammeter-Voltmeter method, Megger, Earth tester for earth resistance measurement, Maxwell's Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge and Wien's Bridge. | **5** |
| **Module 6: Recent developments in Measurements** | **Hrs.** |
| DSO, Power Analyzer, Wave Analyzer & Harmonic Distortion, and Instrument Transformers: Construction, connection of CT & PT in the circuit, advantages of CT / PT, over shunt and multipliers for range extension of MI Instruments. | **5** |

**Module wise Measurable Students Learning Outcomes :**

After the completion of the course the student will be able to

1. Grasp Electrical Measuring systems
2. Grasp of basic concepts of measurement.
3. Identify a proper measuring instrument and working principle of MI and PMMC.
4. Explainmeasurement of Power and Energy.
5. Classify bridges, measuring instruments and equipment's.
6. Identify advanced measuring instruments like DSO, Power Analyzer.

**Laboratory Experiment:**

1. Study of various analog and Digital measuring Instruments.
2. Measurement of active power by using two wattmeter method
3. Measurement of reactive power by using two wattmeter method
4. Calibration of single phase energy meter.
5. Study of different bridges.
6. Earth resistance measurement using earth tester.
7. Insulation measurement using megger.
8. Study of DSO, Power analyzer.

| **Title of the Course: Instrumentation**<br>**Course Code: 5EL 205** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Pre-Requisite Courses:** Control System

**Textbooks:**

1. A.K.Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation", Dhanapat Rai & Company, New Delhi, reprint, 17th Edition, 2005.
2. Rangan, Mani and Sharma, "Instrumentation Devices and Systems", Tata McGraw Hill, New Delhi, 2nd Edition.
3. C. D. Johnson, "Process Control Instrumentation Technology", Pearson Education.

**References:**

1. Doebelin, E.O., "Measurement Systems", McGraw Hill Book Co.
2. Patranabis, D,"Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi.
3. Murthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi.

**Course Objectives :**

1. Impartingbasic knowledge of transducer.
2. To develop skills of instrumentation systems design.
3. It is intended to learn basics of PLC programing.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student willbe able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Explain** the various types of transducer and their application. | 2 | Understanding |
| **CO2** | **Implement** the instrumentation system for measurement of physical parameters. | 3 | Applying |
| **CO3** | **Demonstrate** the use of PLC for industry applications. | 3 | Applying |

**CO-PO Mapping :**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | 2 | | | | | | | | | |
| **CO2** | | | 2 | | | | | | | | | | | |
| **CO3** | | | | | 2 | | | | | | | | | |

**Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Instrumentation System** | **Hrs.** |
|---|---|
| Concept of physical process and control, Instrumentation system-overview, component of system and system feedback, data acquisition system, performance characteristics, calibration of Instrumentation System. Sensors and Transducers- overview, definition, classification, selection criteria, concept of error, signal conditioning. | **6** |
| **Module 2:Transducers- Pressure and Flow** | **Hrs.** |
| Transducers for pressure and strain measurement, type of strain gauges, LVDT and RVDT, flowmeasurement technique, inferential type, variable head & area, magnetic meters, turbine meters, thermal flow meter. | **6** |
| **Module 3: Transducers- Temperature, Speed and Force** | **Hrs.** |
| Temperature measurement, temperature scale, classification, methods of force measurement, eddy current dynamometer, Speed- definition, types of tachometer, synchro-transmitter and receiver. | **6** |
| **Module 4:Output Devices** | **Hrs.** |
| Analog display, Oscilloscope, X-Y recorders, Digital data recorders, Digital input and output devices, LCD, LED, DPM, 7 segment display. | **4** |
| **Module 5: Digital Instrumentation** | **Hrs.** |
| Digital multi meter, digital ac and dc ammeter, digital ac and dc Volt meter, digital frequency meter, digital power meter, multi-function meter, Instrumentation systems design for physical parameters using different types of transducers. | **8** |
| **Module 6: Programmable Logic Controller** | **Hrs.** |
| Introduction to discrete state process control, specification, event sequence description, ladder diagram, relay logic controller, comparison of PLC with relay logic controller, architecture of PLC, operating modes of PLC, difference between PLC and PC, ladder diagram programming of various system, role of PLC in Industry. | **6** |

**Module wise Measurable Students Learning Outcomes:**

After completion of the course students will be able to:

1. Grasp knowledge of basic instrumentation system.
2. Explain different applications of pressure and flow transducers.
3. Explain different applications of temperature, speed and force transducers.
4. Grasp knowledge of basic output devices.
5. Grasp knowledge of basic digital instrumentation system.
6. Explain PLC and its programming for instrumentation, electrical, process control systems and interfacing.

# Professional Core (Lab) Courses

| **Title of the Course: DC Machines and Transformers Lab**<br>**Course Code: 5EL 251** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:**

**Textbooks:**

1. A.E.Clayton and Hancock, "*The Performance and Design of Direct Current Machines",* CBS Publishers, 1st Edition, 2004.
2. M. G. Say. *"The Performance and Design of Alternating Current Machines",* CBS Publishers, 3rd Edition, 2004.
3. O. E. Taylor, *"Performance Design of AC commutator motors",* Wheeler Publisher, 15th Reprint.

**References:**

1. PurkaitandBandyopadhyay *"Electrical Machines"*, Oxford University Press, 1st Edition, 2017.
2. J. B. Gupta, *"Theory and Performance of Electrical Machines"*, S.K.Kataria and Sons, 1st Edition, 2013.
3. Fitzerald and Kingsley, *"Electric Machines"*, Tata McGraw Hill, 7th Edition, 2007.
4. Kothari and Nagrath, *"Electric Machines"*, McGraw Hill, 5th Edition, 2018.

**Course Objectives:**

1. This course intends to develop skills to demonstrate performance operation of DC motors & transformers using different tests.
2. It intends to develop skills to analyze operation and performance of DC machines & transformers.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Experiment** for verification of electrical characteristics and performance of DC Machines and transformer. | 3 | Applying |
| **CO2** | **Analyze** the performance of DC Machines and transformer. | 4 | Analyzing |
| **CO3** | **Develop** appropriate circuit connections and determine ratings of meters to conduct an experiment as a group activity. | 4 | Analyzing |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | **3** | | | | | | | | | |
| **CO2** | | | | **3** | | | | | | | | | | |
| **CO3** | | | | **2** | **1** | | | | | | | | | |

**Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

**List of Experiments:**

1. Speed control of dc shunt motor (i) Armature control method (ii) Field control method.
2. Determination of efficiency of DC motor by Swinburne's test.
3. Determination of efficiency of DC motor by Hopkinson's test.
4. Brake test on shunt motor to determine its performance and efficiency.
5. Load test on compound motor i) cumulative ii) differential.
6. To perform open circuit and short circuit test for determining equivalent circuit parameters of a single phase transformer.
7. Parallel operation of single phase transformer to demonstrate load sharing.
8. Scott connections for converting 3 phase to 2 phase supply.
9. Equivalent Delta test or Heat run Test for determination of temperature rise and efficiency of 3 phase transformer.
10. Parallel connection of 3 phase DY1 and DY11 transformers to demonstrate load sharing.
11. Load test on transformer (single and three phase) to determine losses and efficiency using Sumpner's test.
12. Develop a circle diagram of Universal motor using load test.

| **Title of the Course: Electrical Circuit and Measurement Lab**<br>**Course Code: 5EL 252** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:** NIL

**Textbooks:**

1. C.K. Alexandar and M.O. Sadiku, *"Fundamentals of Electric Circuits",* TMH, 6th Edition 2018
2. H. S. Kalsi "Electronic Instrumentation", McGraw Hill Education, Third edition, 2010.

**References:**

1. James W. Nilsson and Susan A. Riedel "*Electric Circuits*" Prentice Hall, 10th Edition 2015
2. A. K. Sawhney, "A Course in Electrical and Electronics Measurement and Instrumentation", DhanapatRai& Company, New Delhi, reprint, 19th Edition, 2010.

**Course Objectives:**

1. This course intends to provide basic practical knowledge of electrical circuit theorems.
2. It intends to develop skills to demonstrate transient and steady state response of first and second order electrical circuit.
3. It aims to develop an ability to simulate and implement various basic electrical circuits.
4. It intends to develop skills for measurement and instrumentation system.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Determine** parameters of electrical circuits and two port network using hardware and modern tools. | 2 | Understanding |
| **CO2** | **Explain** the transient and steady state response of first and second order circuit using hardware and modern tools. | 2 | Understanding |
| **CO3** | **Employ** measurement and instrumentation system for measurement of electrical and physical parameters. | 3 | Applying |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | 3 | | | | | | | | | |
| **CO2** | | | | | 3 | | | | | | | | | |
| **CO3** | | | | | 2 | | | | | | | | | |

**Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments.

**Course Contents: (Experiments)**

1. Implementation of Mesh and Node analysis to measure current and voltage in D.C. circuit using software tool PSpice.
2. Verification of Superposition Theorem to measure current and voltage in electrical circuit using hardware and validate the result using software tool PSpice.
3. Verification of Thevenin's and Norton's Theorem to obtain equivalent circuit using hardware and validate the result using software tool PSpice.
4. Determine transient and steady state behavior of a first order circuit (R-C circuit) on hardware and validate the results using software tool PSpice.
5. Determine transient and steady state behavior of a second order circuit (R-L-C circuit) using software tool PSpice.
6. Determine Impdenace, Admittance, Transmission and Hybrid parameters of two port electrical network using hardware and validate the result manually.
7. Implementation of Mesh and Node analysis to measure current and voltage in A.C. circuit using software tool PSpice.
8. Determine active power using two wattmeter method and reactive power using one wattmeter method in a three phase circuit and validate the result manually.
9. Determine error in single phase energy meter by calibration.
10. Determine physical parameters using different type of transducers and validate the result manually.

**Computer Usage / Lab Tool:**

1. Use of software simulation tool PSpice etc.

| **Title of the Course: Analog and Digital Circuits Lab**<br>**Course Code: 5EL 253** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:**Basic Electronics Lab

**Textbooks:**

1. Sergio Franco, "*Design with Op-Amps and analog Integrated Circuits*", Tata McGraw-Hill Publication, Third Edition, 2001.
2. Allen Mottershead, "*Electronic Devices &Circuits: An Introduction*", Prentice Hall India, 2010
3. A. Anand Kumar, "*Fundamentals of Digital Circuits"*, Prentice Hall India, Fourth Edition, 2014

**References:**

1. R.A. Gayakwad, "*Op-Amps & Linear Integrated Circuits*", Prentice Hall India, Fourth Edition, 2012.
2. R. L. Boylestad and Louis Nashelsky, "*Electronic Devices & Circuit Theory*", Pearson Publications, Tenth Edition, 2009.
3. M. Moris Mano and Michael Ciletti, "*Digital Design"*, Pearson Publications, Fifth Edition, 2013

**Course Objectives :**

1. This lab course intends to provide basic practical knowledge of various ICs for developing linear integrated circuits.
2. It intends to impart skills to implement different electronic circuits using operational amplifier.
3. It aims to develop an ability to simulate and implement combinational and sequential circuits.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student will be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Distinguish** various analog and digital circuits. | 2 | Understanding |
| **CO2** | **Illustrate** linear integrated circuits using electronic components like Op-amps, transistors, etc. | 3 | Applying |
| **CO3** | **Implement** applications of various analog and digital circuits. | 3 | Applying |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | 3 | | | | | | | | | | |
| **CO2** | | | | 3 | | | | | | | | | | |
| **CO3** | | | | | 3 | | | | | | | | | |

**Assessment:**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments.

**Course Contents: 2Hrs for Each Practical**

1. Demonstration of the performance of opamp in inverting, non-inverting and buffer configuration
2. Implementation of a difference amplifier using operational amplifier
3. Design of Summing, Averaging and Scaling Amplifier using opamp
4. Implementation of Instrumentation Amplifier using opamp
5. Construction of Schmitt Trigger using opamp
6. Demonstration of the performance of half and full wave rectifier.
7. Design of a first order Active Low Pass filter using opamp
8. Design of a first order Active High Pass filter using opamp
9. Development of various types of clippers and clampers.
10. Use of op-amp as differentiator & integrator.
11. Illustrationofop-amp as zero crossing detector & peak detector.
12. Development of phase shifter circuit using op-amp.
13. Design of the astable and mono stable multi vibrators using IC 555
14. Demonstration of the D and JK flip flop
15. Implementation of the circuits of decoders and multiplexers.
16. Experimentation of decade counters.
17. Implementation of Half and Full Adder circuits

Simulation study of above experiments.

**Computer Usage / Lab Tool:**

1. Use of software simulation tools like Proteus, PSpice etc.
2. Use of analog and digital circuit trainer kits.

# Mandatory Life Skill Courses

| Title of the Course: Environmental Sciences<br>Course Code: 5IC201 | L | T | P | Cr |
|---|---|---|---|---|
| | 2 | -- | -- | 0 |

**Desirable Requisite:**

**Textbooks:**

1. Mrinalini Pande, "Disaster Management", Wiley Publications New Delhi, First edition, 2014
2. N.K Uberoi, "Environmental Studies", Excel Books Publications New Delhi, first edition, 2005.
3. R.Rajagopalan, "Environmental Studies from crisis to cure" Oxford university press, second edition, 2011

**References:**

1. William. Cunningham and Barbara Woodworth Saigo, "Environmental Science: A Global Concern", WCB/McGraw Hill publication, 5th Edition, 1999.
2. Peter. H. Raven, Linda. R. Berg, George. B. Johnson, "Environment", McGraw Hill publication, 2nd -Edition, 1998.
3. Catherine Allan & George H. Stanley (Editors), "Adaptive Environmental Management", Springer Publications. 2009.

**Course Objectives :**

1. Infuse an understanding of the various environmental concepts on scientific basis in the functional area of Engineering and technology.
2. Provide a foundation to critically assess the approaches to pollution control, environmental and resource management, sustainable development, cleaner technologies, Environmental Legislation based on an understanding of the fundamental, environmental dimensions.
3. Inculcate the modern concept of green industry and the impact of excess human population, globalization, and climate change on the environment.

**Course Learning Outcomes:**

| | After the completion of the course the student should be able to | Bloom's Cognitive | |
|---|---|---|---|
| | | **Level** | **Descriptor** |
| **CO1** | Describe key concepts of Environmental science and their relationship to engineering. | II | Understanding |
| **CO2** | Explain ethical and legal responsibility of an engineer and his role in effective implementation of sustainable activities through EIA and EMS in the corporate sector. | II | Understanding |
| **CO3** | Predict impact of contemporary issues (Population Explosion, Climate change, Environmental pollution) on the environment. | II | Understanding |

**CO-PO Mapping :**

| PO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | **2** | **2** | | | | | | | |
| **CO2** | | | | | | | **3** | **2** | | | | | | |
| **CO3** | | | | | | | **2** | | | | | | | |

**Assessments: Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|

| | |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Environment, Ecology and Biodiversity** | **Hrs.** |
|---|---|
| Introduction: Natural and Built Environment, Environmental education: definition, scope, objectives and importance, Components of the Environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere.<br>Ecology : Introduction, Types (terrestrial and aquatic ecosystems) , Structure and function, Trophic levels, Food chains, food webs, Ecological pyramids, Ecological succession, Biogeochemical cycles.<br>Biological Diversity: Introduction, Value of biodiversity: consumptive use, Threats to biodiversity, Conservation of biodiversity. | **07** |
| **Module 2: Human Population, Energy and Natural Resources** | **Hrs.** |
| Human Population Growth and Environment: Population Dynamics, Age structures,<br>Energy Scenario: Future projections of Energy Demand, Utilization of various Energy Sources, Conventional Energy Sources and Non- Conventional Energy Sources, Urban problems related to energy.<br>Natural Resources: Food, Water, Forest, Geological, Equitable Use of Resources for Sustainable life style. Case studies. | **05** |
| **Module 3: Climate Change, Environmental Quality and Pollution Control** | **Hrs.** |
| Climate change: Global warming, Ozone depletion, Acid Rain.<br>Environmental Impact: Impact of Modern agriculture on the Environment, Impact of Mining on the Environment, Impact of Large dams on the Environment, Environmental pollution: Air, Water, Soil, Noise, Marine, classification of pollutants, their causes, effects and control measures. Case studies. | **05** |
| **Module 4: Solid, Hazardous Waste and Disaster Management** | **Hrs.** |
| Solid and Hazardous waste management: Introduction, categories, causes, effects and management of municipal solid waste, Hazardous waste<br>Disaster Management: Introduction, types of disasters, Disaster mitigation.<br>Case studies. | **04** |
| **Module 5: Social Issues, Environmental Management and Legislation** | **Hrs.** |
| Environmental ethics: Introduction, Ethical responsibility, issues and possible solutions.<br>Environmental Management**:** Introduction to Environmental Impact Assessment, Environmental Management System: ISO 14001Standard, Environmental Auditing,<br>National and International Environmental protection Agencies pertaining to Environmental Protection.<br>Environmental Legislation: Environmental protection act 1986, Water (prevention and control of pollution) Act 1974, Air (prevention and control of pollution) Act 1981, Wild life Protection Act 1972, and Forest Conservation Act 1980.Municipal Solid Wastes (Management and Handling) Rules, 2000. | **04** |

| **Module 6: Cleaner technology** | **Hrs.** |
|---|---|
| Restoration Ecology, Role of Information Technology in Environment science, Green buildings, Green products, Consumerism and Waste Products, Minimization of Hazardous Products, Reuse of Waste, By-products, Rainwater Harvesting, Translocation of trees. Some Success Stories. Case studies**.** | **03** |
| **Moodle wise Outcomes**<br>At end of each module students will be able to<br>**Module 1:**<br>Determine an in-depth understanding of the interdisciplinary relationship of cultural, ethical, and social aspects of local/global environmental issues. Understand how interactions between organisms and their environments drive the dynamics of individuals, populations, communities, and ecosystems.<br>**Module 2:**<br>Describe the impact of human population on the environment, and the utilization of natural resources for sustainable life style.<br>**Module 3:**<br>Explain the issues like Climate change, Global warming, Global Warming Potential, Ozone depletion, Ozone depletion Potential, Impact of Modern agriculture on the Environment, Impact of Mining on the Environment, Impact of Large dams on the Environment, Bio magnification, Eutrophication and apply learned information to postulated environmental scenarios to predict potential outcomes.<br>**Module 4:**<br>Identify and define different disasters and their mitigation in addition to solid and hazardous waste management.<br>**Module 5:**<br>Sense the legislation governing environmental research and the environment. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.<br>**Module 6:**<br>Describe strategies, technologies, and methods for assessment and sustainable management of environmental systems and for the remediation or restoration of degraded environments. | |
| **Tutorial:** The tutorials consist of Quiz, Tests, Assignments in addition to a mini project work based on diverse environmental issues and topics. | |

# EVEN Semester

# Professional Core (Theory) Courses

| **Title of the Course: Applied Mathematics for Electrical Engineering**<br>**Course code: 5EL221** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:** Engineering Mathematics I and Engineering Mathematics II

**Textbooks:**

1. *"Advanced Engineering Mathematics",* Erwin Kreyszig, Wiley Eastern Limited Publication, 1st Edition, 1978.
2. *"A Text Book of Applied Mathematics, Vol I and II",* P. N. and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune, 2006.
3. *"Higher Engineering Maths",* B .S. Grewal, Khanna Publication, 39th Edition, 2005.

**References:**

1. "*Advanced Engineering Mathematics",* Wylie C.R., Tata McGraw Hill Publication, 8th Edition, 1999.
2. *"Advanced Engineering Mathematics",* H. K. Dass, S. Chand & Company Ltd., 1st Edition, 1988.

**Course Objectives :**

1. To develop mathematical skills and enhance thinking power of students.
2. To introduce fundamental concepts of mathematics and their applications in engineering fields.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | To explain the mathematical concepts in engineering field. | 2 | Understanding |
| **CO2** | Use mathematical and computational methods to solve the problems in science and engineering field. | 3 | Applying |

**CO-PO Mapping :**

| **PO** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | | | | | | | | | | | | | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Linear differential equations with constant coefficients :** | **Hrs.** |
|---|---|
| Definition, Complete solution, The operator D, Auxiliary equation , Rules for finding the complementary function, Inverse operator, Rules for finding the particular integrals , Homogeneous linear differential equations. | **6** |

| **Module 2: Laplace Transform and its applications** | **Hrs.** |
|---|---|
| Definition, Transform of standard functions, properties, Transform of derivative and integral, Inverse Laplace transform, Convolution theorem, Applications to solve linear differential equations, Laplace transform of periodic functions. | **8** |
| **Module 3: Fourier Series** | **Hrs.** |
| Periodic functions, Dirichlet's conditions, Definition, Determination of Fourier coefficients(Euler's formulae), Expansion of functions, Even and odd functions, Change of interval and functions having arbitrary period, Half range Fourier sine and cosine series. | **6** |
| **Module 4: Fourier Transform** | **Hrs.** |
| Definition, Fourier sine and cosine integral, Fourier sine and cosine transform, Inverse Fourier sine and cosine transform, properties, Parseval's identity. | **5** |
| **Module 5: Partial differential equations and its application** | **Hrs.** |
| Partial differential equations, Four standard forms, Application to one dimensional heat equation. | **6** |
| **Module 6: Complex analysis** | **Hrs.** |
| Introduction, function of complex variable, Limit and continuity of a function of complex variable, Differentiability , Analytic function, Harmonic function, Complex integration, Integral theorem and formula, Zero of analytic function, Singular point, Pole , Cauchy Residue theorem. | **8** |

**Module wise Measurable Students Learning Outcomes :**
**After the completion of the course the student should be able to:**
**Module 1:** Solve examples in linear differential equation with constant coefficients.
**Module 2:** Solve examples in Laplace Transform also applications in ordinary differential equations.
**Module 3:** Solve the problems of Fourier series, expansion of function in Fourier series.
**Module 4:** Solve examples in Fourier transforms.
**Module 5:** Solve examples in partial differential equation also applications in PDE.
**Module 6:** Understand and solve analytic function, complex integration, Cauchy Residue theorem.

| **Title of the Course: AC Machines**<br>**Course Code: 5EL 222** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:** DC Machines & Transformers

**Textbooks:**

1. M. G. Say. *"Performance Design of AC Machines",* CBS Publishers, 4th Edition, 1976.
2. O. E. Taylor, *"Performance Design of AC Commutator Motors",* Wheeler Publisher, 15th Reprint.

**References:**

1. J. Chapman, "Electrical Machine", McGraw Hill, 5th Edition, 2009.
2. J. B. Gupta, *"Electrical Machines"*, SK Kataria and Sons, 3rd edition, 2011.
3. Fitzerald and Kingsley,*"Electric Machine"*, Tata McGraw Hill, 2nd Edition, 2000.

**Course Objectives:**

1. This course intends to provide basic concept of operation and performance of asynchronous and synchronous machines.
2. It intends to develop implicational skill to operate asynchronous and synchronous machines.
3. It intends to develop a skill to determine performance of asynchronous and synchronous machines.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive level | Descriptor |
|---|---|---|---|
| **CO1** | **Explain** the working principles, construction and operation of asynchronous and synchronous Machines. | 2 | Understanding |
| **CO2** | **Solve** numerical on asynchronous and synchronous machines. | 3 | Applying |
| **CO3** | **Analyze** the performance of synchronous and asynchronous Machines. | 4 | Analyzing |

**CO-PO Mapping: (Use 1, 2, 3 as correlation strengths)**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | | | | | | | | | | | | | |
| **CO2** | | **3** | | | | | | | | | | | | |
| **CO3** | | | | **2** | | | | | | | | | | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents**☹Arrange contents logically/ process-wise/conceptually/theory followed by application)

| **Module 1: Synchronous Generator** | **Hrs.** |
|---|---|
| Construction, Principle of operation, EMF equation, leakage reactance, armature reaction, armature resistance and reactance, field excitation system, damper winding | **5** |

| **Module 2: Performance of Synchronous Generator** | **Hrs.** |
|---|---|
| Calculation of voltage regulation by synchronous Impedance method, Zero power factor method, MMF method, experimental setup for above method, rating, efficiency and losses, method of synchronizing, synchronizing power, hunting, damping operation single and Infinite bus, power angle equation, short circuit ratio and its significance.<br>**Two Reaction Theory**: Phasor diagram, slip test, power angle equation, saliency power. | **6** |
| **Module 3: Synchronous Motor** | **Hrs.** |
| Method of starting, phasordiagram, torque and torque angle equation, V –curves and experimental setup, hunting and damping, synchronous condenser. | **5** |
| **Module 4: Three Phase Induction Motor** | **Hrs.** |
| a. **Construction, Principle of operation**: Phasor diagram, equivalent circuit, analysis based on approximate equivalent circuit, Torque equation, speed equation, speed torque curve,<br>b. **Slip ring Induction Motor**: Effect of increase in rotor resistance, starting, speed control of motor.<br>c. **Speed control of Induction Motor**: Change of supply frequency, pole changing, cascading, Injection of EMF in secondary.<br>d. **Application and Testing**: Testing as per I.S.S., Industrial applications of induction motor. | **8** |
| **Module 5: Computations and Classification of Three Phase Induction Motor:** | **Hrs.** |
| a) **Computations**: No load test, Blocked rotor test, and circle diagram, starting and types of starter, ratio of starting torque to full load torque.<br>b) **Double Cage Induction Motor (D.C.I.M.)**: Construction, Characteristics and Equivalent circuit.<br>c) **Synchronous Induction Motor**: Construction, Circle diagram, Phasor diagram. | **8** |
| **Module 6: Single Phase Induction Motor and, Three Phase Motor Winding** | **Hrs.** |
| **a) Single Phase Induction Motor:** Types, Construction, Principle of operation, phasordiagram, equivalent circuit, Experimental determination of parameter, application.<br>**b) Three Phase Motor Winding** Single layer, double layer, Integral and fractional slot winding, distribution factor, pitch factor, Elimination of harmonics voltage. | **7** |

**Module wise Measurable Students Learning Outcomes:**

After the completion of the course the students should be able to:

1. Study principals of three phase synchronous machines.
2. Analyze performance and ratings of synchronous machines for given application.
3. Determine performance of the synchronous motor.
4. Evaluate performance rating of induction motor.
5. Determine parameters of three phase induction motor.
6. Design three phase winding of AC machines.

**Tutorial:**

| **Title of the Course: Electrical Transmission and Distribution**<br>**Course Code: 5EL 223** | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:** Electrical Circuits, DC Machines and Transformers

**Textbooks:**

1. Glover, Sharma, Overbye *Power Systems Analysis and Design*, Thompson, 5th Ed., 2012.
2. Ashfaq Husain, *Electrical Power Systems*, CBS, 5th Edition, 2007.

**References:**

1. Nagrath, Kothari, *Modern Power System Analysis*, TMH, 2nd Edition, 2015.
2. HadiSaadat, *Power System Analysis*, TMH, 1st Edition, 2002.
3. Stevenson W.D., *Elements of Power System Analysis*, TMH, 4th Edition, 2014.

**Course Objectives:**

1. Power system forms a major part of electrical systems. This course will appraise the students about the structure and performance analysis of power systems.
2. This course will develop analytical skills in the students for investigating issues related to power systems.
3. This course will help students in preparing for competitive examinations.

**Course Learning Outcomes: (Write from student perspective)**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive level | Bloom's Cognitive Descriptor |
|---|---|---|---|
| **CO1** | **Summarize** structure and performance parameters of power system. | 2 | Understanding |
| **CO2** | **Interpret** the performance of generation, transmission and distribution system. | 3 | Applying |
| **CO3** | **Scrutinize** voltage and power factor control methods for improving performance of transmission and distribution systems | 4 | Analyzing |

**CO-PO Mapping: (Use 1, 2, 3 as correlation strengths)**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | | | | | | | | | | | | 2 | |
| **CO2** | | 3 | | | | | | | | | | | 2 | |
| **CO3** | | | 2 | | | | | | | | | | 2 | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Structure of Power Systems and parameters of transmission lines** | **Hrs.** |
|---|---|
| Generation, transmission, distribution and utilization of electrical power, types of lines, types of | **7** |

| | |
|---|---|
| conductors, voltage levels, R, L, C parameters. | |
| **Module 2: Mechanical aspects of transmission lines** | **Hrs.** |
| Electrical clearances, safety norms, Sag calculations, effect of wind and ice covering of sag, types of insulators, support structures, corona. | **7** |
| **Module 3: Transmission line representation and performance calculation** | **Hrs.** |
| Single Line Diagram (SLD), String Efficiency of insulators, PU quantities, short, medium and long line models, performance calculations, ABCD constants, Power Circle Diagram. | **6** |
| **Module 4: Distribution Systems and Underground Cables** | **Hrs.** |
| Types of feeders, distributors, AC and DC distribution systems, sub-stations, UG cables for LT and HT systems. | **6** |
| **Module 5: Voltage control and Power factor improvement** | **Hrs.** |
| Methods of voltage control, AVRs, tap changing transformers, causes of low p.f., effects of low p.f., Shunt capacitors, calculation of reactive power injection and p.f. correction. | **7** |
| **Module 6: Economic operation of power systems** | **Hrs.** |
| Basics of Economic load sharing, Incremental fuel cost, Economic dispatch neglecting transmissions losses, penalty factor, General Loss Formula, optimum load dispatch considering transmissions losses. | **6** |

**Module wise Measurable Students Learning Outcomes:**

After the completion of the course the student will be able to

1. Understand the basic structure of power system and calculate R, L, C parameters.
2. Interpret the safety norms and mechanical aspects of transmission line.
3. Examine the performance of short, medium and long transmission lines.
4. Describe the types of UG cables, feeders, distributors and sub-stations.
5. Categorize voltage and power factor control methods for improving performance of transmission and distribution systems.
6. Study basic economics of power generation and load sharing methods for optimal load dispatch.

| Title of the Course: Power Electronics<br>Course Code: 5EL 224 | L | T | P | Cr |
|---|---|---|---|---|
| | 3 | -- | -- | 3 |

**Desirable Requisite:** Analog and Digital Circuits

**Textbooks:**

1. M.H.Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 4th Edition, November 2017.
2. P. S. Bhimra, "*Power Electronics",*3rd Edition, Khanna Publishers, 2002.

**References:**

1. B.K. Bose, *"Modern Power Electronics and A.C. Drives",* Prentice Hall of India Pvt. Ltd. Publication, 2002.
2. Mohan, UndelandRobins, *"Power Electronics, Converter Applications and Design*", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3. G. K. Dubey and Others *"Thyristorised Power Controller*", New Edge International Publishers, 1st Edition Reprint, 2005.

**Course Objectives:**

1. This course intends to provide basic knowledge of different power electronic devices, rectifiers, converters, inverters and choppers.
2. It is aimed to impart skills of analysis for different types of converters such as rectifiers, controlled converters, inverters and choppers.
3. Make the students acquainted with design of different types of converters such as rectifiers, controlled converters, inverters, choppers and their associated control circuit.

**Course Learning Outcomes:**

| CO | After the completion of the course the student should be able to | Bloom's Cognitive level | Bloom's Cognitive Descriptor |
|---|---|---|---|
| **CO1** | **Describe** the basics of semiconductor switches, rectifier, control converter, inverter, choppers, cyclo-converter and matrix converter circuits. | 2 | Understanding |
| **CO2** | **Calculate** the performance of semiconductor switches, rectifier, converter, inverter, choppers, cyclo-converter and matrix converter circuits. | 3 | Applying |
| **CO3** | **Analyze** the Power Electronic Circuits such as rectifier, converter, inverter, choppers, cyclo-converter and matrix converter circuits. | 4 | Analyzing |

**CO-PO Mapping:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | | 3 | | | | | | | | | | | | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |

| ESE | 50 |
|---|---|

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

**Course Contents:**(Arrange contents logically/ process-wise/conceptually/theory followed by application)

| **Module 1: Power Semiconductor Switches** | **Hrs.** |
|---|---|
| Characteristics of ideal switch. Characteristics, Rating, protection and cooling of power semiconductor devices such as power diodes, transistor, MOSFET, IGBT and GTO, Study of the driver circuits for thyristor, GTO and IGBT, Introduction to smart power modules, Comparative study of MOSFET, thyristor, GTO, BJT and IGBT. | **6** |
| **Module 2: Single Phase and Three Phase AC to DC rectifiers** | **Hrs.** |
| Single phase half wave and single phase full wave diode bridge. Three phase half wave and three phase full wave diode bridge, Transformer power rating for above configurations. | **6** |
| **Module 3: Phase Controlled AC to DC Converters** | **Hrs.** |
| Classification of converters, Single phase half controlled and fully controlled thyristorconverters, Three pulse and six pulse controlled converters, operation of converter with freewheeling diode. Effect of source inductance on the performance of the converter, overlap – angle. Performance factors for the converter such as displacement factor, distortion factor, total harmonic distortion, ripple factor and transformer utilization factor. Introduction to 12 pulse converter, single phase and three phase dual converter, firing scheme for 1 phase and three phase converter, Brief introduction to commutation methods. Introduction to PWM converters. | **8** |
| **Module 4: DC to DC Converters** | **Hrs.** |
| Control of DC to DC converters, step down (buck) converter, Analysis of buck converter with RLE load, step up converter, buck – boost converter, full bridge DC to DC converter, concept of multiphase choppers, cuk converter. | **6** |
| **Module 5: Switch Mode DC – AC Inverters** | **Hrs.** |
| Basic concepts of switch mode inverters, types: VSI and CSI, single phase half bridge and full bridge inverter, three phase six step inverter, $120^0$ mode of conduction, $180^0$ mode of conduction, three phase PWM Inverter, sinusoidal PWM and selective harmonics elimination methods of PWM. Effect of blanking time on output voltage in PWM inverters, auto sequentially commutated CSI, Solar Inverters, Introduction to multilevel inverters. | **7** |
| **Module 6: Cycloconverters and Matrix Converter** | **Hrs.** |
| Introduction to Single phase and three phase cycloconverters. Working and topologies of Matrix converter, control methods, performance analysis of matrix converter. | **6** |

**Module wise Measurable Students Learning Outcomes:**

After the completion of the course the students should be able to:

1. Compare different power electronics switches.
2. Analyze the single phase and three phase uncontrolled converters.
3. Analyze the single phase and three phase controlled converters.
4. Compare the performance of various types of DC to DC converters.
5. Discus the various types of inverters and their applications.
6. Differentiate cyclo-converter with matrix converter.

| **Title of the Course: Signals and Systems** | L | T | P | Cr |
|---|---|---|---|---|
| **Course Code: 5EL 225** | 3 | 1 | -- | 4 |

**Desirable Requisite:** Engineering Mathematics I, II and III

**Textbooks:**

1. A.V. Oppenheim, A.S. Willsky, S.H. Nawab, "*Signals and Systems"*, Prentice Hall, 2nd Edition, 1998.
2. B. P. Lathi, "*Principles of Linear systems and signals*, Oxford University press, 2nd Edition, 2005.

**References:**

1. M. J. Roberts, "*Signals and systems"*, Tata Macgraw Hill, 3rd Edition, 2011.
2. Simon Haykin, Barry Van Veen, "*Signals and systems"*, Wiley, 2nd Edition, 2007.

**Course Objectives :**

1. This course intends to provide basic knowledge of theoretical structure, formal representation, computational methods, notation, and vocabulary of linear models.
2. It is aimed to impart skills to perform signal analysis with reference to spectrum analysis of deterministic signals.
3. Imparting basic knowledge of signals and systems analysis.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Describe** the mathematical principles of continuous time, discrete-time systems and applications of signal processing techniques. | 2 | Understanding |
| **CO2** | **Calculate** the response of linear systems in time domain using various tools such as convolution, Laplace transform, Z transform etc. | 3 | Applying |
| **CO3** | **Analyze** frequency domain behavior of linear systems using Fourier transform techniques. | 4 | Analyzing |

**CO-PO Mapping :**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | | | | | | | | | | | | | |
| **CO2** | | **3** | | | | | | | | | | | | |
| **CO3** | | **3** | | | | | | | | | | | | |

**Assessment:**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally

last three modules) covered after MSE.

**Course Contents:**

| **Module 1: Introduction to Signals and Systems** | **Hrs.** |
|---|---|
| Continuous and Discrete - Introduction, standard signals, signal representation, classification of signals, systems – representation, classification, Linear, Time invariant, causal, BIBO stable, Static, dynamic. | **7** |
| **Module 2: Time Domain Analysis of Continuous and Discrete Time Systems** | **Hrs.** |
| Zero state and Zero input response, Impulse response, Convolution and its properties, Convolution integral, Properties of Convolution integral, Convolution sum, Properties of Convolution sum, graphical representation of convolution. | **7** |
| **Module 3: Fourier Domain Analysis of Continuous Time Signal** | **Hrs.** |
| Trigonometric Fourier series, Compact Trigonometric Fourier series, Exponential form, Dirichlet Conditions, Frequency domain representation of periodic signals, Fourier Transform representation of aperiodic signals, Properties of CFT duality, time reversal, Convolution – time and frequency domain, etc. | **7** |
| **Module 4: Laplace Transform Analysis of Signals and System** | **Hrs.** |
| Definition, Properties, Solution of differential equation. Transfer function, Poles and Zeroes, System analysis using Laplace Transform. | **6** |
| **Module 5: Fourier Domain Analysis of Discrete Time Signal** | **Hrs.** |
| Representation of CT signals using Samples, Nyquist Sampling Theorem Discrete time Fourier Transform, Representation of aperiodic sequence, Properties of DTFT: time reversal, Linear Convolution – time and frequency domain, conjugate symmetry | **6** |
| **Module 6: Z Transform Analysis of Discrete Time Signals and Systems** | **Hrs.** |
| Definition, Properties, Solution of difference equation. Transfer function, Poles and Zeroes, System analysis using Z-Transform, FIR, IIR systems. | **6** |

**Module wise Measurable Students Learning Outcomes :**

After the completion of the course the student will be able to:

1. Describe principles of continuous time and discrete-time signals and systems.
2. Analyze response of linear continuous-time and discrete-time systems.
3. Describe frequency-domain analysis of linear continuous time systems.
4. Analyze the response of continuous-time systems using Laplace transforms.
5. Describe time-domain and frequency-domain analysis of linear discrete systems.
6. Analyze the response of discrete-time systems using Z transforms.

# Professional Core (Lab) Courses

| **Title of the Course: AC Machines Lab**<br>**Course Code: 5EL 272** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:** Basic Electrical Engineering, DC Machines & Transformers

**Textbooks:**

1. M. G. Say. *"Performance Design of AC Machines",* CBS Publishers, 3rd Edition.
2. O. E. Taylor, *"Performance Design of AC commutator motors",* Wheeler Publisher, 15th Reprint.

**References:**

1. J. Chapman, "Electrical Machine", 3/E, S McGraw Hill.
2. J. B. Gupta, *"Electrical Machines"*, SK Kataria and Sons, New Delhi.
3. Fitzerald and Kingsley, *"Electric Machine"*, Tata McGraw Hill.

**Course Objectives:**

1. This course intends to demonstrate performance operation of synchronous and asynchronous machines.
2. It intends to develop skills to analyze operation and performance of asynchronous and synchronous machines.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Demonstrate** experiment to verify electrical characteristics and performance of induction and synchronous machines. | 3 | Applying |
| **CO2** | **Analyze** performance of induction motors and synchronous machines. | 4 | Analyzing |
| **CO3** | **Estimate** appropriate ratings and develop circuit connections for an experiment as a group activity. | 4 | Analyzing |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | 2 | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | | | | | | | | | | | | | | 1 |

**Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

List of Experiments

1. No load and Blocked rotor test on induction motor and performance of I.M. from circle diagram
2. Study of A.C. Machines parts.
3. Study of Induction motor starters.
4. Speed control of Induction Motor
5. Parameter calculation of single phase induction motor from No load and Blocked rotor test
6. Determination of voltage regulation of alternator using Synchronous Impedance method.
7. Determination of voltage regulation of alternator using MMF method
8. Determination of voltage regulation of alternator using Zero power factor method.
9. Synchronization of alternator with bus bar
10. Parallel operation of alternator.
11. V-Curves of Synchronous motor.
12. Study of starting method of synchronous motor.

| **Title of the Course: Electrical Transmission and Distribution Lab**<br>**Course Code: 5EL 273** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:** Electrical Circuits, DC Machines and Transformers

**Textbooks:**

1. Glover, Sharma, Overbye *Power Systems Analysis and Design*, Thompson, 5th Ed., 2012.
2. Ashfaq Husain, *Electrical Power Systems*, CBS, 5th Edition, 2007.

**References:**

1. Nagrath, Kothari, *Modern Power System Analysis*, TMH, 2nd Edition, 2015.
2. HadiSaadat, *Power System Analysis*, TMH, 1st Edition, 2002.
3. Stevenson W.D., *Elements of Power System Analysis*, TMH, 4th Edition, 2014.

**Course Objectives :**

1. This laboratory course covers basic study of various components/parts of power system, used in practice.
2. It provides hands on skill to conduct simulation studies and analyze the performance of transmission and distribution systems.
3. It lays the foundation for conducting higher level study in power systems.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student will be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Identify** various components of power system and their use. | 4 | Analyzing |
| **CO2** | **Estimate** the performance of transmission and distribution systems using simulations. | 5 | Evaluating |
| **CO3** | **Verify** the voltage control and power factor improvement by performing case studies. | 5 | Evaluating |

**CO-PO Mapping :**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | 3 | | | | | | | | | 3 | |
| **CO2** | | | | | 3 | | | | | | | | 3 | |
| **CO3** | | | | 2 | | | | | | | | | 2 | |

**Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

**Course Contents: 2Hrs for Each Session**

1. Distinguish various symbols used in representation of electrical power system and draw various symbols.
2. Visit to local substation (33KV) for study of various components used in transmission and distribution.
3. Visit to pole mounted substation and study Single Line Diagram of WCE for study of HT and LT distribution system.
4. Development of the MATLAB program for per unit representation of power system quantities.
5. Modelling of transmission line and performance evaluation using MATLAB/MiPower software.
6. Fabrication of scaled model of insulator string and determination of string efficiency and design calculation of transmission towers.
7. Determination of transmission line performance using Transmission Line Simulator (TLS).
8. Calculation of size and rating of capacitor bank for Power Factor Improvement-Case Study.
9. Verification of voltage control by off load transformer tap changing.
10. Examination of economic dispatch using power world/MiPower/MATLAB simulation.

**Computer Usage / Lab Tool:** MATLAB/TLS/Power world/MiPower Simulator

| **Title of the Course: Power Electronics Lab**<br>**Course Code: 5EL 274** | L | T | P | Cr |
|---|---|---|---|---|
| | -- | -- | 2 | 1 |

**Desirable Requisite:** Analog and Digital Circuits

**Textbooks:**

1. M.H.Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 4th Edition, November 2017.
2. P. S. Bhimra, "*Power Electronics",*3rd Edition, Khanna Publishers, 2002.

**References:**

1. B.K. Bose, *"Modern Power Electronics and A.C. Drives",* Prentice Hall of India Pvt. Ltd. Publication, 2002.
2. Mohan, Undel and Robins, *"Power Electronics, Converter Applications and Design*", John Wiley and sons (Asia) Pvt. Ltd., 3rd Edition, 2010.
3. G. K. Dubey and Others *"Thyristorised Power Controller*", New Edge International Publishers, 1st Edition Reprint, 2005.

**Course Objectives:**

1. This course intends to provide the practical knowledge of different power electronics devices.
2. It is aimed to impart skills of working of different power electronic converter through simulation and experimentation.
3. Make the students acquainted with simulation, analysis and design of power electronic converters.

**Course Learning Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | Bloom's Cognitive | |
|---|---|---|---|
| | | level | Descriptor |
| **CO1** | **Demonstrate** experiments on basics of converters such as rectifier, inverter, and Chopper etc. | 3 | Applying |
| **CO2** | **Construct** different types of converters such as rectifier, inverter and Chopper with their control techniques using simulation. | 4 | Analyzing |
| **CO3** | **Measure** the performance of converters such as rectifier, inverter, and Chopper. | 5 | Evaluating |

**CO-PO Mapping:**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | 3 | | | | | 2 | | | | | |
| **CO2** | | | | | 3 | | | | | | | | | |
| **CO3** | | | | 3 | | | | | 2 | | | | | |

**Assessments :**

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

| Assessment | Based on | Conducted by | Conduction and Marks Submission | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 4<br>Submission at the end of Week 5 | 25 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 5 to Week 8<br>Submission at the end of Week 9 | 25 |
| LA3 | Lab activities, attendance, journal | Lab Course Faculty | During Week 10 to Week 14<br>Submission at the end of Week 14 | 25 |
| Lab ESE | Lab Performance and related documentation | Lab Course faculty | During Week 15 to Week 18<br>Submission at the end of Week 18 | 25 |

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

**Course Contents:**

List of Experiments: -

1. Verify the Voltage and current relationship in 3 phase full wave diode bridge rectifier and evaluate the input current harmonic spectrum.
2. Evaluate the load side performance of single phase full wave half control converter.
3. Evaluate the load side performance of single phase full wave full control converter.
4. Evaluate the load side performance of threephase full wave half controlled converter.
5. Evaluate the load side performance of threephase full wave full controlled converter.
6. Develop the firing angle control scheme for single phase full wave, half controlled and full controlled converters.
7. Develop the firing angle control scheme for three phase full wave half controlled converter.
8. Develop the firing angle control scheme for three phase full wave full controlled converter.
9. Evaluate the performance of MOSFET based buck converter.
10. Evaluate the performance of MOSFET based boost converter.
11. Develop the control circuit for single phase PWM Inverter.
12. Develop the control circuit for three phase square wave Inverter.

# This is Last Page