DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW

EVALUAT ION SCHEME & SYLLABUS FOR

B. TECH. III YEAR

ELECTRICAL & ELECTRONICS ENGIN EERING

Session: 2020-21

EVALUATION SCHEME - B. Tech 3rd YEAR (ELECTRICAL & ELECTRONICS ENGINEERING)

SEMESTER V													
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KEE501	Power System - I	3	1	0	30	20	50		100		150	4
2	KEE502	Control System	3	1	0	30	20	50		100		150	4
3	KEE503	Electrical Machines-II	3	1	0	30	20	50		100		150	4
4	KE*051-KE*054	Departmental Elective-I	3	0	0	30	20	50		100		150	3
5	KEE055-KEE058	Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	KEE551	Power System-I Lab	0	0	2				25		25	50	1
7	KEE552	Control System Lab	0	0	2				25		25	50	1
8	KEE553	Electrical Machines - II Lab	0	0	2				25		25	50	1
9	KEN554	Mini Project or Internship Assessment*	0	0	2				50			50	1
10	KNC501/ KNC502	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total	**17**	**3**	**8**							**950**	**22**

**The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.*

DEPARTMENT ELECTIVE - I

KEE051 Robotics
KEE052 Sensors and Transducers
KEE053 Industrial Automation and Control
KEN051 Bio-Medical Instrumentation

DEPARTMENT ELECTIVE - II

KEE055 Optimization Techniques
KEE056 Neural Networks & Fuzzy System
KEE057 Digital Signal Processing
KEE058 Analog & Digital Communication

SEMESTER VI

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KEE601	Power System-II	3	1	0	30	20	50		100		150	4
2	KEE602	Microprocessor and Microcontroller	3	1	0	30	20	50		100		150	4
3	KEE603	Power Electronics	3	1	0	30	20	50		100		150	4
4	KEE061	Departmental Elective-III	3	0	0	30	20	50		100		150	3
5	KOE069	Open Elective-I	3	0	0	30	20	50		100		150	3
6	KEE651	Power System-II Lab	0	0	2				25		25	50	1
7	KEE652	Microprocessor and Microcontroller Lab	0	0	2				25		25	50	1
8	KEE653	Power Electronics Lab	0	0	2				25		25	50	1
10	KNC601/ KNC602	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total	**17**	**3**	**6**							**900**	**21**

DEPARTMENT ELECTIVE - III

KEE 061 Special Electrical Machines
KEN 061 Linear Integrated Circuits
KEE 063 Digital Control System
KEN 062 Embedded Systems

B.Tech. 3RD YEAR V SEMESTER SYLLABUS

POWER SYSTEM-I (KEE-501)

Units	POWER SYSTEM-I
1	**(Power Generation):** **Introduction:** Basic structure of power system, sources of electric energy: conventional and non-conventional; Layout of Hydro-electric, Thermal and Nuclear power plants, Concept of cogeneration, combined heat and power, and captive power plants. Load curve, load duration curve, Concept of Connected Load, Maximum Demand, Average load, Demand Factor, Load factor, Diversity Factor, Capacity Factor, Utilization factor, Plant use factor, Installed capacity, Reserves, role of load diversity in power system economy. Load Sharing between Base load and Peak Load
2	**(Transmission & Distribution of Electric Power- I):** Single line diagram of Power system, choice of transmission voltage, Different kinds of supply system and their comparison. **Configurations of transmission lines**: Types of conductors, Bundled Conductors, resistance of line, skin effect, Kelvin's law, Proximity effect, **Corona Effect**, factors affecting the Corona, Corona Power Loss, Advantages and Disadvantages. **Performance of Lines**: Representation of lines, short transmission lines, medium length lines, nominal T and л-representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect.
3	**(Transmission & Distribution of Electric Power- II):** **Mechanical Design of Over Headlines**: Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers **Overhead line Insulators**: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency
4	**(Transmission Line Parameters):** **Inductance and Capacitance Calculations of Transmission Lines**: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance.
5	**(Insulated Cables):** **Insulated Cables**: Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables

CONTROL SYSTEM (KEE502)

Units	CONTROL SYSTEM
1	**Control System Concepts:** Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, Mathematical Modelling of Physical Systems (Electro Mechanical), Determination of transfer function by block diagram reduction techniques and signal flow method using Mason's gain formula, Basic Characteristics of negative feedback control systems. **Control System Components:** Constructional and working concept of AC & DC servomotor, synchro's, stepper motor and tachometer.
2	**Time Response Analysis:** Standard test signals, time response analysis of first and second order systems, time response specifications of second order system for unit step input, location of roots of characteristics equation and corresponding time response, steady state errors and error constants.

	Basic modes of feedback control: Proportional, Derivative, Integral and PID controllers.
3	**Stability and Algebraic Criteria:** Concept of stability and its necessary conditions, Routh-Hurwitz criteria and its limitations. **Root Locus Technique:** Salient features of root locus plot, Procedure for plotting root locus, root contours.
4	**Frequency Response Analysis:** Frequency Response analysis from transfer function model, Construction of polar and inverse polar plots. **Stability in Frequency Domain:** Nyquist stability criterion, Determination of gain and phase margin from Bode & Nyquist Plots, Correlation between time and Frequency Responses.
5	**Introduction to Design:** The design problems and preliminary considerations of lead, lag and lead-lag compensation networks, design of closed loop systems using compensation techniques in time and frequency domains. **State Space Technique:** The concept of state & space, State-space model of physical system, conversion of state-space to transfer function model and vice-versa, State transition matrix, Concept of controllability and observability and their testing.

ELECTRICAL MACHINE-II (KEE 503)

Units	ELECTRICAL MACHINE-II
1	**Synchronous Machine-I** Constructional features, Armature winding, EMF Equation, Winding coefficients, Equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier's Triangle method, Voltage and frequency control (Governor system) of alternators , Parallel operation of synchronous generators, Operation on infinite bus, Synchronizing power and torque co-efficient.
2	**Synchronous Machine II** Two reaction theory, Transient and sub-transient reactance, Power flow equations of cylindrical and salient pole machines, Operating characteristics. Synchronous Motor - Starting methods, Effect of varying field current at different loads, V- curves, Hunting & damping, Synchronous condenser.
3	**Three phase Induction Machine - I** Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, Equivalent circuit, Torque and power equations, Torque- slip characteristics, No load & blocked rotor tests, Efficiency.
4	**Three phase Induction Machine- II** Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed control (with and without emf injection in rotor circuit).
5	**Single phase Induction Motor** Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, Repulsion motor, Universal motor.

DEPARTMENT ELECTIVE-I

SENSORS AND TRANSDUCERS (KEE 052)

Units	SENSORS AND TRANSDUCERS
1	Sensors & Transducer: Definition, Classification of transducers, Advantages and Disadvantages of Electrical Transducers; Measurement of displacement using Potentiometer, LVDT & Optical Encoder; Measurement of force using strain gauges & load cells; Measurement of pressure using LVDT based diaphragm & piezoelectric sensor
2	Measurement of temperature using Thermistors, Thermocouples & RTD, Concept of thermal imaging; Measurement of position using Hall effect sensors; Proximity sensor: Inductive, Capacitive & Photoelectric, Use of proximity sensor as accelerometer and vibration sensor; Flow Sensor: Ultrasonic & Laser; Level Sensor: Ultrasonic & Capacitive.
3	Machine Vision: Introduction to machine vision, Difference between machine vision and computer vision; Imaging Sensors: CCD and CMOS; sensing & digitizing function in machine vision, image processing and analysis, training the vision system in a pick and place robot.
4	Signal Conditioning: Introduction, Functions of signal conditioning equipment, need for amplification of signals, Types of amplifiers. Data Acquisition Systems and Conversion: Introduction, Objectives & configuration of data acquisition system, Analog & Digital IO, Counters, Timers, need of data conversion.
5	Smart Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Smart city, Industrial robots & electric vehicles.

DEPARTMENT ELECTIVE-II

OPTIMIZATION TECHNIQUES (KEE 055)

Units	OPTIMIZATION TECHNIQUE
1	**Introduction to Optimization:** Engineering application of Optimization, Statement of an optimization problem, Optimal problem formulation, Classification of optimization problem, Optimum design concepts: Definition of Global and Local optima using basic calculus concepts; Classical Optimization Techniques: Unconstrained Optimization - Single variable optimization, Constrained multivariable optimization with equality constraints - Lagrange multipliers method, Constrained multivariable optimization with inequality constraints - Kuhn-Tucker conditions.
2	**Linear Programming:** Standard form of linear programming, Graphical solution, Simplex method, Big-M method, Duality theory, Decomposition principle, Transportation problem using North-West Corner rule and Least cost rule.
3	**Non-Linear Programming:** Standard form of non-linear programming, One–Dimensional Minimization Methods - Unimodal function, Dichotomous search, interval halving method; Unconstrained Optimization Techniques - Univariate method, Steepest descent method; Constrained Optimization Techniques – Interior Penalty function method, Exterior penalty function method.
4	**Simulation:** Definition, types of simulation, General process of simulation, advantages & disadvantages of simulation. **Project Management Techniques:** PERT and CPM **Modern methods of Optimization:** Genetic algorithm, working principle, fitness function, GA operators – crossover & mutation, comparison of GA with traditional methods.
5	**Case study (algorithm only):** Economic load scheduling of power plant (without considering losses), maintenance scheduling of machines in manufacturing industry, fuzzy logic based speed control of DC machines.

POWER SYSTEM LABORATORY – I (KEE551)

Note: Minimum ten experiments are to be performed from the following list, on a software platform preferably on Scilab, MATLAB, or any C, C++ - Compiler

Expts	POWER SYSTEM LABORATORY – I
1	Calculate the parameters of single-phase transmission line
2	Calculate the parameters of three phase single circuit transmission line
3	Calculate the parameters of three phase double circuit transmission line
4	Determine the ABCD constant for transmission line.
5	Simulate the Ferranti effect in transmission line
6	Calculate the corona loss of transmission line
7	Calculation of sag & tension of transmission line
8	Calculation of string efficiency of insulator of transmission line
9	Calculation for grading of underground cables
10	Simulate the skin effect in the transmission line
11	Calculation of ground clearance of transmission line
12	Calculate the parameters for underground cable

Spoken Tutorial (MOOCs):

Spoken Tutorial MOOCs, ' Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)

CONTROL SYSTEM LABORATORY (KEE552)

Note: Minimum 10 experiments are to be performed from the following list

Units	
1	To determine speed-torque characteristics of an AC servomotor.
2	To study Synchro Transmitter characteristics. Obtain Synchro Transmitter – Receiver output vs input characteristics
3	To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
4	To study characteristics of positional error detector by angular displacement of two servo potentiometers.
5	To simulate and compare the response of 2^{nd} order system with and without lead, lag, Lead-Lag compensator / simulate PID controller for transportation lag.
6	To study P, PI and PID temperature controller for an oven and compare their characteristics
7	To study performance of servo voltage stabilizer at various loads using load bank
8	To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.
Software based experiments (Scilab/MATLAB or any equivalent open source software**)**	
9	To determine time domain response of a second order system for step input and obtain performance parameters.
10	To convert transfer function of a system into state space form and vice-versa.
11	To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
12	To plot a Bode diagram of an open loop transfer function
13	To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

ELECTRICAL MACHINE-II LABORATORY (KEE 553)

Note: Minimum 10 experiments are to be performed from the following list:

***The available Experiments from above list may be performed on virtual lab on following virtual lab link:** http://vlab.co.in/

Expts	ELECTRICAL MACHINE-II LABORATORY
1	To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2	To perform load test on a three phase induction motor and draw Torque -speed characteristics
3	To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
4	To study speed control of three phase induction motor by varying supply voltage and by keeping V/f ratio constant
5	To perform open circuit and short circuit tests on a three phase alternator
6	To determine V-curves and inverted V-curves of a three phase synchronous motor
7	To determine the direct axis reactance (Xd) and quadrature axis reactance (Xq) of synchronous machine.
8	To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method
9	To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
10	To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation
11	To determine speed-torque characteristics of a three phase induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage
12	To draw O.C. and S.C. characteristics of a three phase alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors
13	To determine steady state performance of a three phase induction motor using equivalent circuit
14	Load Test on Three Phase Alternator

CONSTITUTION OF INDIA, LAW AND ENGINEERING (KNC 501)

Units	CONSTITUTION OF INDIA, LAW AND ENGINEERING (KNC 501)
1	**Introduction and Basic Information about Indian Constitution**: Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.
2	**Union Executive and State Executive:** Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges,

	Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.
3	**Introduction and Basic Information about Legal System**: The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace
4	**Intellectual Property Laws and Regulation to Information: Intellectual Property Laws:** Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.
5	**Business Organizations and E-Governance: Sole Traders, Partnerships**: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

B.TECH. 3RD YEAR VI SEMESTER SYLLABUS

POWER SYSTEMS-II (KEE 601)

Units	POWER SYSTEMS-II (KEE 601
1	**(Fault Analysis in Power System):** One-line diagram, Impedance and reactance diagram, per unit system changing the base of per unit quantities, advantages of per unit system **Symmetrical Components**: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks **Fault Calculations**: Fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase faults, faults on power systems, and faults with fault impedance, reactors and their location, short circuit capacity of a bus
2	**(Load Flow Analysis):** Introduction, Formation of Z_{BUS} and Y_{BUS}, development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, Comparison of Gauss Siedel and Newton Raphson Method, approximation to N-R method, fast decoupled method.
3	**(Travelling Waves in Power System):** Travelling Waves on Transmission Lines: Production of traveling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor

	connection at a T-junction, Attenuation of travelling waves, Bewley's Lattice diagram.
4	**(Stability in Power System):** Power flow through a transmission line, Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion. Factors affecting steady state and transient stability and methods of improvement.
5	**(Introduction to Power System Protection):** **Relays**: Operating Principle of a general relay, **Basic Terminology**: Relay, Energizing Quantity, setting, Pickup, drop out, Flag, fault clearing time, Relay time, Breaker time, Overreach, Underreach; Classification of Relays according to applications, according to time. Overcurrent Relay, Distance Protection, Differential Protection. **Circuit Breakers:** Arc Phenomenon, Arc Extinction and its Methods, Restriking Voltage & Recovery Voltage, Circuit Breaker Rating

MICROPROCESSOR AND MICROCONTROLLER (KEE602)

Units	MICROPROCESSOR AND MICROCONTROLLER (KEE602)
1	**Introduction to Microprocessor:** Microprocessor architecture and its operations, Memory, Input & output devices, the 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, interfacing output displays, interfacing input devices, Memory mapped I/O. **Basic Programming concepts**: Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts
2	**Intel 8086 microprocessor:** Internal architecture (Bus Interface Unit, Execution unit, Pipelining, Register organization), Pin Diagram, Memory addressing, Physical memory organization, Interrupts (hardware & software interrupts)
3	**Peripheral Devices:** 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C. Fundamental of Programming: Program structure & programming techniques for microprocessors, 8085 Addressing modes, 8085 Instruction set, Assembly language programming of 8085 microprocessor with examples (arithmetic operations on 8-bit numbers – add, subtract, multiply, divide, square & square root etc, largest/ smallest number; ascending/ descending order).
4	**8051 Microcontroller Basics**: Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins of 8051. Memory Address Decoding, 8031/51 Interfacing with External ROM and RAM. 8051 Addressing Modes.
5	**Assembly programming and instruction of 8051:** Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 Timers. Serial Port Programming, Interrupts Programming, Comparison of Microprocessor, Microcontroller, PIC and ARM processors and their application areas.

POWER ELECTRONICS (KEE 603)

Units	POWER ELECTRONICS (KEE 603)
1	**Power semiconductor devices:** **Introduction:** Concept of Power Electronics, scope and applications, desired Characteristics of controllable switches **Power semiconductor switches and their characteristics**: Power Diode, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO.
2	**Thyristor:** Rating & protection, Methods of SCR commutation, Gate Drive Circuit, Series and Parallel operation. **DC-DC Converters**: Introduction, Control Strategies, Buck converter, Boost Converter, Buck-Boost converter, Analysis of buck converter, Switched Mode power Supply (SMPS).
3	**Phase Controlled Converters:** Single phase half wave controlled rectifier with various loads, Effect of freewheeling diode, Single phase fully controlled and half controlled bridge converters with various loads. Performance Parameters of single phase uncontrolled and controlled converters, three phase half wave converters, Three phase fully controlled and half controlled bridge converters, Effect of source impedance, Single phase and three phase dual converters
4	**AC Voltage Controllers:** Principle of On-Off and phase controls, Single phase ac voltage controller with resistive and inductive loads, sequence control, Introduction to Matrix converter. **Cyclo Converters:** Basic principle of operation, single phase to single phase, three phase to single phase output voltage equation.
5	**Inverters:** Single phase and Three phase bridge inverters, voltage source inverters, current source inverters, Voltage control of single phase inverters, Pulse width modulation, Introduction to Multi level inverter.

DEPARTMENT ELECTIVE-III

SPECIAL ELECTRICAL MACHINES (KEE 061)

Units	SPECIAL ELECTRICAL MACHINES: KEE 061
1	**Induction Machines**: Concept of constant torque and constant power controls, SEIG, DFIG: Operating Principle, Equivalent Circuit, Characteristics, Applications, Linear Induction Motors. Construction, principle of operation, Linear force, and applications. **Two Phase AC Servomotors**: Construction, torque-speed characteristics, performance and applications
2	**Stepper Motors**: Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multistack configurations, Torque equations, Characteristics, Drive circuits, Microprocessor control of stepper motors, Closed loop control, Applications.
3	**Switched Reluctance Motors**: Constructional features, Rotary and Linear SRM, Principle of operation, Torque production, performance characteristics, Methods of Rotor position sensing, Sensor less operation, Closed loop control and Applications
4	**Permanent Magnet Machines:** Permanent Magnet synchronous generator Operating Principle, Equivalent Circuit, Characteristics, Permanent magnet DC motors, sinusoidal PMAC motors, their important features and applications, PCB motors, **Permanent Magnet Brushless D.C. Motors**: Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Motor characteristics and control, Applications.

5	**Single phase synchronous motor**; construction, operating principle and characteristics of reluctance and hysteresis motors; **Single Phase Commutator Motors:** Construction, principle of operation, characteristics of universal and repulsion motors;

UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY – HUMAN ASPIRATIONS AND ITS FULFILLMENT (KOE-069)

Units	**UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY – HUMAN ASPIRATIONS AND ITS FULFILLMENT : KOE-069**
1	Introduction: The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution
2	Understanding Human being and its expansion: The domain of right understanding starts from understanding the human being (the knower, the experience and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).
3	Activities of the Self: Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.
4	Understanding Co-existence with other orders: The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).
5	Expansion of harmony from self to entire existence: Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behaviour and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.

INDIAN TRADITIONS, CULTURAL AND SOCIETY: KNC 602

Units	**INDIAN TRADITIONS, CULTURAL AND SOCIETY: KNC 602**
1	**Society State and Polity in India** State in Ancient India: Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women. Four-class Classification, Slavery.
2	**Indian Literature, Culture, Tradition, and Practices** Evolution of script and languages in India: Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali,Prakrit And Sanskrit, Kautilya's Arthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature, Malayalam Literature ,Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature
3	**Indian Religion, Philosophy, and Practices** Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines, Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern

	religious practices.
4	**Science, Management and Indian Knowledge System** Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India , Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times
5	**Cultural Heritage and Performing Arts** Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Seals, coins, Pottery, Puppetry, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs and Festivals, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema

POWER SYSTEM LAB-II (KEE 651)

Note: - Minimum 10 experiments are to be performed from the following list:

(A) Hardware Based Experiments:

Expts	POWER SYSTEM LAB-II (KEE 651)
1	To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
2	To Study the over-current relay and the effect of PSM and TSM.
3	To study percentage differential relay.
4	To study Impedance, MHO and Reactance type distance relays and zones of protection.
5	To study Ferranti effect of a transmission line/cable
6	To measure the dielectric Strength of transformer oil.
7	To study the Synchronization of alternator with infinite bus bar.
8	To determine positive sequence, negative sequence and zero sequence reactance of an alternator.
9	To Study the effect of different shape of electrodes on dielectric (air) breakdown.
10	To Study the gas actuated Buchholz relay for oil filled transformer
11	To determine the sub-transient (Xd″), transient (Xd′) and steady state reactance (Xd) of a synchronous machine.

***The available Experiments from above list may be performed on virtual lab on following virtual lab link:** http://vlab.co.in/

(B) Simulation Based Experiments (using Scilab/MATLAB or any other equivalent open source software platform)

Expts	POWER SYSTEM LAB-II (KEE 651)
1	To obtain formation of Y-bus
2	Perform load flow analysis on a 3- Bus System using G-S Method
3	Perform load flow analysis on a 3- Bus System using N-R Method
4	To perform symmetrical fault analysis in a power system.
5	To perform unsymmetrical fault analysis in a power system.
6	Swing Curve by Step-by-Step Method.
7	Determination of the stability of a SMIB system in occurrence of a fault by solving the Swing equation by Euler's Method.

MICROPROCESSOR AND MICROCONTROLLER LAB (KEE 652)

Note: Minimum ten experiments are to be performed from the following list (on 8085 / 8086 microprocessor)

Expts	MICROPROCESSOR AND MICROCONTROLLER LAB (KEE 652)
1	To study 8085 / 8086 based microprocessor system
2	To perform mathematical operations (addition & subtraction) on two 8-bit numbers
3	To perform multiplication on two 8-bit numbers
4	To perform division on two 8-bit numbers
5	To develop and run a program for finding out the largest number from given two 8-bit numbers
6	To develop and run a program for finding out the smallest number from given two 8-bit numbers
7	To develop and run a program for arranging in ascending order of a given set of 8-bit numbers
8	To develop and run a program for arranging in descending order of a given set of 8-bit numbers
9	To perform conversion of temperature from degree F to degree C
10	To perform computation of square root of a given number
11	To obtain interfacing of 8255 – PPI with 8085 microprocessor
12	To perform microprocessor based traffic light control
13	To perform microprocessor based stepper motor operation through 8085 / 8086 kit
14	To obtain interfacing of DMA controller with 8085 / 8086 microprocessor

PART –B SUGGESTIVE LIST OF EXPERIMENTS (Through Virtual Lab Link)

Expts	MICROPROCESSOR AND MICROCONTROLLER LAB (KEE 652)
1	Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers. **(Through Virtual Lab Link)**
2	Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers. **(Through Virtual Lab Link)**
3	To perform multiplication and division of two 8 bit numbers using 8085. **(Through Virtual Lab Link)**
4	To find the largest and smallest number in an array of data using 8085 instruction set.
5	To write a program using 8086 to arrange an array of data in ascending and descending order. **(Through Virtual Lab Link)**
6	To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8086 instruction set
7	To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes.
8	To write a program to initiate 8251 and to check the transmission and reception of character.
9	Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
10	Write a program to generate 10 kHz square wave using 8051.
11	Write a program to show the use of INT0 and INT1 of 8051
12	Write a program for temperature & to display on intelligent LCD display.
13	Interfacing of Stepper motor to 8051
14	Interfacing of ADC to 8051.
15	To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes
16	To write a program to initiate 8251 and to check the transmission and reception of character.

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php

Available on: http://www.vlab.co.in/broad-area-electronics-and-communications

POWER ELECTRONICS LABORATORY (KEE 653)

Note: Minimum 10 experiments are to be performed from the following list:.

Units	POWER ELECTRONICS LABORATORY (KEE 653)
1	To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor
2	To study V-I characteristics of SCR and measure latching and holding currents.
3	To compare the R, RC & UJT trigger circuit for SCR.
4	To study the commutation circuit for SCR.
5	To study single phase fully controlled bridge rectifiers with resistive and inductive loads.
6	To study single phase fully controlled bridge rectifiers with DC motor load.
7	To study three-phase fully controlled bridge rectifier with resistive and inductive loads.
8	To study single-phase ac voltage regulator with resistive and inductive loads.
9	To study single phase cyclo-converter
10	To study the four quadrant operation of chopper circuit
11	To study MOSFET/IGBT based single-phase bridge inverter.

Software based experiments (Scilab/MATLAB or any equivalent open source software)

Units	POWER ELECTRONICS LABORATORY (KEE 653)
12	To obtain the simulation of single phase half wave controlled rectifier with R and RL load and plot load voltage and load current waveforms.
13	To obtain simulation of single phase fully controlled bridge rectifier and plot load voltage and load current waveform for inductive load
14	To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
15	To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current