Programme Educational Objectives

I.	**Preparation:** To prepare students to excel in undergraduate programmes or to succeed in industry/ technical profession through global, rigorous education.
II.	**Core Competence:** To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
III.	**Breadth:** 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.
IV.	**Professionalism:** 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.
V.	**Learning Environment:** 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

a.	Graduates will demonstrate knowledge of differential equations & partial differential, Fourier series, Fourier transforms, laplace transformation, vector calculus, complex variable, matrix theory, probability theory, physics, chemistry and electrical and electronics engineering, manufacturing practice; basics of thermodynamics, simple machines: mechanism of source.
b.	Graduates will have the ability to identify, formulates and solve electrical engineering problems.
c.	Graduate will have the ability to design electrical circuits and conduct experiments with electrical systems, analyze and interpret data.
d.	Graduates will have the ability to design digital and analog systems and component.
e.	Graduates will have the ability to visualize and work on laboratory and muti-disciplinary tasks.
f.	Graduates will have the ability to use modern engineering tools, software and equipment to analyze problems.
g.	Graduates will have the knowledge of professional and ethical responsibilities.
h.	Graduate will be able to communicate effectively in both verbal and written form.
i.	Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
j.	Graduate will develop confidence for self-education and ability for life-long learning.
k.	Graduate who can participate and succeed in competitive examinations like GATE, GRE, GRE Subject, ES, IES, etc.

IKG Punjab Technical University

Teaching Scheme

(3rd- 4th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

Semester III [Second year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-301-18	Electrical Circuit Analysis	3	1	0	4	40	60	100	4
2	BTEE-302-18	Analog Electronics	3	0	0	3	40	60	100	3
3	BTEE-303-18	Electrical Machines – I	3	0	0	3	40	60	100	3
4	BTEE-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	BTEE-311-18	Analog Electronics Laboratory	0	0	2	2	30	20	50	1
7	BTEE-312-18	Electrical Machines – I Laboratory	0	0	2	2	30	20	50	1
8	BTMC-XXX-18	Mandatory Course (BTMC-101-18 or BTMC 102-18)	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
10	BTEE-321-18	Institutional Summer Vacation Training*	-	-	-	35*	-	-		S/US
		Total	**18**	**4**	**4**	**26**	**350**	**400**	**750**	**20**

Semester IV [Second year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-401-18	Digital Electronics	3	0	0	3	40	60	100	3
2	BTEE-402-18	Electrical Machines – II	3	0	0	3	40	60	100	3
3	BTEE-403-18	Power Electronics	3	0	0	3	40	60	100	3
4	BTEE-404-18	Signals and Systems	3	0	0	3	40	60	100	3
5	BTAM-302-18	Mathematics-III (Probability & Statistics)	3	1	0	4	40	60	100	4
6	BTEE-411-18	Measurements and Instrumentation Lab.	2	0	2	4	30	20	50	3
7	BTEE-412-18	Digital Electronics Laboratory	0	0	2	2	30	20	50	1
8	BTEE-413-18	Electrical Machines – II Laboratory	0	0	2	2	30	20	50	1
9	BTEE-414-18	Power Electronics Laboratory	0	0	2	2	30	20	50	1
10	BTMC-XXX-18	Mandatory Course (BTMC-101-18 or BTMC 102-18)	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
Total			**20**	**2**	**8**	**30**	**410**	**440**	**850**	**22**
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.

BTEE-321-18: Institutional Summer Vacation Training: Four (04) weeks Institutional Summer Vacation Training after 2nd semester for programme. B. Tech. (Electrical Engineering)

Objective: The training is compulsory and is for the orientation of the students of the Electrical Engineering so that they are aware of/can identify the industrial, departmental, environmental, societal and other issues that are a challenge in the society and develop the ability to find solutions. The training in the concerned discipline will be provided in College/Department Labs /Workshops

Content to be covered:

Module I, II & III: Hands on training/ practical knowledge on any three/four of the given contents

Module IV & V: Compulsory

Module	Content	Remarks
I	• Hands on training of wiring (Tube light, Incandescent bulb & LED light fitting, extension board, staircase). • Preparation of wiring diagram for domestic load/commercial load • Study of types of switches, protective devices (samples to be made available) • Types of electrical wires and Cables (samples to be made available) • Classification of Insulation (samples to be made available)	30 hours
II	• Single Line diagram of power generation, transmission distribution • Power scenario in India (Conventional & renewable sources of energy) (recent information from the website of Ministry of power to be included) • Introduction to the concept of Heating, Ventilation and Air conditioning. • The need of industrial safety. • Introduction to electrical machines and their maintenance.	30 hours
III	• Introduction to multimeter, function generator, CRO, • Identification and testing of resistors, capacitors, transistors and diodes, etc. • Observing the response of various circuits on CRO • Design and fabrication of +5V / +12V powers supply on bread board • Design and fabrication of half wave and/or full wave rectifier • Logics gates (using ICs)	30 hours
IV	• Study of main components of a sub-station and visit to local sub Station • Visit to industry/manufacturing unit related to discipline/branch (In case of small-scale industries/MSMEs, the faculty and students to	25 hours

Module	Content	Remarks
	identify small issues and propose requisite solutions/ remedies/ innovative solutions based on engineering) • Invited talk by Industry Expert • Expert talk on recent technologies	
V	• Visit to local NGO/village/city to identify socio-economic/ environmental issues and identify a problem and prepare a "Problem formulation report" • To have a group discussion on the issues identified with faculty and to propose requisite solutions/remedies/innovative solutions based on Engineering.	25 hours
Total Time		140 hours

Evaluation Criterion:

i) Four (04) weeks Institutional Summer Vacation Training after 2nd semester is a compulsory non-Credit course.
ii) The students are required to maintain a daily dairy and submit it along with the "Problem formulation report".
iii) Student falling short of 75% attendance criterion is required to repeat the training with next batch.
iv) Continuous evaluation to be done and proper record to be maintained.
v) The result will be "Satisfactory/Unsatisfactory" which is to be recorded within 3 working days after the completion of the training.

BTEE-521-18	**Summer Industry Internship/ Field Training**	**(Non-Credit)**

Six weeks in an Industry in the area of Electrical Engineering during summer vacations after 4th semester. 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)

Internal ***(to be evaluated by Industry)***	***Marks***	***External**** ***(to be evaluated by Department)***	***Marks***
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		
Total	***60***	***Total***	***40***

*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 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 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 Engineering) and Minor Degree in B.Tech. (other Engineering) with effect from 3rd 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 8th Semester.

Open Elective: A student 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)

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

IK Gujral Punjab Technical University

Syllabus

(3rd- 4th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

SEMESTER: III
[Second Year]

BTEE-301-18	Electrical Circuit Analysis	3L:1T:0P	4 credits

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 (14 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 (14 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 (10 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 (10 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, π-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, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.

5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

BTEE- 302-18	Analog Electronics	3L:0T:0P	3 credits

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 characteristics of transistors.
CO 2	Design and analyse various rectifier and amplifier circuits.
CO 3	Design sinusoidal and non-sinusoidal oscillators.
CO 4	Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode and BJT circuits (12 Hours)

P-N junction diode, *V-I* characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

BJT circuits: Structure and *V-I* characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers.

Module 2: MOSFET circuits (10 Hours)

MOSFET structure and *V-I* characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 3: Differential, multi-stage and operational amplifiers (10 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 4: Linear applications of op-amp (10 Hours)

Idealized analysis of op-amp circuits. Specifications. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, voltage regulator, Oscillators: Principle of operation, Wein's bridge and phase shift oscillator.

Text/References:

1. A. S. Sedra & K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

BTEE-303-18	Electrical Machines-I	3L:0T:0P	3 credits

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 (12 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 (12 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 (12 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", New York, McGraw Hill Education, 2013.

2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

BTEE-304-18	Electromagnetic Fields	3L:1T:0P	4 credits

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.
CO 5	To understand the propagation of EM waves.

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 (15 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 (10 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 (15 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, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

BTXX-XXX-18	**Engineering Mechanics**	**3L:1T:0P**	**4 credits**

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: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between twoand 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: Dentition 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 and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media,1986.

BTEE-311-18	Analog Electronics Laboratory	0L:0T:2P	1 Credit

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 equipments used in the laboratory.
CO 2	Ability to make circuits on bread-board.
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.
CO 5	Evaluate the performance electronic circuits and working small projects employing semiconductor devices.

Hands-on experiments related to the course contents of BTEE302-18

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

Suggested List of Experiments:

1. To draw *V-I* characteristics of a PN junction diode (Ge, Si, switching and signal).
2. To design half wave rectifier.
3. To design full wave and bridge rectifiers.
4. To study the transistor characteristics in common base, common collector, and common emitter configurations.
5. To study the *V-I* characteristics of a MOSFET.
6. To design a voltage regulator IC using zener diode and also see the effect of line and load regulation
7. To design various clippers and clampers using diodes.
8. To obtain the frequency response of an amplifier and calculate the gain bandwidth of the amplifier.
9. To investigate the emitter follower (Buffer) amplifier and determine A_V,R_i, and R_O
10. To design and study various type of oscillators, and determine frequency of oscillations.
11. To design a transistor series voltage regulator with current limits and observe its current feedback characteristics.
12. To study the characteristics of a complementary symmetry amplifier.
13. To study the application of an Op-Amp (741) as inverting and non-inverting amplifier.
14. To use the OP-AMP as summing, scaling and averaging amplifier.
15. Design differentiator and integrator using OP-AMP and also determine the time constant and cut-off frequency.

BTEE-312-18	Electrical Machines – I Laboratory	0L:0T:2P	1 Credit

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 BTEE303-18

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]

BTEE-401-18	Digital Electronics	3L:0T:0P	3 credits

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

Module 1: Fundamentals of Digital Systems and logic families (10 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 lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits (10 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 (12 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 o 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 (10 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, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

BTEE-402-18	Electrical Machines – II	3L:0T:0P	3 credits

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 rotating magnetic fields.
CO 2	Understand the operation of AC machines.
CO 3	Analyse performance characteristics of AC machines.
CO4	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 (12 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 (12 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 (10 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, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

BTEE-403-18	Power Electronics	3L:0T:0P	3 credits

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

Module 1: Power switching devices (8 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 (10 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 (12 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 (12 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, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
5. P. S. Bimbhra, Power Electronics”, Khanna Publishers

BTEE-404-18	Signals and Systems	3L:0T:0P	3 credits

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 continuous time and discrete time systems.
CO 2	Analyse systems in complex frequency domain.
CO 3	Understand sampling theorem and its implications.
CO 4	Understand mathematical tools to be able to apply in state variable modeling

Module 1: Introduction to Signals and Systems (12 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 (12 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 (10 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. V. Oppenheim, A.S. Willsky & S.H. Nawab, “Signals and systems”, Prentice Hall, 1997.
2. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
3. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall,2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.

BTAM302-18	**Mathematics-III (Probability and Statistics)**	**L-3, T-1,P-0**	**4 Credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

Pre-requisite: None

Course Objectives: The objective of this course is to familiarize the student with statistical techniques. It aims to equip he students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Course Outcomes: At the end of the course, the student will be able to

CO1	Have basics knowledge about measure of central tendency, skewness, kurtosis and moments and their applications in engineering fields.
CO2	Familiarize the student with expectations of discrete and continuous random variable.
CO3	Familiarize probability techniques and random variables and detailed knowledge of probability distribution with so as to use it with any date of engineering problem formulation.
CO4	Have basic idea about statistics including correlation, regression and then up to advanced level with testing of large samples that is important in solving problems related to engineering.
CO5	To fit the given data into curves by various methods which forms an important application in engineering .

Section A **(22 lectures)**

Unit I

Measures of Central tendency: Moments, skewness and Kurtosis, Variance, Probability, conditional probability, Discrete and Continuous random variables, Expectations 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 distribution, Bivariate distributions and their properties.

Section B **(20 lectures)**

Unit III

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

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.

Suggestion Text/Reference Books

1. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, 33^{rd} 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^{th} Edition, Pearons Education India, 2002.
4. N.P Bali and Mukesh Goyal, A text book of Engineering Mathematics , Laxmi Publications, Reprint, 2010.
5. Robert V. Hogg, Joseph W. Mekean and Allen T. Craig, Introduction to Mathematics Statistics,7^{th} Edition, Pearsons, 2012.

BTEE-411-18	Measurements and Instrumentation Laboratory	2L:0T:2P	3 credits

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	Design and validate DC and AC bridges.
CO 2	Analyze the dynamic response and the calibration of few instruments.
CO 3	Learn about various measurement devices, their characteristics, their operation and their limitations.
CO 4	Understand statistical data analysis.
CO 5	Understand computerized data acquisition.

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.

BTEE-412-18	Digital Electronics Laboratory	0L:0T:2P	1 Credit

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	To understand of basic electronic components and circuits
CO 2	Understanding verify truth tables of TTL gates
CO 3	Design and fabrication and realization of all gates and basic circuits
CO 4	Design the truth tables and basic circuits
CO 5	Testing of basic electronics circuits

Hands-on experiments related to the course contents of BTEE401-18

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 = 0.1ms 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.

BTEE-413-18	Electrical Machines-II Laboratory	0L:0T:2P	1 Credit

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	Construct equivalent circuits induction motors by routine tests.
CO 2	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
CO 3	Construct equivalent circuits of synchronous generator and motor.
CO 4	Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.
CO 5	Construct characteristic curves for induction and synchronous machines
CO 6	Understand the concept of parallel operation of three phase alternators.

Hands-on experiments related to the course contents of BTEE402-18

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

Suggested List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
   a) To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit.
   b) To develop an algorithm (Matlab/C/C++) for speed torque characteristics using calculated equivalent circuit parameters.
2. To study the speed control of three-phase Induction motor by Kramer's Concept.
3. 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.
4. To study star- delta starters physically and
   a) to draw electrical connection diagram
   b) to start the three-phase Induction motor using it.
   c) to reverse the direction of three-phase Induction motor
5. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque –speed characteristics.
6. 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.
7. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
8. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
9. 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.
10. Parallel operation of three phase alternators using
    (i) Dark lamp method (ii) Two-Bright and one dark lamp method
11. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
12. Starting of synchronous motors using:
    (i) Auxiliary motor (ii) Using Damper windings

BTEE-414-18	Power Electronics Laboratory	0L:0T:2P	1 Credit

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 properties and characteristics of thyristors.
CO 2	Understand the different types of waveforms of inverter and chopper circuits.
CO 3	Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
CO 4	Understand the effect of free-wheeling diode on pf with RL load.
CO 5	Check the performance of a choppers, and inverter.

Hands-on experiments related to the course contents of BTEE403-18

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.

BTEE-521-18	**Summer Industry Internship/ Field Training**	**(Non-Credit)**

Six weeks in an Industry in the area of Electrical 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)

Internal ***(to be evaluated by Industry)***	***Marks***	***External**** ***(to be evaluated by Department)***	***Marks***
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		
Total	***60***	***Total***	***40***

*External examiner not to be called.

Mandatory Courses (non-credit)

BTMC-101-18	Indian Constitution	3L:0T:0P	0 credits

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 nottruly 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 TheDirectivePrinciplesofStatePolicy–Itsimportanceandimplementation
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 Article19
15 ScopeoftheRighttoLifeandPersonalLibertyunderArticle21

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

BTMC-102-18	Essence of Indian Traditional Knowledge	3L:0T:0P	0 credits

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

- Fritzof Capra Too of Physics
- Fritzof 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 5th 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.

IKG Punjab Technical University

Teaching Scheme

(5th - 8th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

Students to undertake Six Weeks Summer Industry Internship (during vacation).

Semester V [Third year]						**Branch: Electrical Engineering**				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-501-18	Power Systems – I (Apparatus & Modelling)	3	0	0	3	40	60	100	3
2	BTEE-502-18	Control Systems	3	0	0	3	40	60	100	3
3	BTEE-503-18	Microprocessors	3	0	0	3	40	60	100	3
4	BTEE-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	BTEE-511-18	Power Systems-I Laboratory	0	0	2	2	30	20	50	1
8	BTEE-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
9	BTEE-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
10	BTEE-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
Total			**18**	**1**	**6**	**25**	**420**	**480**	**900**	**21**

Semester VI [Third year]						**Branch: Electrical Engineering**				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-601-18	Power Systems – II (Operation and Control)	3	0	0	3	40	60	100	3
2	BTEE-602X-18	Programme Elective-2	3	0	0	3	40	60	100	3
3	BTEE-603X-18	Programme Elective-3	3	0	0	3	40	60	100	3
4	BTEE-604-18	Power System Protection	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	BTEE-621-18	Seminar	0	0	2	2	100	-	100	1
8	BTEE-611-18	Electronic Design Laboratory	1	0	4	5	30	20	50	3
9	BTEE-612-18	Power Systems-II Laboratory	0	0	2	2	30	20	50	1
10	BMPD-601-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit

Total			**19**	**1**	**8**	**28**	**450**	**400**	**850**	**23**
Semester VII [Fourth year]			**Branch: Electrical Engineering**							
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-701X-18	Programme Elective-4	3	0	0	3	40	60	100	3
2	BTEE-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	BTEE-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	EVS-102-18	Environmental Studies	3	0	0	3	40	60	100	3
7	BTEE-703-18	Project Stage-I	0	0	6	6	60	40	100	3
8	BMPD-701-18	Mentoring and Professional Development of Students		1	0	1	50	-	50	Non-credit
Total			**18**	**1**	**6**	**25**	**350**	**400**	**750**	**21**

Semester VIII [Fourth year]			**Branch: Electrical Engineering**							
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-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	BTEE-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
Total			**9**	**1**	**16**	**26**	**210**	**240**	**450**	**17**

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

PROFESSIONAL ELECTIVE (PE) COURSES [ELECTRICAL ENGINEERING]
(also Professional Elective Courses for Minor Degree of B. Tech. (Electrical Engineering)

Sr. No.	Semester	Programme Elective	Course Code	Course Title	Hrs/week	Credits
1.	V (odd)	PE-1	BTEE-504A-18	Electrical Energy Conservation & Auditing	3L:0T:0P	3
2.	V (odd)	PE-1	BTEE-504B-18	Electrical Machine Design	3L:0T:0P	3
3.	V (odd)	PE-1	BTEE-504C-18	Optimisation Techniques	3L:0T:0P	3
4.	V (odd)	PE-1	BTEE-504D-18	Materials in Electrical Engineering	3L:0T:0P	3
5.	VI (even)	PE-2	BTEE-602A-18	Industrial Electrical Systems	3L:0T:0P	3
6.	VI (even)	PE-2	BTEE-602B-18	Microcontroller and PLC	2L:0T:2P	3
7.	VI (even)	PE-2	BTEE-602C-18	Electrical Drives	3L:0T:0P	3
8.	VI (even)	PE-2	BTEE-602D-18	Electromagnetic Waves	3L:0T:0P	3
9.	VI (even)	PE-3	BTEE-603A-18	Digital Signal Processing	3L:0T:0P	3
10.	VI (even)	PE-3	BTEE-603B-18	High Voltage Engineering	3L:0T:0P	3
11.	VI (even)	PE-3	BTEE-603C-18	Line-Commutated and Active PWM Rectifiers	3L:0T:0P	3
12.	VI (even)	PE-3	BTEE-603D-18	Artificial Intelligence	3L:0T:0P	3
13.	VII (odd)	PE-4	BTEE-701A-18	Power System Economics	3L:0T:0P	~~3~~
14.	VII (odd)	PE-4	BTEE-701B-18	Wind and Solar Energy Systems	3L:0T:0P	3
15.	VII (odd)	PE-4	BTEE-701C-18	Electrical and Hybrid Vehicles	3L:0T:0P	3
16.	VII (odd)	PE-4	BTEE-701D-18	Computational Electromagnetics	3L:0T:0P	3
17.	VII (odd)	PE-5	BTEE-702A-18	Control Systems Design	3L:0T:0P	3
18.	VII (odd)	PE-5	BTEE-702B-18	Computer Aided Power System Analysis	2L:0T:2P	3
19.	VII (odd)	PE-5	BTEE-702C-18	Digital Control Systems	3L:0T:0P	3
20.	VII	PE-5	BTEE-702D-18	Power Quality and FACTS	3L:0T:0P	3

	(odd)					
21.	VIII (even)	PE-6	BTEE-801A-18	Advanced Electric Drives	3L:0T:0P	3
22.	VIII (even)	PE-6	BTEE-801B-18	HVDC Transmission Systems	3L:0T:0P	3
23.	VIII (even)	PE-6	BTEE-801C-18	Power System Dynamics and Control	3L:0T:0P	3
24.	VIII (even)	PE-6	BTEE-801D-18	Smart Grid	3L:0T:0P	3

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS OFFERED BY ELECTRICAL ENGINEERING

Prerequisite: To have passed Basic Electrical Engineering/Basic Electronics Engineering Course

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

Sr. No.	AICTE Course Code	Course Code	Course Title	Hours/ week	Credits
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

Sr. No.	AICTE Course Code	Course Code	Course Title	Hours/ week	Credits
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