M. Tech. - COURSE STRUCTURE & SYLLABUS – RK24

(Applicable from the academic year 2024-25 onwards)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M. Tech (Power Electronics and Drives) Programme

Course Code Format:

Regulation	Branch	Year	Semester	Course Serial Number
2 Digits	2 Digits	1 Digit	1 Digit	2 Digits
24	52	1/2	1/2	01/02/03/04/..../09/10

Branch Code:

Code	Branch	Specialization
52	Electrical & Electronics Engineering	Power Electronics and Drives

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

M. Tech I Year, I Semester (Power Electronics and Drives)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24521101	Core	Electrical Machine Modeling and Analysis	3	0	--	3
2	24521102	Core	Analysis of Power Electronic Converters	3	0	--	3
3	24521103	Elective-I	i. Modern Control Theory ii. Power Quality and Custom Power Devices iii. Programmable Logic Controllers & Applications	3	0	--	3
4	24521104	Elective-II	i. Artificial Intelligence Techniques ii. Renewable Energy Technologies iii. HVDC Transmission and Flexible ACTransmission Systems	3	0	--	3
5	24521105		Research Methodology and IPR	2	0	0	2
6	24521106	Lab	Power Electronics Simulation Laboratory	--	--	4	2
7	24521107	Lab	Power Converters Laboratory	--	--	4	2
8	24521108	Audit	Audit Course –1	2	0	0	0
Total				**16**	**0**	**8**	**18**

M. Tech I Year, II Semester (Power Electronics and Drives)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24521201	Core	Switched Mode Power Conversion	3	0	--	3
2	24521202	Core	Power Electronic Control of Electrical Drives	3	0	--	3
3	24521203	Elective-III	i. Control & Integration of Renewable EnergySystems ii. Hybrid Electric Vehicles iii. Digital Control Systems	3	0	--	3
4	24521204	Elective-IV	i. Advanced Digital Signal Processing ii. Applications of Power Converters iii. Microcontrollers	3	0	--	3
5	24521205	Lab	Electric Drives Simulation Laboratory	--	--	4	2
6	24521206	Lab	Electric Drives Laboratory	--	--	4	2
7	24521207	Project	Mini Project With Seminar	--	--	4	2
8	24521208	Audit	Audit Course –2	2	0	0	0
Total				**14**	**0**	**12**	**18**

Chairman - BOS
Electrical & Electronics Engineering
RKCE (Autonomous)

M. Tech II Year, I Semester (Power Electronics and Drives)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24522101	Program Elective-V	i. Digital Signal Processing Controlled Drives ii. Smart Grid Technologies iii. Modeling & Simulation of Power Electronic Systems	3	0	--	3
2	24522102	Open Elective	i. Industrial Safety ii. Energy Audit, Conservation & Management iii. Composite Materials	3	0	--	3
3	24522103	Project	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)*	--	--	20	10
Total				**6**	**0**	**20**	**16**

* Evaluated and displayed in 4th Semester marks list

** Students Going for Industrial Project / Thesis will complete these courses through MOOCS

M. Tech II Year, II Semester (Power Electronics and Drives)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24522201	Project	Project / Dissertation Phase II (Continued from III Semester)	0	0	32	16
Total				**0**	**0**	**32**	**16**

Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Chairman - BOS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I- Semester

Electrical Machines Modeling and Analysis

Pre-requisite: Electrical machines & Special machines.

Course Educational Objectives:

- To know the concepts of generalized theory of electrical machines.
- To represent the DC and AC machines as Basic Two Pole machine.
- To model the electrical machines with voltage, current, torque and speed equations.
- To investigate the steady state and transient behavior of the electrical machines.
- To understand the dynamic behavior of the AC machines.

UNIT– 1

Basic concepts of Modeling

Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron"s primitive Machinevoltage, current and torque equations.

UNIT– 2

DC Machine Modeling

Mathematical model of separately excited D.C motor – Steady state analysis-transient State analysis-sudden application of inertia load-transfer function of separately excited D.C motor- Mathematical model of D.C Series motor, Shunt motor-Linearization techniques for small perturbations

UNIT– 3

Reference frame theory & Modeling of single phase Induction Machines

Linear transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and vice-versa, transformation to rotating reference frame, (αβ0 to dqo) and vice versa -Power equivalence-Mathematical modeling of single phase induction machines.

UNIT– 4

Modeling of three phase Induction Machine

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame model--power equation, electromagnetic torque equation, state space model in induction motor with flux linkages as variables

UNIT– 5

Modeling of Synchronous Machine

Synchronous machine inductances –derivation of voltage equations in the rotor"s dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space models with flux linkages as variables.

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

- Analyze the characteristics of different types of DC motors to design suitable controllers fordifferent applications.
- Apply the knowledge of reference frame theory for AC machines to model the induction andSynchronous machines.
- Evaluate the steady state and transient behavior of induction and synchronous machines to proposethe suitability of drives for different industrial applications
- Analyze the behavior of induction machines using voltage and torque equations.

Text Books

1. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications.

Reference Books:

1. Generalized theory of Electrical Machines -Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. Dynamic simulation of Electric machinery using MATLAB / Simulink –CheeMunOng-PrenticeHall, 2003.
3. Magneto electric devices transducers, transformers and machines-G. R. Slemon- Wiley in NewYork, London, 1966.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year **I-Semester**

Analysis of Power Electronic Converters

Pre-Requisite: Power Electronics.

Course Educational Objectives:

- To understand the control principle of ac to ac conversion with suitable power semi - conductor devices.
- To have the knowledge of ac to dc conversion and different ac to dc converter topologies.
- To understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters
- To acquire the knowledge on dc-ac converters and to know the different control techniques of dc-ac converters.
- To know multilevel inverter configuration to improve the quality of the inverter output voltage.

UNIT– 1

Overview of Switching Devices:

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT– 2

AC-DC converters: Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor- Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT– 3

Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

UNIT– 4

PWM Inverters: Principle of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 60°PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.

UNIT– 5

Multi level inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying- Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters- Comparisons of Multilevel Converters.

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

- Describe and analyze the operation of AC-DC converters.
- Analyze the operation of power factor correction converters.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

- Analyze the operation of three phase inverters with PWM control.
- Study the principles of operation of multi- level inverters and their applications.

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint-2008.

Reference Books:

1. Power Electronics Daniel W. Hart - McGraw-Hill, 2011.
2. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
3. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
Modern Control Theory (Elective-I)

Pre-requisite: Control Systems, differential equations.

Course Educational Objectives:

- To facilitate the evolution of state variable approach for the analysis of control systems.
- To examine the importance of controllability and observability in modern control engineering.
- To enable students to analyze various types of nonlinearities & construction of trajectories usingdescribing functions and phase plane analysis.
- To study the analysis of stability and instability of continuous time invariant system.

UNIT– 1
State Variable Analysis

The concept of state – State Equations for Dynamic systems– Solution of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it"s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model

UNIT– 2
Design using state variable technique

Design of state feedback controller through pole placement technique-Necessary and sufficient condition- Ackermann"s formula. Concept of observer-Design of full order state observer-reduced order observer.

UNIT– 3
Non Linear Systems

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear systems - Singular Points –Linearization of nonlinear systems– Describing function – describing function analysis of nonlinear systems- Stability analysis of Nonlinear systems through describing functions.

UNIT– 4
Stability Analysis

Stability in the sense of Lyapunov, Lyapunov"s stability and Lyapunov"s instability theorems – Stability Analysis of Linear Continuous time invariant systems by Lyapunov method – Generation of Lyapunov functions – Variable gradient method – Krasooviski"s method.

UNIT– 5
Introduction to Optimal Control

Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine equation.

Typical optimal control performance measures-optimal control based on Quadratic performance measures- Quadratic optimal regulator systems- State regulator problems –Output regulator problems, tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation- determination of optimal feedback gain matrix.

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

- Formulate and solve the state equations of dynamic systems, analyze controllability and observability.

- Design a state feedback controller; design an observer.
- Linearize a nonlinear system model; analyze non-linear systems through describing functions.
- Determine the stability of a given system; generate a Lyapunov function.
- Minimize a given functional, design an optimal feedback gain matrix.

Text Books:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication.

Reference Books:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.
6. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India,2009

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
Power Quality and Custom Power Devices (Elective-I)

Pre requisite: Knowledge on electric circuit analysis, power systems and power electronics and conceptof reactive power compensation techniques.

Course Educational Objectives:

- To understand significance of power quality and power quality parameters.
- To know types of transient over voltages and protection of transient voltages.
- To understand harmonics, their effects, harmonic indices and harmonic minimization techniques.
- To understand the importance of power devices and their applications.
- To understand different compensation techniques to minimize power quality disturbances.

UNIT– 1

Introduction to power quality: Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT– 2

Transient and Long Duration Voltage Variations: Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems.
Principles of Regulating the Voltage, Device for Voltage Regulation, Utility Voltage Regulator Application, Capacitor for Voltage Regulation, End-user Capacitor Application, Regulating Utility Voltage with Distributed generation

UNIT– 3

Harmonic Distortion and solutions: Voltage vs. Current Distortion, Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics

UNIT– 4

Custom Power Devices: Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT– 5

Application of custom power devices in power systems: Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic Voltage Restorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner

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

- Identify the issues related to power quality in power systems.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

- Address the problems of transient and long duration voltage variations in power systems.
- Analyze the effects of harmonics and study of different mitigation techniques.
- Identify the importance of custom power devices and their applications.
- Acquire knowledge on different compensation techniques to minimize power quality disturbances.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W,Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, FirstEdition, IEEE Press; 2000.
3. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van NostradReinhold, New York.
4. Power Quality c.shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum-Elsevier
7. Power Quality, C. Shankaran, CRC Press, 2001
8. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
9. Custom Power Devices - An Introduction, ArindamGhosh and Gerard Ledwich, Springer, 2002
10. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
Programmable Logic Controllers & Applications
(Elective-I)

Pre-requisite: Knowledge on relay logic and digital electronics.

Course Educational Objectives:

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

UNIT– 1
PLC Basics:
PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT– 2
PLC Programming:
Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram constructionand flow chart for spray process system.

UNIT– 3
PLC Registers:
Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT– 4
Data Handling functions:
SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controllingof two axis and three axis Robots with PLC, Matrix functions.

UNIT– 5
Analog PLC operation:
Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

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

- Understand the PLCs and their I/O modules.
- Develop control algorithms to PLC using ladder logic etc.
- Manage PLC registers for effective utilization in different applications.
- Handle data functions and control of two axis and their axis robots with PLC.
- Design PID controller with PLC.

Text Books:

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A.Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.

Reference Books:

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
Artificial Intelligence Techniques
(Elective-II)

Pre –requisite: Fundamentals of Neural networks and Fuzzy Logic

Course Educational Objectives:

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

UNIT– 1
Introduction
Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linearseparability- XOR function.

UNIT– 2
ANN Paradigms
ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen"sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT– 3
Classical and Fuzzy Sets
Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT– 4
FUZZY LOGIC CONTROLLER (FLC)
Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– 5
Application of AI Techniques
Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

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

- Differentiate between Algorithmic based methods and knowledge based methods.
- Use appropriate AI framework for solving power system problems.
- To design fuzzy logic controllers for power engineering applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaranand G.A.VijayalakshmiPai – PHI Publication.
2. Modern power Electronics and AC Drives – B. K. Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
5. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S. Sumathi,S N Deepa.
6. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, S. Sumathi,S N Deepa Springer,2007.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I Semester
Renewable Energy Technologies
(Elective-II)

Pre requisite: UG power Electronics.

Course Educational Objectives:

- To learn technical challenges in renewable energy.
- To learn basics of wind energy conversion & PV power generation.
- To analyze the of fuel cell system.

UNIT– 1

Introduction: Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems

UNIT– 2

Induction Generators: Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation - Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.

UNIT– 3

Wind Power Plants: Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation- General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

UNIT– 4

Photovoltaic Power Plants: Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy

UNIT– 5

Fuel Cells: The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage

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

- Understand various general aspects of renewable energy systems.
- Analyze and design induction generator for power generation from wind.
- Design MPPT controller for solar power utilization.
- Utilize fuel cell systems for power generation.

Text Books:

1. Felix A. Farret, M. Godoy Simo` es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and

WindPower Systems, John Wiley & Sons, 2011.

Reference Books:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
HVDC Transmission and Flexible AC TransmissionSystems
(Elective-II)

Pre-requisite: Knowledge on Power Electronics, Power Systems and High Voltage Engineering

Course Educational Objectives:

- To learn various schemes of HVDC transmission.
- To learn the operation and analysis of different HVDC converter circuits.
- To learn the control of HVDC systems.
- To learn the basic types of FACTS controllers.
- To learn the series and shunt compensators.

UNIT– 1

HVDC Transmission: DC Power Transmission: Need for power system interconnections, Evolution of AC and DC transmission systems, Comparison of HVDC and HVAC Transmission systems, Types of DC links, relative merits, Components of a HVDC system, Modern trends in DC Transmission systems

UNIT– 2

Analysis of HVDC Converters: Pulse number, choice of converter configurations, Analysis of Graetz circuit with and without overlap, voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms

UNIT– 3

HVDC Control: Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current Control, CEA Control, firing angle control of valves, starting and stopping of a dc link, Power control

Harmonics and Filters: effects of Harmonics, sources of harmonic generation, Types of filters – Design examples

UNIT– 4

Power Flow Analysis in AC/DC Systems: Modelling of DC links, solutions of AC-DC Power flow

Flexible AC Transmission Systems (FACTS): FACTS concepts and general system conditions: Power flow in AC systems, Relative importance of controllable parameters, Basic types of FACTS controllers,shunt and series controllers, Current source and Voltage source converters

UNIT– 5

Static Shunt Compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, STATCOM, basic operating principle,control approaches and characteristics

Static Series Compensators: Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, Independent control of real and reactive power.

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

- Compare HVDC and EHVAC transmission systems
- Analyze converter configurations used in HVDC and evaluate the performance metrics.
- Understand controllers for controlling the power flow through a dc link and compute filterParameters.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

- Apply impedance, phase angle and voltage control for real and reactive power flow in actransmission systems with FACTS controller.
- Analyze and select a suitable FACTS controller for a given power flow condition.

Text Books:

1. NarainG.Honorani, Laszlo Gyugyi: Understanding FACTS –Concepts and Technology of FlexibleAC Transmission Systems, Wiley-IEEE Press, 2000.
2. K.R.Padiyar: HVDC Power Transmission Systems –Technology and System Interactions, NewAge International Publishers, 2011.

Reference Books:

1. Kimbark: Direct Current Transmission, 1971.
2. Jos Arrillaga: High Voltage Direct Current Transmission, The Institution of electrical Engineers,1998.
3. Yong Hua Song, Allan T Johns: Flexible AC Transmission Systems, The Institution of electrical Engineers, 1999.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
Research Methodology and IPR

UNIT-I
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineering students""
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year I-Semester
POWER ELECTRONICS SIMULATION LABORATORY

Course Educational Objectives:

- To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.

Any 10 of the following experiments are to be conducted. List of Experiments:

1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of single-phase full bridge inverter using Uni-polar & Bi-polar PWM techniques.
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM.
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor voltage balancedmethods.
10. Simulation of single phase AC voltage regulator.
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level& three level inverter (FFT analysis).
13. Simulation of 5-level inverter using carrier based PWM methods.
14. Simulation of three phase full converter with RL & RLE loads.
15. Simulation of three-phase dual converter.

Course Outcome: To understand the operation of DC-DC converters, AC-DC converters, AC voltageregulators and DC-AC converters by simulation.

Chairman - BoS
Electrical & Electronics Engineeri
RKCE (Autonomous)

I Year I-Semester
POWER CONVERTERS LABORATORY

Course Educational Objectives:
To study and understand the different converters and inverters for single and three phase loads.

Any 10 of the following experiments are to be conducted. List of experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter.
2. Study of DC-DC Buck-Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕsemi- converter and 1-ϕ full-converter (Inductive load)
5. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction angle control.
6. Study of 1-ϕ square wave and sinusoidal PWM inverter.
7. Study of 3-ϕ inverter with 120° and 180° mode of operation.
8. Study of 3-ϕ sinusoidal PWM inverter.
9. Study of 3-level NPC inverter.
10. Study of 5-level cascaded H-bridge inverter.
11. Determination of input p.f. and harmonic factor for 3-ϕ full converter (Inductive load).
12. Determination of input p.f. and harmonic factor for 3-ϕ semi converter (Inductive load).
13. Study the characteristics of IGBT, MOSFET & GTO"s.
14. Design of gate drive circuits for IGBT & MOSFET"s.

Course Outcomes: Students are able to implement the converter and inverters in real time applications.

Chairman - BOS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Switched Mode Power Conversion

Pre-requisite: Concepts of electrical circuit analysis and power electronics.

Course Educational Objectives:

- To understand the control operation of non-sinusoidal DC-DC converters.
- To understand the basic operation of resonant converters.
- To understand the control operation of isolated DC-DC converters.
- To understand the control schemes of DC-DC converters and designing of magnetic components.
- To understand the modeling and control design of switch mode conversion based on linearization.
- To understand how to analyze the switch mode converters using small-signal analysis.

UNIT– 1
Non-isolated switch mode converters:
Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, Converter realization with non-ideal components.

UNIT– 2
Isolated switched mode converters:
Forwarded converter, flyback converter, push-pull converter, half-bridge converter, full bridge converter.

UNIT– 3
Resonant converters:
Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching quasi-resonant buck converter, zero current switching quasi-resonant boost converter, zero voltage switching quasi-resonant buck converter, zero voltage switching quasi-resonant boost converter.

UNIT– 4
Control schemes of switching converters:
Voltage control, Current mode control, control scheme for resonant converters. Magnetic design consideration: Transformer design, inductor and capacitor design.

UNIT– 5
Modeling and Controller design based on linearization:
Formulation of averaged models for buck and boost converters:state space analysis, average circuitmodels, linearization and small – signal analysis, small-signal models.
Control design based on linearization: Transfer function of converters, control design, large signal issuesin voltage-mode and current-mode control.

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

- Analyze operation and control of non-isolated and isolated switch mode converters.
- Design of non-isolated and isolated switch mode converters.
- Analyze operation and control of resonant converters.
- Feedback design of switch mode converters based on linearized models.

Text Books:

1. Fundamentals of Power Electronics-Erickson, Robert W., Maksimovic, Dragan, Springer, 2011.
2. Power switching converters-Simon Ang, Alejandro Oliva, CRC Press, 2010.
3. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
4. Design of Magnetic Components for Switched Mode Power Converters- Umanand, S.P. Bhat, JohnWiley & Sons Australia, 1992.

Reference Books:

1. Power Electronics: Essentials and applications- L. Umanand, Wiley publications
2. Switching Power Supply Design-Abraham I. Pressman, McGraw-Hill Ryerson, Limited, 1991.
3. Power Electronics – IssaBatareseh, Jhon Wiley publications, 2004.
4. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins-Wiley publications.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Power Electronic Control of Electrical Drives

Pre-requisite: Knowledge of Power Electronics and Electrical Machines.

Course Educational Objectives:

- To familiarize with advanced control schemes for induction motor drives and control techniquesfor PMSM, BLDC and SRM drives.

UNIT– 1
Vector Control of Induction Motor Drive:
Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control, decoupling circuits.

UNIT– 2
Sensor less Control of induction Motor Drive:
Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers.

UNIT– 3
Direct Torque Control of Induction Motor Drive:
Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC ofinduction motors.

UNIT– 4
Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives:
Advantages and limitations of Permanent magnet machines, operating principle of PMSM,modeling of PMSM, operating principle of BLDC, modeling of BLDC, similarities and difference between PMSM and BLDC, need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methodsof reducing torque ripples of BLDC motor.

UNIT– 5
Control of Switched Reluctance Motor (SRM) Drive:
SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous -torque control using current controllers and flux controllers.

Course Outcomes: After the completion of the course, student will be able to

- Understand the concepts of scalar and vector control methods for drive systems.
- Analyze and design controllers and converters for induction motor, PMSM and BLDC drives.
- Select and implement proper control techniques for induction motor and PMSM for specific applications.
- Analyze and design control techniques and converters for SRM drives.

Text Books:

1. Bose B. K., "Power Electronics and Variable Frequency Drives",IEEE Press, Standard PublisherDistributors. 2001.
2. Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

IndiaPrivate Limited.

Reference Books:

1. Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics, 1993.
2. Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley publications

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Control & Integration of Renewable EnergySystems
(Elective -III)

Pre-requisite: Power Electronics

Course Educational Objectives:

- To understand different conventional & non-conventional dynamic energy conversion technologies.
- To learn the principles of static energy conversion technologies.
- To understand the basics of real & reactive power control with renewable generators.
- To learn the principles of standalone and grid connected systems.

UNIT-1

Introduction: Electric grid introduction, Supply guarantee and power quality, Stability, Effects of renewable energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns, static and dynamic energy conversion technologies, interfacing requirements .

UNIT-2

Dynamic Energy Conversion Technologies: Introduction to different conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies, control and integrated operation of differentdynamic energy conversion devices.

UNIT-3

Static Energy Conversion Technologies: Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra-capacitors, plug-in-hybrid vehicles, control and integrated operation of different static energy conversion devices.

UNIT-4

Real and reactive power control: Control issues and challenges in Diesel, PV, wind and fuel cell based generators, PLL, Modulation Techniques, Dimensioning of filters, Linear and nonlinear controllers, predictive controllers and adaptive controllers, Fault-ride through Capabilities, Load frequency and Voltage Control .

UNIT-5

Integration of different Energy Conversion Technologies: Resources evaluation and needs, Dimensioning integration systems, Optimized integrated systems, Interfacing requirements, integrated Control of different resources, Distributed versus Centralized Control, Synchro Converters, Grid connected and Islanding Operations, stability and protection issues, load sharing, Cases studies

Course Outcomes: After the completion of the course, student will be able to

- Gain knowledge on different renewable energy sources and storage devices
- Recognize, model and simulate different renewable energy sources
- Analyze, model and simulate basic control strategies required for grid connection
- Implement a complete system for standalone/grid connected system

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

Text books:

1. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric PowerSystem" John Wiley publishing company
2. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", IET Power Electronics Series, 2012
3. G. Masters, "Renewable and Efficient Electric Power Systems", IEEE-Wiley Publishers, 2013

References:

1. Quing-Chang Zhong, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", Wiley, IEEE Press
2. Bin Wu, Yongqiang Lang, NavidZargari, "Power Conversion and Control of Wind Energy Systems", Wiley 2011.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Hybrid Electric Vehicles
(Elective-III)

Pre-requisite: Knowledge of Power Electronics and Electric Drives

Course Educational Objectives:

- To learn the concept of hybrid vehicles, types of electric drives used in hybrid vehicles andtheir control.

UNIT– 1
Introduction:
History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT– 2
Hybridization of Automobile:
Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT– 3
Plug-in Hybrid Electric Vehicle:
PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT– 4
Power Electronics in HEVs:
Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DC- DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– 5
Battery and Storage Systems
Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

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

- Know the concept of electric vehicles and hybrid electric vehicles.
- Familiar with different motors used for hybrid electric vehicles.
- Understand the power converters used in hybrid electric vehicles
- Know different batteries and other energy storage systems.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric andFuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction – Dhanpat Rai & Co, 2007.

Research Books:

1. Pistooa G., "Power Sources , Models, Sustanability, Infrastructure and the market", Elsevier 2008
2. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications withPractical Perspectives" 1995.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-SEMESTER
DIGITAL CONTROL SYSTEMS
(ELECTIVE-III)

Pre-Requisite: Control Systems, digital control systems.

Course Educational objectives:

- To understand fundamentals of digital circuits and devices using Z-transforms and Inverse Z-Transforms
- To understand the controllability and observability in digital domain
- To understand the stability and controller design in digital domain
- To understand the design an observer
- To understand the solving of a given optimal control problem

UNIT– 1
Introduction

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold. Review of Z–transforms and Inverse Z– transforms- solving differential equations. Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips

UNIT– 2
State space analysis and the concepts of Controllability and observability

State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations – controllability and observability – concepts, conditions and tests, Principle of duality.

UNIT– 3
Stability Analysis and Controller Design

Stability criterion – Modified Routh"s stability criterion and Jury"s stability test, Lyapunov"s stability analysis.

Design of state feedback controller through pole placement techniques, Necessary and sufficient conditions, Ackermann"s formula, controller for deadbeat response, control system with reference input, Design of full order observer-reduced order observer.

UNIT– 4
State Observer

Necessary and sufficient condition for state observation-Full order state observer- error dynamics – design of prediction observers- Ackermann"s formula-effect of the addition of observer on closed loop system-Current observer- minimum order observer observed – state feedback control system with minimum order observer -control system with reference input.

UNIT– 5
Quadratic Optimal Control Systems

Quadratic optimal control problems-Solution by minimization method using Lagrange multipliers-Evolution of the minimum performance index – discretize quadratic optimal control –Steady state Riccati equations-Lyapunov approaches to the solution of the Steady state quadratic optimal regulator problem and optimal control problem - Quadratic optimal control of a servo system.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

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

- Analyze digital control systems using Z-transforms and Inverse Z-Transforms.
- Evaluate the state transition matrix and solve state equation for discrete model for continuous timesystems, investigate the controllability and observability.
- Determine the stability; design state feedback controller.
- Design an observer.
- Solve a given optimal control problem.

Text Book:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. B. C. Kuo, "Digital control systems"- Holt Saunder"s International Edition, 1991.

Reference Books:

1. M. Gopal: Digital control engineering, New Age Int. Ltd., India, 1998.
2. K. Ogata, "Modern control engineering"- PHI, 1991.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-semester
Advanced Digital Signal Processing
(Elective-IV)

Pre-requisite: Signals & Systems

Course Educational Objectives:

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the concepts of power spectrum estimation of periodic and non-periodic signals

UNIT– 1

Digital Filter Structure: Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

UNIT– 2

Digital filter design: Preliminary considerations-Bilinear transformation method of IIR filter design-design of lowpass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –mean- square-error-constrained least-square design of FIR digital filters

UNIT– 3

DSP algorithm implementation: Computation of the discrete Fourier transform- number representation- arithmetic operations handling of overflow-tunable digital filters-function approximation.

UNIT– 4

Analysis of finite Word length effects: The quantization process and errors- quantization of fixed -point and floating -point Numbers-Analysis of coefficient quantization effects, Analysis of arithmetic round-off errors, dynamic range scaling-signal- to- noise ratio in low -order IIR filters-low-sensitivity digital filters- Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms.

UNIT– 5

Power Spectrum Estimation: Estimation of spectra from finite duration observations signals – Non-parametric methods for power spectrum estimation – parametric method for power spectrum estimation, estimation of spectral form-finite duration observation of signals-non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

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

- Describe structure of digital filters.
- Design digital filters with different techniques.

Chairman - BOS
Electrical & Electronics Engineering
RKCE (Autonomous)

- Understand the implementation aspects of signal processing algorithms.
- Know the effect of finite word length in signal processing.
- Analyze different power spectrum estimation techniques.

Text Books:

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint

Reference Books:

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI – 3rdedition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design-Auntonian-TMH.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I year II-Semester
Applications of Power Converters
(Elective-IV)

Pre-requisites: Analysis of Power Electronic Converters

Course Educational Objectives:

- To understand the inverters for induction heating applications
- To understand the power converters for different industrial applications
- To understand modeling of high voltage power supplies using the power converters for radar andspace applications
- To understand modeling of low voltage and high current power supplies using the powerconverters for microprocessors and computer loads
- To understand the applications of DC-DC converters

UNIT-1

Inverters for Induction Heating: For induction cooking, induction hardening, melting, and weldingapplications.

UNIT-2

Power Converters for Lighting, pumping and refrigeration Systems: Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications.

UNIT-3

High Voltage Power Supplies - Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT-4

Low voltage high current power supplies: Power converters for modern microprocessor and computer loads

UNIT-5

Bi-directional DC-DC (BDC) converters: Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers

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

- Analyze power electronic application requirements.
- Identify suitable power converter from the available configurations.
- Develop improved power converters for any stringent application requirements.
- Improvise the existing control techniques to suit the application. Design of Bi-directionalconverters for charge/discharge applications

Text books:

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRCPress, 2005.

2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel CellVehicles, 1st Edition,CRC Press, 2004.

References:

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Microcontrollers (Elective-IV)

Pre-requisite: Basic micro-processors & micro controllers.

Course Educational Objectives:

- To learn about microcontrollers architecture.
- To learn about DSP architecture and assembly programming for DSP processors.
- To learn about basics of FPGA controllers.

UNIT– 1
PIC Microcontrollers
PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC)

UNIT– 2
Introduction to DSP
Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface , System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT– 3
I/O & Control Registers
Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT– 4
ADC & Event Manager
ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV), Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs, Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information

UNIT– 5
Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Xilinx C3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study.

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

- Design the interfacing circuits for input and output to PIC micro controllers and DSP processors.
- Write ALP for DSP processors.
- Design PWM controller for power electronic circuits using FPGA.

Text Books:

1. Microcontrollers-Theory and Applications - Ajay V Deshmukh, McGraw Hills, 2005.
2. DSP Based Electro Mechanical Motion Control -Hamid.A.Toliyat and Steven G.Campbell,

Chairman-- BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

CRC Press New York, 2004.

Reference Books:

1. The 8051 Microcontroller-Kennith J ayala, Thomson publishers,2005.
2. Microprocessor and Microcontrollers by Prof C.R.Sarma.
3. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA, 1998.
4. Wayne Wolf," FPGA based system design ", Prentice hall, 2004

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Electric Drives Simulation Laboratory

Pre-requisite: Power electronics & Drives

Course Educational Objectives:
The student should be able to understand the simulate different electrical machines and drives

Any 10 of the following experiments are to be conducted.

List of Experiments:

1. Simulation of DC shunt machine as motor & generator.
2. Simulate the speed control of DC motor using chopper converter.
3. Simulation of induction motor modes using d-q model.
4. Simulate the speed control of induction motor by using V/f control.
5. Simulate the BLDC motor and observe the speed transients.
6. Simulate speed control of induction motor by using vector control.
7. Compare the transient performance of induction motor controlled by v/f control & vector controlmethods.
8. Simulate PMSM motor by using d-q model.
9. Simulate the multi-level inverter fed induction motor drive.
10. Simulate the re-generative braking of inverter fed induction motor.
11. Study of PWM controlled inverter fed PMSM drive.
12. Evaluation of switching frequency effect on electric drive

Course Objectives:
The student should analyze the performance of different electrical machines and drives

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Electric Drives Laboratory

Course Educational Objectives:
To study the speed control methods of DC & AC drives.

Any 10 of the following experiments are to be conducted.

List of experiments:

1. Study of armature controlled separately excited DC drive with 1-ϕ full converter.
2. Study of chopper controlled separately excited DC drive.
3. Study of armature controlled separately excited DC drive with 3-ϕ full converter
4. Study of dynamic braking of DC drives.
5. Study of regenerative braking of DC drive.
6. Study of performance characteristics of a 3-ϕ induction motor using V/f control.
7. Vector control based speed control of induction motor.
8. Study of direct torque control of induction motor.
9. Speed control of PMSM drive with 3-ϕ inverter.
10. Speed control of BLDC drive with 3-ϕ inverter.
11. Speed control of switched reluctance motor drive.

Course Outcome: The student should Understand the performance of DC & AC drives.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

I Year II-Semester
Mini Project with Seminar

Note:

It is recommended that a Supervisor/advisor should be allotted to each student at the end of thesemester-I or allot at the start of the semester-II

Syllabus content:

A Student has to select one paper published in any of the IEEE Transactions and simulate the same. The student has to present the progress of the work at the middle of the semester. At the endof the semester, the student has to present the results by explaining the idea of the topic, methodology, finding of the simulations. A Student should also submit a report of the entire work carried out under this course. The end semester presentation must be video recorded and preserved.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

- Understand that how to improve your writing skills and level of readability Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedgingand Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are neededwhen writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman"sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards:** Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People"s Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies""New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice HallOf India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &DeepPublication Pvt. Ltd., New Delhi.

Chairman - BOS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjectsenhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the hugeknowledge from ancient literature

Syllabus

Unit	Content	Hou
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India"s Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood Being a logical language will help to develop logic in

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	• Values and self-development –Social values and individual attitudes.Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism.Love for nature ,Discipline	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

1 Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course outcomes

Students will be able to 1.Knowledge of self-development
2.Learn the importance of Human values 3.Developing the overall personality

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals" constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in theearly years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus		
Units	**Content**	**Hours**
1	• **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	• **Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	• **Contours of Constitutional Rights & Duties:** • Fundamental Rights • Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Fundamental Duties.	4
4	• **Organs of Governance:** • Parliament, Composition ,Qualifications and Disqualifications • Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	4
5	• **Local Administration:** • District"s Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEof Municipal Corporation. • Pachayati raj: Introduction, PRI: ZilaPachayat. • Elected officials and their roles, CEO ZilaPachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy	4
6	• **Election Commission:** • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before thearrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Syllabus		
Units	**Content**	**Hours**
1	• **Introduction and Methodology:** • Aims and rationale, Policy background, Conceptual framework andterminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	2
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of includedstudies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogicalpractices. • Pedagogic theory and pedagogical approaches. • Teachers" attitudes and beliefs and Pedagogic strategies.	4
4	• Professional development: alignment with classroom practices andfollow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	4
5	• **Research gaps and future directions** • Research design • Contexts • Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact.	2

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare,31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primaryeducation. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, „learning to read" campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classroomsin developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum andguidance materials best support effective pedagogy?

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	• Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don"t"s in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	• Asan and Pranayam 1. Various yog poses and their benefits for mind & body 2. Regularization of breathingtechniques and its effects-Types of pranayam	8

Suggested reading

1. „Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)

AUDIT 1 and 2:
PERSONALITY DEVELOPMENT THROUGH LIFEENLIGHTENMENT SKILLS

Course Objectives
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont"s) • Verses- 71,73,75,78 (do"s)	8
2	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, • Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	8
3	• Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8

Suggested reading
1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari"s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
Students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality andachieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity Study of Neetishatakam will help in developing versatile personality of students

Chairman - BoS
Electrical & Electronics Engineering
RKCE (Autonomous)