



**Programme Educational Objectives**

<b>I.</b>	<b>Preparation:</b> To prepare students to excel in undergraduate programmes or to succeed in industry/ technical profession through global, rigorous education.
<b>II.</b>	<b>Core Competence:</b> To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
<b>III.</b>	<b>Breadth:</b> To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real-life problems.
<b>IV.</b>	<b>Professionalism:</b> To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context.
<b>V.</b>	<b>Learning Environment:</b> To provide student with an academic environment aware of excellence, leadership, ethical code and guidelines, and the life-long learning needed for a successful professional career.



### Programme Outcomes

<b>a.</b>	An ability to apply knowledge of mathematics, science and engineering.
<b>b.</b>	An ability to design and conduct experiments, as well as to analyze and interpret data.
<b>c.</b>	An ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
<b>d.</b>	An ability to function on multidisciplinary teams.
<b>e.</b>	An ability to identify, formulate, and solve engineering problems.
<b>f.</b>	An understanding of professional and ethical responsibility.
<b>g.</b>	An ability to communicate effectively.
<b>h.</b>	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
<b>i.</b>	A recognition of the need for, and an ability to engage in life-long learning.
<b>j.</b>	A knowledge of contemporary issues.
<b>k.</b>	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.



# **I K Gujral Punjab Technical University**

**Teaching Scheme**

**(3<sup>rd</sup>- 4<sup>th</sup> Semester)**

**for**

**Undergraduate Degree Programme**

**Bachelor of Technology**

**in**

**ELECTRICAL AND INDUSTRIAL  
CONTROL ENGINEERING**

**2023 & onwards**



Semester III [Second year]				Branch: Electrical and Industrial Control Engineering							
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits	
1	BTEIC-301-18	Electrical Circuit Analysis	3	1	0	4	40	60	100	4	
2	BTEIC-302-18	Transducers & Sensors	3	0	0	3	40	60	100	3	
3	BTEIC-303-18	Electrical Machines – I	3	0	0	3	40	60	100	3	
4	BTEIC-304-18	Electromagnetic Fields	3	1	0	4	40	60	100	4	
5	BTXX-XXX-18	Engineering Mechanics	3	1	0	4	40	60	100	4	
6	BTEIC-311-18	Transducers & Sensors Lab	0	0	2	2	30	20	50	1	
7	BTEIC-312-18	Electrical Machines – I Laboratory	0	0	2	2	30	20	50	1	
8	BTMC-XXX-18	Mandatory Course	3	0	0	3	40	60	100	S/US	
9	BMPD-301-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit	
<b>Total</b>			<b>18</b>	<b>4</b>	<b>4</b>	<b>26</b>	<b>350</b>	<b>400</b>	<b>750</b>	<b>20</b>	
Semester IV [Second year]				Branch: Electrical and Industrial Control Engineering							
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits	
1	BTEIC-401-18	Digital Electronics	3	0	0	3	40	60	100	3	
2	BTEIC-402-18	Electrical Machines – II	3	0	0	3	40	60	100	3	
3	BTEIC-403-18	Power Electronics	3	0	0	3	40	60	100	3	
4	BTEIC-404-18	Signals and Systems	3	0	0	3	40	60	100	3	
5	BTAM-302-23	Mathematics-III (Probability & Statistics)	4	1	0	4	30	20	50	4	
6	BTEIC-411-18	Measurements and Instrumentation Lab.	2	0	2	4	30	20	50	3	
7	BTEIC-412-18	Digital Electronics Laboratory	0	0	2	2	30	20	50	1	
8	BTEIC-413-18	Electrical Machines – II Laboratory	0	0	2	2	30	20	50	1	
9	BTEIC-414-18	Power Electronics Laboratory	0	0	2	2	30	20	50	1	
10	BTMC-XXX-18	Mandatory Course	3	0	0	3	40	60	100	S/US	
11	BMPD-401-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non Credit	
<b>Total</b>			<b>21</b>	<b>2</b>	<b>8</b>	<b>30</b>	<b>400</b>	<b>400</b>	<b>800</b>	<b>22</b>	
Students to undertake Six weeks summer industry internship/field training (during vacation).											



**Additional Lectures/Tutorials:** Need based additional lectures/tutorials may be introduced of any course, however, the credits of the course will not change.

<b>BTEIC-521-18</b>	<b>Summer Industry Internship/ Field Training</b>	<b>(Non-Credit)</b>
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Six weeks in an Industry in the area of Electrical and Industrial Control Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended. Performance to be rated as Satisfactory/Un -Satisfactory (S/US). For unsatisfactory the internship to be repeated.

Evaluation scheme (Summer Industry Internship/ Field Training)

<i>Internal (to be evaluated by Industry)</i>	<i>Marks</i>	<i>External* (to be evaluated by Department)</i>	<i>Marks</i>
Attendance	15	Daily Dairy	5
Performance of work/Simulation/Hardware/Project developed	30	Report	10
Report	10	Presentation/Simulation/Project developed	25
Daily Dairy of student	05		
<b>Total</b>	<b>60</b>	<b>Total</b>	<b>40</b>

\*External Examiner not to be called

**Range of credits for honors degree** -Minimum credits as per scheme are required by a student to be eligible to get Under Graduate degree in Electrical and Industrial Control Engineering. A student will be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. These could be acquired through MOOCs and registering in the department.

**Range of Credits and Courses for Major Degree in B. Tech. (Electrical and Industrial Control Engineering) and Minor Degree in B.Tech. (Other Engineering)**

- (i) A student admitted in B. Tech (EE) may opt for Major Degree in B. Tech. (Electrical and Industrial Control Engineering) and Minor Degree in B.Tech. (other Engineering) with effect from 3<sup>rd</sup> semester onwards.
- (ii) The student must clear his/her previous two semesters.
- (iii) The student/candidate will require to clear at least five theory subjects for Minor Degree in B.Tech.
- (iv) The minimum credits for Minor Degree in B. Tech. will be 20 in which the student will have to clear minimum two (2) Core Courses and three (3) Professional Elective (PE) Courses / Core Courses).
- (v) A student is permitted to take maximum two (2) courses per semester pertaining to their Minor Degree in B.Tech.

**Virtual Laboratories:** Students may take at least one virtual laboratory any time before the commencement of the 8<sup>th</sup> Semester.



**Open Elective:** A student of B.Tech. Electrical and Industrial Control may take Courses from the list of Open Electives offered by other Departments or MOOCs Courses of SWAYAM/MOOCs courses approved by the Board of Studies.

**MANDATORY COURSES (Non-Credit Courses)**

<b>Sr. No.</b>	<b>Semester</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hours/Week</b>	<b>Credits</b>
1.	I/II	EVS 102-18	Environmental Studies	3L:0T:0P	Nil
2.	III/IV	BTMC-101-18	Indian Constitution	3L:0T:0P	Nil
3.	III/IV	BTMC-102-18	Essence of Indian Traditional Knowledge	3L:0T:0P	Nil



# **I K Gujral Punjab Technical University**

**Syllabus**

**(3<sup>rd</sup>- 4<sup>th</sup> Semester)**

**for**

**Undergraduate Degree Programme**

**Bachelor of Technology**

**in**

**ELECTRICAL AND INDUSTRIAL  
CONTROL ENGINEERING**

**2018 & onwards**



# SEMESTER: III

## [Second Year]





<b>BTEIC-301-18</b>	<b>Electrical Circuit Analysis</b>	<b>3L:1T:0P</b>	<b>4 credits</b>
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Internal Marks: 40      External Marks: 60      Total Marks: 100

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Apply network theorems for the analysis of electrical circuits.
CO 2	Obtain the transient and steady-state response of electrical circuits.
CO 3	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase). Analyze two port circuit behavior.
CO 4	Synthesize networks and filters.

### Module 1: Basic Network Analysis (8 Hours)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

### Module 2: Electrical circuit and steady state analysis (7 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot convention in coupled circuits, Ideal Transformer. Analysis of electrical circuits using Laplace Transform for standard inputs, transformed network with initial conditions. Frequency response (magnitude and phase plots), series and parallel resonances.

### Module 3: Network functions and two port network (8 Hours)

Driving point impedance and admittance, natural response of a network, transfer impedance and admittance, concept of pole and zeros in a network function, Routh Hurwitz criterion of stability.

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

### Module 4: Network Synthesis and Filters (8 Hours)

Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

Filters: Classification of filters, characteristics impedance and propagation constant of pure reactive network, ladder network, T-section,  $\pi$ -section, terminating half section, pass bands and stop bands, Design of constant-K, m-derived filters.

### Text / References:

1. M. E. Van Valkenburg, "*Network Analysis*", Prentice Hall.
2. D. R. Choudhury, "*Networks and Systems*", New Age International.
3. F. F. Kuo, "*Network Analysis & Synthesis*", Wiley.
4. W. H. Hayt and J. E. Kemmerly, "*Engineering Circuit Analysis*", McGraw Hill Education.
5. C. K. Alexander and M. N. O. Sadiku, "*Electric Circuits*", McGraw Hill Education.



6. M. L. Soni and J.B. Gupta, “A Course in Electrical Circuit Analysis”, Dhanpat Rai & Sons.
7. K. V. V. Murthy and M. S. Kamath, “*Basic Circuit Analysis*”, Jaico Publishers.



<b>BTEIC-302-18</b>	<b>Transducers &amp; Sensors</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO1	Understand the role of sensors and transducers for different real time systems
CO2	Analyse the working principles and operations of different sensors
CO3	To design various projects based on different sensors
CO4	Analyse the need of Automation systems

### Module 1: Introduction (12 hrs)

Introduction to sensors and transducers, Difference in primary and secondary transducers, Active and passive transducers, various transducers and their classifications.

### Module 2: Pressure & Temperature transducers (12 hrs)

Manometers, Elastic transducers, High Pressure transducers, Mcloed Gauge, Pirani-gauge, Ionization gauge, Knudsen Gauge, pressure smart transmitters.

Resistive transducers (Platinum Resistance Thermometer), Thermistor, Thermoelectric sensors, Solid-state Sensors & Pyrometers.

### Module 3: Flow & Level Transducers (12 hrs)

Classification of flow meter, Volume flow Sensors (orifice, Nozzle, Venture, Pitot type) Turbine type, Rotometers, Anemometers, Ultrasonic, Mass flow meters, Positive displacement type flow-meter, Open channel flow measurement, E.M. Flow-meter.

Thermal effect type, Electric methods (Resistive method, Conductance probe method, Inductive level gauging and capacitive method), Ultrasonic method.

### Module 4: Force & Acoustics Transducers (12 hrs)

Force Transducers: load Cell, Hydraulic Load Cell Torque Transducers: Absorption type, transmission Type, Stress Type, Deflection type.

Acoustics sensors: ceramic microphones, capacitor microphones, electric microphones, magnetic microphone, Humidity sensors: Hair hygrometer, electrode hygrometer, moisture sensors.

### Text / References:

1. A. K. Sawhney, “*Electrical & Electronic measurement and Instrumentation*”, Dhanpat Rai & Sons.
2. D. M. Considine, “*Process/Industrial Instruments & Controls*” McGraw Hill.
3. H.S.Kalsi, “*Electronic Instrumentation*”, TMH.



<b>BTEIC-303-18</b>	<b>Electrical Machines-I</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
Internal Marks: 40	External Marks: 60	Total Marks: 100	

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of magnetic circuits.
CO 2	Understand the operation of DC machines.
CO 3	Analyse the differences in operation of different DC machine configurations.
CO 4	Analyse single phase and three phase transformers circuits.

### Module 1: Magnetic fields and magnetic circuits (6 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

### Module 2: DC machines (10 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

### Module 3: DC machine - motoring and generation (10 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed.  $V-I$  characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

### Module 4: Transformers (14 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.



**Text / References:**

1. A. E. Fitzgerald and C. Kingsley, “*Electric Machinery*”, McGraw Hill Education.
2. A. E. Clayton and N. N. Hancock, “*Performance and design of DC machines*”, CBS Publishers.
3. S. Chapman, “*Electric Machinery Fundamentals*”, McGraw-Hill Education.
4. M. G. Say, “*Performance and design of AC machines*”, CBS Publishers.
5. S. Ghosh, “*Electrical Machines*”, Pearson Education India.
6. A. Hussian, “*Electrical Machines*”, Dhanpat Rai & Company.
7. P. S. Bimbhra, “*Electrical Machinery*”, Khanna Publishers.
8. I. J. Nagrath and D. P. Kothari, “*Electric Machines*”, McGraw Hill Education.
9. B. S. Guru and H. R. Hiziroglu, “*Electrical Machinery and Transformers*”, Oxford University Press.



<b>BTEIC-304-18</b>	<b>Electromagnetic Fields</b>	<b>3L:1T:0P</b>	<b>4 credits</b>
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Internal Marks: 40      External Marks: 60      Total Marks: 100

### Course Outcomes:

At the end of the course, students will demonstrate the ability:

CO 1	To understand the basic laws of electromagnetism.
CO 2	To obtain the electric and magnetic fields for simple configurations under static conditions.
CO 3	To analyse time varying electric and magnetic fields.
CO 4	To understand Maxwell's equation in different forms and different media.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

### Module 1: Review of Vector Calculus (8 hours)

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

### Module 2: Static Electric Field (9 Hours)

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

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

### Module 3: Magnetic Forces, and Inductance (6 Hours)

Biot-Savart's law, Ampere's law of force, Ampere's circuital law, Faraday's law, Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, calculations of inductances and mutual inductances for a solenoid and toroid.

### Module 4: Maxwell's Equations in Time Varying Fields and Wave theory (10 Hours)

Concept of displacement current and conduction current, Maxwell's equation-differential and integral form, Poynting's theorem, its significance and Poynting's vector, Boundary Conditions.

Wave theory: Derivation of wave equation, uniform plane waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Attenuation, phase and propagation constant, intrinsic impedance, Relation between E & H, wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect.

### Text / References:



1. M. N. O. Sadiku, “*Elements of Electromagnetics*”, Oxford University Publication.
2. A. Pramanik, “*Electromagnetism - Theory and applications*”, Prentice Hall India.
3. A. Pramanik, “*Electromagnetism-Problems with solution*”, Prentice Hall India, 2012.
4. G. W. Carter, “*The Electromagnetic Field in its Engineering Aspects*”, Longmans.
5. W. J. Duffin, “*Electricity and Magnetism*”, McGraw Hill.
6. W. J. Duffin, “*Advanced Electricity and Magnetism*”, McGraw Hill.
7. E. G. Cullwick, “*The Fundamentals of Electromagnetism*”, Cambridge University Press.
8. B. D. Popovic, “*Introductory Engineering Electromagnetics*”, Addison-Wesley Educational Publishers.
9. W. H. Hatt, J. A. Buck, “*Engineering Electromagnetics*”, McGraw Hill Education.



<b>BTXX-XXX-18</b>	<b>Engineering Mechanics</b>	<b>3L:1T:0P</b>	<b>4 credits</b>
Internal Marks: 40	External Marks: 60	Total Marks: 100	

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of co-ordinate systems.
CO 2	Analyse the three-dimensional motion.
CO 3	Understand the concepts of rigid bodies.
CO 4	Analyse the free-body diagrams of different arrangements.
CO 5	Analyse torsional motion and bending moment.

### Module 1: Introduction to vectors and tensors and co-ordinate systems (5 hours)

Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

### Module 2: Three-dimensional Rotation (4 hours)

Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

### Module 3: Kinematics of Rigid Body (6 hours)

Kinematics of rigid bodies: Definition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

### Module 4: Kinetics of Rigid Bodies (5 hours)

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Definition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

### Module 5: Free Body Diagram (1 hour)

Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

### Module 6: General Motion (9 hours)

Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

### Module 7: Bending Moment (5 hours)

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

### Module 8: Torsional Motion (2 hours)

Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.





**Module 9: Friction (3 hours)**

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

**Text / References:**

1. J. L. Meriam, L. G. Kraige and J. N. Bolton, “*Engineering Mechanics: Dynamics*”, Wiley.
2. M. F. Beatty, “*Principles of Engineering Mechanics*”, Springer Science & Business Media.
3. R. S. Khurmi, “*A Textbook of Engineering Mechanics*”, S. Chand.



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<b>BTEIC-311-18</b>	<b>Transducers &amp; Sensors Lab</b>	<b>0L:0T:2P</b>	<b>1 Credit</b>
Internal Marks: 30	External Marks: 20	Total Marks: 50	

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the use and importance of various types of sensors and transducers used in the laboratory.
CO 2	Ability to calibrate the requisite sensor and transducer as per application.
CO 3	Analyze, take measurements to understand circuit behavior and performance under different conditions.
CO 4	Troubleshoot, design and create electronic circuits meant for different applications.

**Hands-on experiments related to the course contents of BTEIC-302-18**

Note: A student to perform any 8-10 experiments and make one minor working model project.

**Suggested List of Experiments:**

1. To calibrate and analyse Performance of LVDT.
2. To measure temperature with different range temperature transducers.
3. To verify seeback effect by using a temperature transducer
4. To measure unknown resistance by using RTD & Thermistors.
5. Design & Performance of Instrumentation amplifiers and Active filters
6. Design & Performance of Strain Gauge
7. To analyse the performance of pressure transducers
8. To study P, PI and PID Controllers.
9. Design & Performance of Microprocessor/Micro-controller based system.
10. Design & Performance of PC-based systems.



<b>BTEIC-312-18</b>	<b>Electrical Machines – I Laboratory</b>	<b>0L:0T:2P</b>	<b>1 Credit</b>
Internal Marks: 30	External Marks: 20	Total Marks: 50	

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Analyze three-phase transformer/system connections.
CO 2	Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer.
CO 3	Analyze parallel operation of transformers.
CO 4	Analyze performance characteristics of DC generators.

### Hands-on experiments related to the course contents of BTEIC-303-18

Note: A student to perform any 8-10 Experiments and make one minor working model project.

### Suggested List of Experiments:

1. To perform the load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence draw the equivalent circuit, calculate the voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of a three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of DC machine and to draw sketches of different components.
8. To measure armature and field resistance of DC shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of DC shunt/series/compound generator.
10. To draw speed-torque and torque-speed characteristics of DC shunt/series /compound generator.
11. To study the three point and four point DC motor starters.
12. To perform Swinburne's test (no load test) to determine various losses of DC shunt motor.
13. To visualize the magnetic fields produced by a bar magnet and a current carrying coil using FEMM/ ANSYS Maxwell.
14. To visualize the magnetic field produced in an electrical machine using FEMM/ ANSYS Maxwell.



# SEMESTER: IV

## [Second Year]



<b>BTEIC-401-18</b>	<b>Digital Electronics</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
Internal Marks: 40	External Marks: 60	Total Marks: 100	

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Understand working of logic families and logic gates.
<b>CO 2</b>	Design and implement Combinational and Sequential logic circuits.
<b>CO 3</b>	Understand the process of Analog to Digital conversion and Digital to Analog conversion.
<b>CO 4</b>	Be able to understand memories.

### Module 1: Fundamentals of Digital Systems and logic families (8 Hours)

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

### Module 2: Combinational Digital Circuits (8 Hours)

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

### Module 3: Sequential circuits and systems (8 Hours)

A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K- T and D- types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

### Module 4: A/D and D/A Converters (8 Hours)

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

### Text/References:

1. R. P. Jain, "*Modern Digital Electronics*", McGraw Hill Education.
2. J. W. Bignell and R. Donovan, "*Digital Electronics*," Delmar Publishers.
3. M.M. Morris, "*Digital Design*", Pearson Education
4. A. Kumar, "*Fundamentals of Digital Circuits*", Prentice Hall India.
5. T. J. Tronald, "*Digital Systems-Principles and Applications*", Prentice Hall of India.



<b>BTEIC-402-18</b>	<b>Electrical Machines – II</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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Internal Marks: 40      External Marks: 60      Total Marks: 100

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Understand the concepts of rotating magnetic fields.
<b>CO 2</b>	Understand the operation of AC machines.
<b>CO 3</b>	Analyse performance characteristics of AC machines.
<b>CO 4</b>	To understand the difference between the synchronous machines and asynchronous machines

**Module 1: Fundamentals of AC machine windings (8 Hours)**

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

**Module 2: Pulsating and revolving magnetic fields (8 Hours)**

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

**Module 3: Induction Machines (8 Hours)**

Concept of rotating magnetic field, Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and maximum torque, power flow diagram, Equivalent circuit. Phasor diagram, Losses and efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-fed induction machines.

Single phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

**Module 4: Synchronous machines (8 Hours)**

Constructional features, cylindrical rotor and salient pole synchronous machine - generated EMF, coil span and distribution factor, equivalent circuit and phasor diagram, armature reaction at different power factor loads, voltage regulation by synchronous impedance and zero power factor method, concept of short circuit ratio, Operating characteristics of synchronous machines, V-curves and inverter-V curves. Hunting. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

**Text/References:**

1. A. E. Fitzgerald and C. Kingsley, “*Electric Machinery*”, McGraw Hill Education.
2. M. G. Say, “*Performance and Design of AC machines*”, CBS Publishers.
3. P. S. Bimbhra, “*Electrical Machinery*”, Khanna Publishers.
4. S. Ghosh, “*Electrical Machines*”, Pearson Education India.
5. I. J. Nagrath and D. P. Kothari, “*Electric Machines*”, McGraw Hill Education.
6. P. C. Sen, “*Principles of Electric Machines and Power Electronics*”, John Wiley & Sons.



7. C. I. Hubert, “*Electric Machines: Theory, Operation, Applications, Adjustment, and Control*,” Pearson Education India.



<b>BTEIC-403-18</b>	<b>Power Electronics</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
Internal Marks: 40	External Marks: 60	Total Marks: 100	

### Course Outcomes:

At the end of this course students will demonstrate the ability to:

<b>CO 1</b>	Understand the differences between signal level and power level devices.
<b>CO 2</b>	Analyse controlled rectifier circuits.
<b>CO 3</b>	Analyse the operation of DC-DC choppers.
<b>CO 4</b>	Analyse the operation of voltage source inverters.

### Module 1: Power switching devices (6 Hours)

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

### Module 2: Thyristor rectifiers (6 Hours)

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

### Module 3: DC-DC buck converter (10 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. DC-DC boost converter: Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

### Module 4: Single-phase voltage source inverter (10 Hours)

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

### Text/References:

1. M. H. Rashid, “*Power Electronics: circuits, devices, and applications*”, Pearson Education India.
2. N. Mohan, T. M. Undeland and W. P. Robbins, “*Power Electronics: Converters, Applications and Design*”, Wiley India.
3. R. W. Erickson and D. Maksimovic, “*Fundamentals of Power Electronics*”, Springer Science & Business Media.
4. J. Vithyathil, “*Power Electronics*,” McGraw-Hill.
5. L. Umanand, “*Power Electronics: Essentials and Applications*”, Wiley India.
6. B. K. Bose, “*Modern Power Electronics and AC Drives*,” Pearson Education.





<b>BTEIC-404-18</b>	<b>Signals and Systems</b>	<b>3L:0T:0P</b>	<b>3 credits</b>
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Internal Marks: 40    External Marks: 60    Total Marks: 100

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Understand the concepts of continuous time and discrete time systems.
<b>CO 2</b>	Analyse systems in complex frequency domain.
<b>CO 3</b>	Understand sampling theorem and its implications.
<b>CO 4</b>	Understand mathematical tools to be able to apply in state variable modeling

### Module 1: Introduction to Signals and Systems (8 hours):

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

### Module 2: Behavior of continuous and discrete-time LTI systems (8 hours)

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

### Module 3: Fourier, Laplace and z- Transforms (8 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

### Module 4: Sampling and Reconstruction (8 hours)

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

### Text/References:

1. A. V. Oppenheim, A.S. Willsky & H. Nawab, “*Signals and Systems*”, Prentice Hall India.
2. G. Proakis and D. G. Manolakis, “*Digital Signal Processing: Principles, Algorithms, and Applications*”, Pearson.
3. H. Hsu, “*Signals and Systems*”, McGraw Hill Education.
4. S. Haykin and B. V. Veen, “*Signals and Systems*”, John Wiley and Sons.
5. A. V. Oppenheim and R. W. Schaffer, “*Discrete-Time Signal Processing*”, Prentice Hall.
6. M. J. Robert “*Fundamentals of Signals and Systems*”, McGraw Hill Education.
7. P. Lathi, “*Linear Systems and Signals*”, Oxford University Press.



<b>BTAM 302-23</b>	<b>Mathematics-III (Probability and Statistics)</b>	<b>L-4,P-1,T-0</b>	<b>4 Credits</b>
Internal Marks: 40    External Marks: 60    Total Marks: 100			
<b>Pre-requisite:</b> Intermediate Calculus and Basic algebra			
<b>Course Objectives:</b> The objective of this course is to familiarize the students with fundamental concepts of theory of probability and statistics. The major focus of the course will be on a systematic mathematical treatment of these concepts and their applications.			
<b>Course Outcomes:</b> At the end of the course, the student will be able to			
<b>CO1</b>	Analyze given data using measures of central tendency, skewness and kurtosis.		
<b>CO2</b>	Understand and deal with randomness occurring in real world phenomena.		
<b>CO3</b>	Apply theoretical discrete and continuous probability distributions to deal with real world problems.		
<b>CO4</b>	Analyze given data using the concepts of correlation and regression and fitting of curves.		
<b>CO5</b>	Analyze hypothesis based on small and large samples using different tests of significance.		

**Detailed Content:**

**Unit I**

Measures of Central tendency: Moments, skewness and Kurtosis, Random experiment, Probability axioms, Definition of Probability, conditional probability, Discrete and Continuous random variables, Expectation of Discrete and Continuous random variables.

**Unit II**

Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, Evaluation of statistical parameters for these three distributions, Bivariate distributions and their properties.

**Unit III**

Correlation and regression for bivariate data, Rank correlation. Curve fitting by the method of least squares, fitting of straight lines, second degree parabolas and more general curves.

**Unit IV**

Test of significances: Sampling and standard error, Tests of significance for large samples and small samples (t-distribution, F-distribution), Chi-square test for goodness of fit and independence of attributes.

**Recommended Books:**

1. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, 33<sup>rd</sup> Edition, 2005.
2. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
3. S. Ross, A First Course in Probability, 6<sup>th</sup> Edition, Pearson Education India, 2002.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. Robert V. Hogg, Joseph W. Mckean and Allen T. Craig, Introduction to Mathematical Statistics, 7<sup>th</sup> Edition, Pearson, 2012.



<b>BTEIC-411-18</b>	<b>Measurements and Instrumentation Laboratory</b>	<b>2L:0T:2P</b>	<b>3 credits</b>
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Internal Marks: 30 External Marks: 20 Total Marks: 50

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Design and validate DC and AC bridges.
<b>CO 2</b>	Analyze the dynamic response and the calibration of few instruments.
<b>CO 3</b>	Learn about various measurement devices, their characteristics, their operation and their limitations.
<b>CO 4</b>	Understand statistical & computerized data analysis.

**Lectures/Demonstrations:**

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation,  $C_p$ ,  $C_{pk}$ .
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

**Experiments**

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.
10. Measurement of frequency using Wein's Bridge.
11. To find 'Q' of an inductance coil and verify its value using Q- meter.
12. Plotting of Hysteresis loop for a magnetic material using flux meter.

Note: A student to perform any 8-10 Experiments and make one minor working model project.



<b>BTEIC-412-18</b>	<b>Digital Electronics Laboratory</b>	<b>0L:0T:2P</b>	<b>1 Credit</b>
Internal Marks: 30    External Marks: 20    Total Marks: 50			

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	To understand of basic electronic components and circuits
<b>CO 2</b>	Understanding verify truth tables of TTL gates
<b>CO 3</b>	Design and fabrication and realization of all gates and basic circuits
<b>CO 4</b>	Design the truth tables and basic circuits

### Hands-on experiments related to the course contents of BTEIC-401-18

Note: A student to perform any 8-10 Experiments and make one working minor project.

### Suggested List of Experiments:

1. Design a delay circuit using 555 timer and study the monostable, bistable and astable operations using 555.
2. a) Verification of the truth tables of TTL gates viz;  
7400,7402, 7404, 7408,7432,7486.  
b) Design and fabrication and realization of all gates using NAND/NOR gates.
3. Verification of truth table of Mutiplexer(74150)/Demultiplexer(74154)
4. Design and verification of truth tables of half-adder, full-adder and subtractor circuits using gates 7483 and 7486(controlled inverter).
5. To study the operation of Arithmetic Logic Unit IC 74181.
6. Design fabrication and testing of
  - a) Monostable multivibrator of  $t = 0.1\text{ms}$  approx. using 74121/123.testing for both positive and negative edge triggering, variation in pulse width and retriggering.
  - b) Free running mutivibrator at 1KHz and 1Hz using 555 with 50% duty cycle. Verify the timing from theoretical calculations.
7. Design and test S-R flip-flop using NOR/NAND gates.
8. Design, fabricate and test a switch debouncer using 7400.
9. Verify the truth table of a JK flip flop using IC 7476,
10. Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
11. Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LED's.
12. Verify the truth table of decoder driver7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock. Repeat the above with the BCD to Decimal decoder 7442.



<b>BTEIC-413-18</b>	<b>Electrical Machines-II Laboratory</b>	<b>0L:0T:2P</b>	<b>1 Credit</b>
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Internal Marks: 30    External Marks: 20    Total Marks: 50

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Construct equivalent circuits induction motors by routine tests.
<b>CO 2</b>	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
<b>CO 3</b>	Construct equivalent circuits of synchronous generator and motor.
<b>CO 4</b>	Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.

### Hands-on experiments related to the course contents of BTEIC-401-18

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

### Suggested List of Experiments:

- To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
  - To perform no-load and blocked-rotor tests on three-phase Induction motor to obtain equivalent circuit.
  - To develop an algorithm (Matlab/C/C++) for speed torque characteristics using calculated equivalent circuit parameters.
- To study the speed control of three-phase Induction motor by Kramer's Concept.
- To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
- To study star- delta starters physically and
  - to draw electrical connection diagram
  - to start the three-phase Induction motor using it.
  - to reverse the direction of three-phase Induction motor
- To start a three-phase slip -ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque -speed characteristics.
- To perform no-load and blocked-rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory.
- To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
- To find voltage regulation of an alternator by zero power factor (ZPF.) method.
- To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
- Parallel operation of three phase alternators using
  - Dark lamp method
  - Two-Bright and one dark lamp method
- To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
- Starting of synchronous motors using:
  - Auxiliary motor
  - Using Damper windings



<b>BTEIC-414-18</b>	<b>Power Electronics Laboratory</b>	<b>0L:0T:2P</b>	<b>1 Credit</b>
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Internal Marks: 30    External Marks: 20    Total Marks: 50

### Course Outcomes:

At the end of this course, students will demonstrate the ability to:

<b>CO 1</b>	Understand the properties and characteristics of thyristors.
<b>CO 2</b>	Understand the different types of waveforms of inverter and chopper circuits.
<b>CO 3</b>	Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
<b>CO 4</b>	Understand the effect of free-wheeling diode on pf with RL load.

### Hands-on experiments related to the course contents of BTEIC-401-18

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

### Suggested List of Experiments:

1. To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
3. To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
4. Study of the microprocessor-based firing control of a bridge converter.
5. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6. To study Jones chopper or any chopper circuit to check the performance.
7. Thyristorised speed control of a D.C. Motor.
8. Speed Control of induction motor using thyristors.
9. Study of series inverter circuit and to check its performance.
10. Study of a single-phase cycloconverter.
11. To check the performance of a McMurray half-bridge inverter.



<b>BTEIC-521-18</b>	<b>Summer Industry Internship/ Field Training</b>	<b>(Non-Credit)</b>
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Six weeks in an Industry in the area of Electrical and Industrial Control Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended. Performance to be rated as Satisfactory/Un -Satisfactory (S/US). For unsatisfactory the internship to be repeated.

Evaluation scheme (Summer Industry Internship/ Field Training)

<i>Internal (to be evaluated by Industry)</i>	<i>Marks</i>	<i>External* (to be evaluated by Department)</i>	<i>Marks</i>
Attendance	15	Daily Dairy	5
Performance (Work done /simulation/hardware/project developed)	30	Report	10
Report	10	Presentation (Work done /simulation/hardware/project developed)	25
Daily Dairy	05		
<b>Total</b>	<b>60</b>	<b>Total</b>	<b>40</b>

\*External examiner not to be called.



# **Mandatory Courses (non-credit)**





<b>BTMC-101-18</b>	<b>Indian Constitution</b>	<b>3L:0T:0P</b>	<b>0 credits</b>
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*Internal Marks: 40      External Marks: 60      Total Marks: 100*

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own

ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

#### **Course content**

- 1 Meaning of the constitution law and constitutionalism
- 2 Historical perspective of the Constitution of India
- 3 Salient features and characteristics of the Constitution of India
- 4 Scheme of the fundamental rights
- 5 The scheme of the Fundamental Duties and its legal status
- 6 The Directive Principles of State Policy – Its importance and implementation
- 7 Federal structure and distribution of legislative and financial powers between the Union and the States
- 8 Parliamentary Form of Government in India – The constitution powers and status of the President of India
- 9 Amendment of the Constitutional Powers and Procedure



- 10 The historical perspectives of the constitutional amendments in India
- 11 Emergency Provisions : National Emergency, President Rule, Financial Emergency
- 12 Local Self Government – Constitutional Scheme in India
- 13 Scheme of the Fundamental Right to Equality
- 14 Scheme of the Fundamental Right to certain Freedom under Article 19
- 15 Scope of the Right to Life and Personal Liberty under Article 21

**Objectives:** The objective of the course is to provide the basic knowledge about the Political System of the Country. The basic idea is to make the students aware of their duties and rights. Apart from it the course will aim to educate the pupils about the working of different organs of the government, various constitutional bodies and the agencies of the government. In addition to it, students will be given brief knowledge regarding the different challenges of Indian Political System, forms of Government in India and nature & dimensions of Indian Federal System.

**Course Pedagogy:** Since the course is of Practical Importance, it is recommended that during the course students will be taken out for one visit to any place with the potential of imparting practical knowledge to the students about the Indian Political System. Such places can be Indian Parliament, State Legislative Assembly, Youth Parliament Pune. It is expected that students should be given case studies about the Indian Political System and Debates on Constitutional Issues should be organised in the campus.

**Course Outcome:** After the successful completion of the course students will be to understand the different dimensions of Indian Political System. They will be aware about their duties towards the fellow citizens. Students will be able to challenges of the democratic institutions and theoretical aspects of the state and its organs.

**Suggested Reading:**

1. Indian Political System by J C Johri
2. Indian Political System by Mahendra Prasad Singh
3. Fundamentals of Indian Political System by Rajesh K Jha
4. Our Constitution by Subhash C Kashyap
5. Our Political System by Subhash C Kashyap
6. Indian Federalism – An Introduction by Mahendra Prasad Singh
7. Indian Federalism and Autonomy by S Chandrasekhar



<b>BTMC-102-18</b>	<b>Essence of Indian Traditional Knowledge</b>	<b>3L:0T:0P</b>	<b>0 credits</b>
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*Internal Marks: 40 External Marks: 60 Total Marks: 100*

### **Part-1**

#### **Course objective**

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-1 focuses on introduction to Indian Knowledge System. Indian perspective of modern scientific world -view and basis principal of Yoga and holistic health care system.

#### **Course contents**

- i. Basic Structure of Indian Knowledge system
- ii. Modern Science and Indian Knowledge system
- iii. Yoga and Holistic Health Care
- iv. Case studies

#### **References**

- Fritzo Capra Too of Physics
- Fritzo Capra The Wave of life
- Yoga Sutra of Patanjali. Ramakrishna Mission. Kolkata.
- RN Jha Science of Consciousness Psychotherapy and Yoga Practices. Vidyanidhi Prakashan. Delhi2016
- PB Sharma (English translation) ShodashangHridayam

**Pedagogy:** Problem based learning, group discussion, collaborative mini projects

**Outcome:** Ability to understand connect up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

### **Part-2**

#### **Course objective**

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-2 focuses on Indian philosophical traditions. Indian linguistic Tradition, and Indian artistic tradition.

#### **Course contents**

- i. Philosophical Tradition
- ii. Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- iii. Indian Artistic Tradition
- iv. Case studies

#### **References**

- V.Sivaramakrishnan (Ed.), Cultural Heritage of India-Course material, Bhartiya Vaidya Bhawan Mumbai 5<sup>th</sup> Edition 2014
- S.C Chaterjee &D.M .Datta , An introduction to Indian Philosophy ,University of Calcutta 1984



- KS Subrahmanialyer ,Vakyapadiya of Bhattaraihari (Brahma Kanda), Deccan College Pune 1965
- VN Jha, Language Thought and Reality
- Pramod Chandra. India Arts Howard Univ. Press 1983
- Krishna Chaitanya Arts of India. Abhinav Publications. 1987
- R Nagaswamy , Foundations of Indian Art Tamil Arts Academy.2002

**Pedagogy:** Problem based learning, group discussion, collaborative mini projects

**Outcome:** Ability to understand connects up and explain basics of Indian traditional Knowledge in Modern scientific perspective.



# **I K Gujral Punjab Technical University**

**Teaching Scheme**

**(5<sup>th</sup> - 8<sup>th</sup> Semester)**

**for**

**Undergraduate Degree Programme**

**Bachelor of Technology**

**in**

**ELECTRICAL AND INDUSTRIAL  
CONTROL ENGINEERING**

**2018 & onwards**



Students to undertake six weeks summer industry internship (during vacation).

Semester V [Third year]			Branch: Electrical and Industrial Control Engineering								
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits	
1	BTEIC-501-18	Process Control	3	0	0	3	40	60	100	3	
2	BTEIC-502-18	Control Systems	3	0	0	3	40	60	100	3	
3	BTEIC-503-18	Microprocessors	3	0	0	3	40	60	100	3	
4	BTEIC-504X-18	Programme Elective-1	3	0	0	3	40	60	100	3	
5	BTOE-XXX-18	Open Elective-1	3	0	0	3	40	60	100	3	
6	BTXX-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3	
7	BTEIC-511-18	Process control Laboratory	0	0	2	2	30	20	50	1	
8	BTEIC-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1	
9	BTEIC-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1	
10	BTEIC-521-18	Summer Industry Internship	-	-	-	-	40	60	100	S/US	
11	BMPD-501-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit	
<b>Total</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>25</b>	<b>420</b>	<b>480</b>	<b>900</b>	<b>21</b>	

Semester VI [Third year]			Branch: Electrical and Industrial Control Engineering								
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits	
1	BTEIC-601-18	Fundamentals of Power Systems	3	0	0	3	40	60	100	3	
2	BTEIC-602X-18	Programme Elective-2	3	0	0	3	40	60	100	3	
3	BTEIC-603X-18	Programme Elective-3	3	0	0	3	40	60	100	3	
4	BTEIC-604-18	Microcontroller and PLC	3	0	0	3	40	60	100	3	
5	BTOE-XXX-18	Open Elective-2	3	0	0	3	40	60	100	3	
6	BTXX-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3	
7	BTEIC-611-18	Electronic Design Laboratory	1	0	4	5	30	20	50	3	
8	BTEIC-612-18	Power Systems Laboratory	0	0	2	2	30	20	50	1	
9	BTEIC-613-18	Microcontroller and PLC Laboratory	0	0	2	2	30	20	50	1	
9	BMPD-	Mentoring and Professional	0	1	0	1	50	-	50	Non-	



601-18	Development of Students									credit
<b>Total</b>			<b>19</b>	<b>1</b>	<b>8</b>	<b>28</b>	<b>380</b>	<b>420</b>	<b>800</b>	<b>23</b>
<b>Semester VII [Fourth year]</b>			<b>Branch: Electrical and Industrial Control Engineering</b>							
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits
1	BTEIC-701X-18	Programme Elective-4	3	0	0	3	40	60	100	3
2	BTEIC-702X-18	Programme Elective-5	3	0	0	3	40	60	100	3
3	BTOE-XXX-18	Open Elective-3	3	0	0	3	40	60	100	3
4	BTOE-XXX-18	Open Elective-4	3	0	0	3	40	60	100	3
5	BTXX-XXX-18	Humanities & Social Sciences including Management	3	0	0	3	40	60	100	3
6	BTEIC-703-18	Project Stage-I	0	0	6	6	60	40	100	3
7	BTEIC-721	Seminar	0	0	0	2	100	-	100	1
8	BMPD-701-18	Mentoring and Professional Development of Students		1	0	1	50	-	50	Non-credit
<b>Total</b>			<b>15</b>	<b>1</b>	<b>6</b>	<b>24</b>	<b>410</b>	<b>340</b>	<b>750</b>	<b>19</b>

<b>Semester VIII [Fourth year]</b>			<b>Branch: Electrical and Industrial Control Engineering</b>							
Sr. No.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits
1	BTEIC-801X-18	Programme Elective-6	3	0	0	3	40	60	100	3
2	BTOE-XXX-18	Open Elective-5	3	0	0	3	40	60	100	3
3	BTOE-XXX-18	Open Elective-6	3	0	0	3	40	60	100	3
4	BTEIC-802-18	Project Stage-II	0	0	16	16	40	60	100	8
5	BMPD-801-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit
<b>Total</b>			<b>9</b>	<b>1</b>	<b>16</b>	<b>26</b>	<b>210</b>	<b>240</b>	<b>450</b>	<b>17</b>



<b>PROFESSIONAL CORE COURSES [ELECTRICAL AND INDUSTRIAL CONTROL ENGINEERING]</b> <b>(also Core Courses for Minor Degree of B. Tech. (Electrical and Industrial Control Engineering))</b>										
Sem.	Course code	Course Title	L	T	P	Hours/Week	Internal Marks	External Marks	Total Marks	Credits
Odd	BTEIC-301-18	Electrical Circuit Analysis	3	1	0	4	40	60	100	4
Odd	BTEIC-302-18	Transducers & Sensors	3	0	0	3	40	60	100	3
Odd	BTEIC-311-18	Transducers & Sensors Laboratory	0	0	2	2	30	20	50	1
Odd	BTEIC-303-18	Electrical Machines – I	3	0	0	3	40	60	100	3
Odd	BTEIC-312-18	Electrical Machines – I Laboratory	0	0	2	2	30	20	50	1
Odd	BTEIC-304-18	Electromagnetic Fields	3	1	0	4	40	60	100	4
Even	BTEIC-401-18	Digital Electronics	3	0	0	3	40	60	100	3
Even	BTEIC-412-18	Digital Electronics Laboratory	0	0	2	2	30	20	50	1
Even	BTEIC-402-18	Electrical Machines – II	3	0	0	3	40	60	100	3
Even	BTEIC-413-18	Electrical Machines – II Laboratory	0	0	2	2	30	20	50	1
Even	BTEIC-403-18	Power Electronics	3	0	0	3	40	60	100	3
Even	BTEIC-414-18	Power Electronics Laboratory	0	0	2	2	30	20	50	1
Even	BTEIC-404-18	Signals and Systems	3	0	0	3	40	60	100	3
Even	BTEIC-411-18	Measurements and Instrumentation Lab.	2	0	2	4	30	20	50	3
Odd	BTEIC-501-18	Process Control	3	0	0	3	40	60	100	3
Odd	BTEIC-511-18	Process control Laboratory	0	0	2	2	30	20	50	1
Odd	BTEIC-502-18	Control Systems	3	0	0	3	40	60	100	3
Odd	BTEIC-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
Odd	BTEIC-503-18	Microprocessors	3	0	0	3	40	60	100	3
Odd	BTEIC-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
Even	BTEIC-601-18	Fundamentals of Power Systems	3	0	0	3	40	60	100	3
Even	BTEIC-612-18	Power Systems Laboratory	0	0	2	2	30	20	50	1
Even	BTEIC-611-18	Electronic Design Laboratory	1	0	4	5	30	20	50	3
Even	BTEIC-604-18	Microcontroller and PLC	3	0	0	3	40	60	100	3





Even	BTEIC-613-18	Microcontroller and PLC	0	0	2	2	30	20	50	1
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**PROFESSIONAL ELECTIVE (PE) COURSES [ELECTRICAL AND INDUSTRIAL CONTROL ENGINEERING]**

(also Professional Elective Courses for Minor Degree of B. Tech. (Electrical and Industrial Control Engineering))

Sr. No.	Semester	Programme Elective	Course Code	Course Title	Hrs/week	Credits
1.	V (odd)	PE-1	BTEIC-504A-18	Electrical Energy Conservation & Auditing	3L:0T:0P	3
2.	V (odd)	PE-1	BTEIC-504B -18	Electrical Machine Design	3L:0T:0P	3
3.	V (odd)	PE-1	BTEIC-504C -18	Optimisation Techniques	3L:0T:0P	3
4.	V (odd)	PE-1	BTEIC-504D -18	Materials in Electrical and Industrial Control Engineering	3L:0T:0P	3
5.	VI (even)	PE-2	BTEIC-602A-18	Industrial Electrical Systems	3L:0T:0P	3
6.	VI (even)	PE-2	BTEIC-602B-18	Biomedical Instrumentation	2L:0T:2P	3
7.	VI (even)	PE-2	BTEIC-602C-18	Electrical Drives	3L:0T:0P	3
8.	VI (even)	PE-2	BTEIC-602D-18	Electromagnetic Waves	3L:0T:0P	3
9.	VI (even)	PE-3	BTEIC-603A-18	Digital Signal Processing	3L:0T:0P	3
10.	VI (even)	PE-3	BTEIC-603B-18	High Voltage Engineering	3L:0T:0P	3
11.	VI (even)	PE-3	BTEIC-603C-18	Virtual Instrumentation	3L:0T:0P	3
12.	VI (even)	PE-3	BTEIC-603D-18	Artificial Intelligence	3L:0T:0P	3
13.	VII (odd)	PE-4	BTEIC-701A-18	Power System Economics	3L:0T:0P	3
14.	VII (odd)	PE-4	BTEIC-701B-18	Wind and Solar Energy Systems	3L:0T:0P	3
15.	VII (odd)	PE-4	BTEIC-701C-18	Advanced Process control	3L:0T:0P	3
16.	VII (odd)	PE-4	BTEIC-701D-18	Computational Electromagnetics	3L:0T:0P	3
17.	VII (odd)	PE-5	BTEIC-702A-18	Control Systems Design	3L:0T:0P	3



18.	VII (odd)	PE-5	BTEIC-702B-18	Computer Aided Power System Analysis	2L:0T:2P	3
19.	VII (odd)	PE-5	BTEIC-702C-18	Digital Control Systems	3L:0T:0P	3
20.	VII (odd)	PE-5	BTEIC-702D-18	Power Quality and FACTS	3L:0T:0P	3
21.	VIII (even)	PE-6	BTEIC-801A-18	Advanced Electric Drives	3L:0T:0P	3
22.	VIII (even)	PE-6	BTEIC-801B-18	HVDC Transmission Systems	3L:0T:0P	3
23.	VIII (even)	PE-6	BTEIC-801C-18	Power System Dynamics and Control	3L:0T:0P	3
24.	VIII (even)	PE-6	BTEIC-801D-18	Smart Grid	3L:0T:0P	3

**LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS  
OFFERED BY ELECTRICAL AND INDUSTRIAL CONTROL ENGINEERING**

**Prerequisite:** To have passed Basic Electrical and Industrial Control Engineering/Basic Electronics Engineering Course

Sr. No.	Course Code	Semester	Course Title	L	T	P	Hours/Week	Credits
1.	OECEIC-01	Odd	Control Systems	3	0	0	3	3
2.	OECEIC-02	Odd-	Power Electronics	3	0	0	3	3
3.	OECEIC-03	Odd	Electrical Energy Conservation & Auditing	3	0	0	3	3
4.	OECEIC-04	Even	Electric Machines	3	0	0	3	3
5.	OECEIC-05	Even	Industrial Electrical Systems	3	0	0	3	3
6.	OECEIC-06	Even	Wind and Solar Energy Systems	3	0	0	3	3

**HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT**

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits	Semester
1	BTXX-XXX-18	English	2:0:2	3	II
2	BTXX-XXX-18	To be selected by Individual Institutions from the given list of Humanities & Social Sciences including Management	3:0:0	3	V
3	BTXX-XXX-18		3:0:0	3	VI
4	BTXX-XXX-18		3:0:0	3	VII
			Total		12



**List of Humanities & Social Sciences including Management**

<b>Sr. No.</b>	<b>AICTE Course Code</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hours/week</b>	<b>Credits</b>
1.	HSMC (HED-314)	BTXX-XXX-18	Education, Technology and Society	3L:0T:0P	3
2.	HSMC (HHI-305)	BTXX-XXX-18	History of Science and Technology in India	3L:0T:0P	3
3.	HSMC (HVE-310)	BTXX-XXX-18	Values and Ethics	3L:0T:0P	3
4.	HSMC (HSL-317)	BTXX-XXX-18	Introduction to Women's and Gender Studies	3L:0T:0P	3
5.	HSMC (LLG-305)	BTXX-XXX-18	Sanskrit Bhasa	3L:0T:0P	3
6.	HSMC (HPY-306)	BTXX-XXX-18	Human Relations at Work	3L:0T:0P	3
7.	HSMC (MME-303)	BTXX-XXX-18	Law and Engineering	3L:0T:0P	3