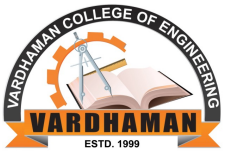

VARDHAMAN COLLEGE OF ENGINEERING

(AUTONOMOUS)

Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade, **ISO 9001:2015** Certified

Kacharam, Shamshabad, Hyderabad - 501218, Telangana, India

www.vardhaman.org

CURRICULUM

For

Master of Technology

Power Electronics and Electrical Drives

Under

Choice Based Credit System (CBCS)

M. Tech. - Regular Two Year PG Degree Program

(For batches admitted from the Academic Year 2022-2023)

October 2022

M. Tech – Power Electronics and Electrical Drives

Regulations: VCE-R22

College Vision:

- **To be a pioneer institute and leader in engineering education to address societal needs through education and practice.**

College Mission:

- **To adopt innovative student centric learning methods.**
- **To enhance professional and entrepreneurial skills through industry institute interaction.**
- **To train the students to meet dynamic needs of the society.**
- **To promote research and continuing education.**

Department Vision:

- Producing professionally competent graduates in the domain of electrical engineering to serve the industry/society addressing the challenges.

Department Mission:

- Provide professional skills in electrical circuit design and simulation to the students.
- Bringing awareness among the students with emerging technologies to meet the dynamic needs of the society.
- Develop industry-institute interface for collaborative research, internship and entrepreneurial skills among the stakeholders (Students/Faculty).
- Encourage multi-disciplinary activities through research and continuous learning activities.

Program Educational Objectives(PEOs):

- **PEO1: Graduates will demonstrate peer recognized technical competency to design, analyze, develop solutions for problems in the field of power electronics and electrical drives.**

- **PEO2: Graduates will demonstrate leadership and initiative to advance professional and organizational goals with commitment to ethical standards of profession, teamwork and respect for diverse cultural background.**

- **PEO3: Graduates will be engaged in ongoing learning and professional development through pursuing higher education and self-study.**

- **PEO4: Graduates will be committed to creative practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.**

Program Outcomes(POs):

- **PO1: An ability to independently carry out research/investigation and development work to solve practical problems.**
- **PO2: An ability to write and present a substantial technical report/document.**
- **PO3: An ability to demonstrate a degree of mastery in the domain of power electronics and electrical drives.**
- **PO4:An ability to identify Power Electronics based solutions to improve power conversion, power quality and reliability in Electrical systems.**
- **PO5: An ability to conceptualize, design and analyze various control strategies for energy efficient drives.**

Programme Curriculum Structure
M. Tech – Power Electronics and Electrical Drives

Regulations: VCE-R22

I Year I Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6301	Power Electronic Converters	3	0	3	40	60	100
2	B6302	Electrical Drives System	3	0	3	40	60	100
3		Professional Elective - I	3	0	3	40	60	100
4		Professional Elective - II	3	0	3	40	60	100
5	B6303	Electrical Drives Laboratory	0	4	2	40	60	100
6	B6304	Power Electronics Simulation Laboratory - I	0	4	2	40	60	100
7	B6001	Research Methodology and IPR	2	0	2	40	60	100
8		Audit Course - I	2	0	0	-	100*	100*
Total			16	08	18	280	520	800

I Year II Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6305	Modeling and Analysis of Electrical Machines	3	0	3	40	60	100
2	B6306	Digital Control of Power Electronic and Drive Systems	3	0	3	40	60	100
3		Professional Elective - III	3	0	3	40	60	100
4		Professional Elective - IV	3	0	3	40	60	100
5	B6307	Electrical Drives Simulation Laboratory	0	4	2	40	60	100
6	B6308	Power Electronics Simulation Laboratory - II	0	4	2	40	60	100
7	B6341	Mini-Project with seminar	0	2	2	100	-	100
8		Dissertation Work Review - I	-	-	-	-	-	-
9		Audit Course - II	2	0	0	-	100*	100*
Total			14	10	18	340	460	800

Programme Curriculum Structure
M. Tech – Power Electronics and Electrical Drives

Regulations: VCE-R22

II Year I Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1		Professional Elective - V	3	0	3	40	60	100
2		Open Elective	3	0	3	40	60	100
3	B6342	Dissertation Work Review – II	0	12	6	100	-	100
Total			6	12	12	160	140	300

II Year II Semester								
#	Course Code	Title of the Course	Hours per Week and Credit			Assessment Marks		
			L	P	C	CIE	SEE	Total
1	B6343	Dissertation Work Review – III	0	12	6	100	-	100
2	B6344	Dissertation Viva - Voce	0	28	14	-	100	100
Total			0	40	20	100	100	200

Programme Curriculum Structure
M. Tech – Power Electronics and Electrical Drives

Regulations: VCE-R22

List of Professional Electives

Professional Elective - I	
Course Code	**Title of the Course**
B6351	Energy Storage Systems
B6352	PWM Converter and Applications
B6353	Power Quality

Professional Elective - II	
Course Code	**Title of the Course**
B6354	Static VAR Controllers and Harmonic Filtering
B6355	Electric and Hybrid Vehicles
B6356	Microgrid Technologies

Professional Elective - III	
Course Code	**Title of the Course**
B6357	Switched Mode and Resonant Converters
B6358	Industrial Load Modeling and Control
B6359	Digital Control Systems

Professional Elective - IV	
Course Code	**Title of the Course**
B6360	Applications of Power Electronic Converters
B6361	Distributed Generation
B6362	Smart Grids

Professional Elective - V	
Course Code	**Title of the Course**
B6363	SCADA Systems and Applications
B6364	FACTS and Custom Power Devices
B6365	High Voltage DC Transmission

Programme Curriculum Structure
M. Tech – Power Electronics and Electrical Drives

Regulations: VCE-R22

Audit Courses		
#	Course Code	Title of the Course
1	B6091	Disaster Management
2	B6092	Value Education
3	B6093	Constitution of India
4	B6094	Stress Management by Yoga
5	B6095	Personality Development through Life Enlightenment skills
6	B6096	Pedagogy Studies

Open Electives		
#	Course Code	Title of the Course
1	B6081	Business Analytics
2	B6082	Waste to Energy
3	B6083	Operations Research
4	B6084	IoT and Applications
5	B6085	Cyber Security
6	B6086	Mobile Cloud Computing

I YEAR I SEMESTER

Course Structure

B6301 - Power Electronic Converters

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The objective is to make them familiar with various power electronic converter circuits. This course deals with the analysis of power semiconductor switched circuits for various loads. Also, this course mainly emphasizes on the analysis of various power electronic converter circuits such as phase-controlled rectifiers, dc-dc converters, AC voltage controllers, Cyclo-converters, and Inverters.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6301.1 Analyse the performance of power semiconductor switched circuits with various loads.
B6301.2 Analyse the performance of AC-DC converters for the specified applications.
B6301.3 Analyse and design the performance of DC-DC converters to meet specific requirements.
B6301.4 Apply PWM techniques to enhance the performance of inverters.
B6301.5 Analyse and design the performance of AC-AC converters to meet specific requirements.

3. Course Syllabus

Module 1: Analysis of power semiconductor switched circuits with R, L, RL, RC loads D.C. motor load. Battery charging circuit.

Module 2: Single-Phase and Three-Phase AC to DC converters. Half controlled configurations-operating domains of three phase full converters and semi-converters. Reactive power considerations.

Module 3: Analysis and design of DC to DC converters. Control of DC-DC converters: Buck converters, Boost converters, Buck Boost converters, Cuk converters.

Module 4: Single phase and three phase inverters. Voltage source and Current source inverters. Voltage control and harmonic minimization in inverters.

Module 5: AC to AC power conversion using voltage regulators. Choppers and cycloconverters. Consideration of harmonics, introduction to Matrix converters.Design aspects of converters, Few practical applications.

4. Books and Materials

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins (2003), Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley & Sons.
2. M. H. Rashid (1998), Power Electronics: Circuits, Devices and Applications, 3rd Edition,Prentice Hall of India, New Delhi.

Reference Books:

1. P. C. Sen(2001), Power Electronics, 30th Edition, Tata Mc Graw Hill Publishing, New Delhi.
2. Vedam Subramanyam (1997), Power Electronics, New Age International (P) Limited, New Delhi.

Course Structure

B6302 - Electrical Drives System

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course provides an introduction to the dynamics of electric drives. It also elaborates the different types of load torque and steady state stability. This course gives an explanation about the DC drives controlled by converters and choppers. The various speed control schemes of AC machines is also discussed. It also explains the characteristics of traction and industrial drives.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6302.1 Apply the basic electrical knowledge to understand the load torque and its components of electrical drives.
B6302.2 Analyse the torque equations and Speed control methods of different Electrical drives.
B6302.3 Compare the operation of phase controlled and chopper controlled DC drives.
B6302.4 Analyze the dynamic modelling and speed control of poly phase induction machines.
B6302.5 Analyze the characteristics of traction drives and industrial drives.

3. Course Syllabus

Module 1: Dynamics of Electric Drives: Fundamentals of torque equation. Speed torque convention and ulti-quadrant operation, components of load torques.

Module 2: Classification of load torques steady state stability. Load equation, Speed control and drive classification.Close loop control of drives.

Module 3: DC motor Drives-Modeling of DC machines. Steady state characteristics with armature and speed control. Phase controlled DC motor drives, chopper controlled DC motor drives.

Module 4: Poly-phase induction machines- Dynamic modeling of induction machines. Small signal equations, control characteristics of induction machines. Phase-controlled induction machines. Stator voltage control. Slip energy recovery scheme, frequency control and vector control of induction motor drives.

Module 5: Traction motor: Starting Speed-Time characteristics, Braking, Traction motors used in practice. Industrial Drives-Digital Control of Electric Drives,Stepper motor, Servo motor and their Applications.

4. Books and Materials

Text Books:

1. G.K, Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey, 1989.
2. R.Krishanam, “Electric motor drives modeling, analysis and control”, PHI-India-2009.
3. G. K. Dubey,“Fundamentals of electric Drives, Narosa Publishing House”, 2nd Edition, 2011

Reference Books:

1. W. Leonhard, “Control of Electrical drives”, Springer, 3rd Edition, 2001.
2. P.C. Krause –, “Analysis of Electric Machine”, Wiley-IEEE press , 3rd Edition.
3. K. Bose, “Modern Power Electronics and AC Drives”, Prentice Hall publication, 1st Edition, 2001.

Course Structure

B6303 - Electrical Drives Laboratory

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

This Laboratory course gives an exposure on different speed control techniques employed and closed loop control of PMDC motor. It also provides you a practical experience on the speed control of induction machines using cyclo converter. This lab course gives an opportunity to conduct test on single phase half and full controlled converter with inductive load.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6303.1 Make use of different methods to control the speed of the Induction motor using power electronic converters.

B6303.2 Apply closed loop control technique to control the speed of the DC motor and PMDC motor.

B6303.3 Analyze the four quadrant operation of a DC motor and a PMDC motor with a suitable chopper drive.

B6303.4 Apply the basic principles of power electronic converters to study the operation of a half controlled and fully controlled converter with inductive load.

3. Course Syllabus

1. Speed measurement and closed loop control using PMDC motor.
2. Thyristorised drive for PMDC motor with speed measurement and closed loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3- Phase input, Thyristorised drive, 3 Hp DC motor with closed loop.
6. 3- Phase input IGBT, 4 quadrant chopper drive for DC motor with closed loop control equipment.
7. Cyclo converter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single phase full controlled converter with inductive load.

10. Single phase Half controlled converter with inductive load.

4. Laboratory Equipment/Software/Tools Required

1. Functional Kits of above experiments
2. Tachometer

5. Books and Materials

Text Books:

1. W. Leonhard, "Control of Electrical drives", Springer, 3rd Edition, 2001.
2. P.C. Krause –, "Analysis of Electric Machine", Wiley-IEEE press , 3rd Edition.

Reference Books:

1. R.Krishanam, "Electric motor drives modeling, analysis and control", PHI-India-2009.
2. G. K. Dubey,"Fundamentals of electric Drives, Narosa Publishing House", 2nd Edition, 2011

Course Structure

B6304 - Power Electronics Simulation Laboratory - I

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

The course exposes students to operation and characteristics of power electronic converters. The student will have exposure to operating principles, design,simulate and synthesis of different powerelectronic converters.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6304.1 Use modern tool simulator to simulate and analyse the basic power electronic converters with various loads.

B6304.2 Use modern tool simulator as a learning aid and gain understanding into the working of various basic power electronic converters.

B6304.3 Use modern tool simulator as an aiding tool to design basic power electronic converters.

3. Course Syllabus

1. MATLAB Simulation of Single-phase full converter using RL&E loads.
2. MATLAB Simulation of Single-phase Semi converter using RL&E loads.
3. MATLAB Simulation of Three-phase full converter using RL&E loads.
4. MATLAB Simulation of Three-phase Semi converter using RL&E loads.
5. MATLAB Simulation of Single-phase AC Voltage controller with RL load.
6. MATLAB Simulation of Three-phase AC Voltage controller with RL load.
7. MATLAB Simulation of Single-phase Half Bridge inverter with R and RL loads.
8. MATLAB Simulation of Single-phase H bridge inverter with R and RL loads.
9. MATLAB Simulation of Buck Converter with RLE load.
10. MATLAB Simulation of Boost Converter with RLE load.

4. Laboratory Equipment/Software/Tools Required

1. Matlab Software

2. Desktop Computer

5. Books and Materials

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins (2003), Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley & Sons.
2. M. H. Rashid (1998), Power Electronics: Circuits, Devices and Applications, 3rd Edition,Prentice Hall of India, New Delhi.

Reference Books:

1. P. C. Sen(2001), Power Electronics, 30th Edition, Tata Mc Graw Hill Publishing, New Delhi.
2. Vedam Subramanyam (1997), Power Electronics, New Age International (P) Limited, New Delhi.

Course Structure

B6001 - Research Methodology and IPR

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
2	0	28	0	2	40	60	100

1. Course Description

Course Overview

Research is an art of scientific investigation. Research is an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison and experiment. This course will help students to understand about the research process, tools, importance of ethics. Students can learn about the law of patent and copyrights and knowledge on IPR (Intellectual Property rights)

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

B6001.1. Identify an appropriate research problem in their suitable domain.
B6001.2. Construct a well-structured research paper and scientific presentations.
B6001.3. Express the importance of research ethics in scientific community.
B6001.4. Explore on various component of IPR and process of filing.
B6001.5. Gain knowledge on patents and copyrights.

3. Course Syllabus

Research Problem: Scope and objectives, Selection criteria, Research Problems, Research Approaches, Data collection, Data analysis, Ethics, Instrumentation, Interpretation.

Literature Studies: Effective literature studies, Types of literature review, Process and Purpose, Survey, Critical analysis, classification and comparison, case study, identifying the knowledge gap and propose a action plan.

Technical Writing: Effective Report/Article/Thesis writing, tools required, documentation using suitable application (Word, LaTeX, Pages), data representation using graphs, bar diagrams, pi-charts, preparation of manuscript, plagiarism, presentation of research work, Abstract and Conclusion.

Research proposal: Problem defining, national and international Scenario of proposed research, key factors, cost and contingencies, preparing timeline for research plan, funding agencies, collaboration, product and patent development.

Patent Rights and IPR: Process of Patenting and Development, Copyright, Trademark, Licensing and transfer of technology, Patent information and databases, New Developments in IPR, Administration of Patent System, Trade Secret, Copyright Infringement.

4. Books and Materials

Text Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology : Methods And Techniques, New Age International Publishers; 4th edition, 2019
2. P Suganda Devi, Research Methodology: A Handbook for Beginners, Notion Press; 1st edition, 2017
3. Brad Sherman and Lionel Bently, Intellectual Property Law, Oxford University Press, 4th edition, 2014

I YEAR II SEMESTER

Course Structure

B6305 - Modeling and Analysis of Electrical Machines

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course deals with the development of mathematical models for various electrical machines. Also covers the Analysis of singly and doubly excited electro mechanical system with linear magnetics - using energy and co-energy principles and construct various machines model based on Reference frames.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6305.1 Apply the principles of science and engineering to model the electrical machines.
B6305.2 Develop a mathematical model of DC machine using reference frame theory to determine its equivalent circuit parameters.
B6305.3 Model an Induction machine using reference frame theory to determine its equivalent circuit parameters.
B6305.4 Develop a mathematical model of a synchronous machine using reference frame theory to determine its equivalent circuit parameters.
B6305.5 Develop a mathematical model of Switched Reluctance motor and permanent magnet machines.

3. Course Syllabus

Module 1: Principles of Electromagnetic Energy Conversion. General expression of stored magnetic energy. Co-energy and force/torque, example using single and doubly excited system.

Module 2: Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phase, machine inductance using physical machine data; Voltage and torque equation of dc machine.

Module 3: Three phase symmetrical induction machine and salient pole synchronous, machines in phase variable, form, Application of reference frame theory to three phase symmetrical induction and synchronous machines, Dynamic direct and quadrature axis model in

arbitrarily rotating reference frames.

Module 4: Determination of Synchronous machine dynamic equivalent circuit parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

Module 5: Special Machines - Permanent magnet synchronous machine, Surface permanent magnet (square and sinusoidal back emf type) and interior, permanent magnet machines, Construction and operating principle Dynamic modelling and self-controlled operation. Analysis of Switch Reluctance Motors. Brushless D.C. Motor for space Applications, Recent trends.

4. Books and Materials

Text Books:

1. Charles Kingsle, Jr., A.E. Fitzgerald, Stephen D.Umans, "Electric Machinery", Tata Mcgraw Hill.
2. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India.

Reference Books:

1. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press.
2. P.C. Krause "Analysis of Electric Machine, 3rd Edition, Wiley IEEE Press.
3. Chee-MunOng, "Dynamic Simulation of Electric Machinery using MATLAB / Simulink", Prentice Hall, 1998.

Course Structure

B6306 - Digital Control of Power Electronic and Drives Systems

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

Digital control of power electronics and drive systems is a theory course intended to enhance the knowledge of students in various control aspects of electrical drives.This course deals with simulation of single phase and three-phase controlled converter based DC motor control, Chopper based control of DC motors and four quadrant operation of DC drives. This course also deals with speed control of Induction motor with single phase and three phase inverters. It also deals with application of numerical methods to solve DC and AC transients. This course is an extension of power electronics applications to AC and DC drives which gives knowledge about power semiconductor drives and motor control.

Course Pre/co-requisites

UG Course - Power Electronics, Electrical Machines, Network thoerems.

2. Course Outcomes (COs)

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

B6306.1 Apply numerical methods to solve transients DC and AC networks..
B6306.2 Model power electronic devices and its gate drive/base drive circuits in MATLAB/Simulation..
B6306.3 Design electrical machines in MATLAB to observe it characteristics and stability in different loading conditions.
B6306.4 Simulate single phase and three phase converters with DC motor drives and also the power factor correction schemes..
B6306.5 Simulate single phase and three phase inverters with induction motor drives by applying various PWM techniques.

3. Course Syllabus

Module 1: Review of numerical methods, Application of numerical methods to solve transients in D.C, Switched R, L, R- L, R-C and R-L-C circuits. Extension to AC circuits.

Module 2: Modelling of diode in simulation, Diode with R, R-L, R-C and R-L-C load with AC supply, Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation, Application of numerical methods to R, L, C circuits with power electronic switches. Simulation of

gate/base drive circuits, simulation of snubber circuits.

Module 3: State space modelling and simulation of linear systems. Introduction to electrical machine modelling: induction, DC, and synchronous machines, simulation of basic electric drives, stability aspects.

Module 4: Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers. Converters with self-commutated devices- simulation of power factor correction schemes. Simulation of converter fed DC motor drives. Simulation of thyristor choppers with voltage. Current and load commutation schemes. Simulation of chopper fed DC motor.

Module 5: Simulation of single and three phase inverters with thyristors and self commutated devices. Space vector representation. Pulse-width modulation methods for voltage control. Waveform control. Simulation of inverter fed induction motor drives.

4. Books and Materials

Text Books:

1. L. Ashok Kumar, A. Kalaiarasi, Y. Uma Maheswari, "Power Electronics with MATLAB", Cambridge University Press, 2017.
2. Simulink Reference Manual, Math works, USA.

Reference Books:

1. Randal Shaffer, "Fundamentals of Power Electronics With Matlab", Charles River Media, 2006.
2. Narayanaswamy P R Iyer, 'Power Electronic Converters - Interactive Modelling Using Simulink", 1st Edition, CRC Press, 2018

Course Structure

B6307 - Electrical Drives Simulation Laboratory

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

This laboratory course gives the students an exposure on MATLAB Simulink to simulate the closed loop control of PMDC motor. It also makes the students to understand the single and multi-quadrant operation of DC drives by simulating using MATLAB Simulink. The simulation experiments on Induction machines using different controllers gives a better understanding of theoretical concepts to the students.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6307.1 Make use of MATLAB simulink to control the speed of the Induction motor using power electronic converters.

B6307.2 Apply closed loop control technique using MATLAB simulink to control the speed of the PMDC motor.

B6307.3 Analyze the four quadrant operation of a chopper controlled DC motor drive using MATLAB simulink.

B6307.4 Apply the basic principles of power electronic converters to study the operation of a single phase and three phase DC motor drive using MATLAB simulink.

3. Course Syllabus

1. MATLAB Simulation of closed loop control of buck converter fed PMDC motor.
2. MATLAB Simulation of closed loop control of boost converter fed PMDC motor.
3. MATLAB Simulation of buck-boost converter fed PMDC motor.
4. MATLAB Simulation of two quadrant chopper fed DC motor drive.
5. MATLAB Simulation of four quadrant chopper fed DC motor drive.
6. MATLAB Simulation of Single-Phase Converter fed DC motor drive.
7. MATLAB Simulation of Three-Phase Converter fed DC motor drive.
8. MATLAB Simulation of Cycloconverter fed Induction motor drive.
9. MATLAB Simulation of AC voltage controller fed Induction motor drive.

10. MATLAB Simulation of PWM inverter fed induction motor drive.

4. Laboratory Equipment/Software/Tools Required

1. Matlab Software
2. Desktop Computer

5. Books and Materials

Text Books:

1. P.C. Krause –, "Analysis of Electric Machine", Wiley-IEEE press , 3rd Edition.
2. K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall publication, 1st Edition, 2001.

Reference Books:

1. R.Krishanam, "Electric motor drives modeling, analysis and control", PHI-India-2009.
2. G. K. Dubey,"Fundamentals of electric Drives, Narosa Publishing House", 2nd Edition, 2011

Course Structure

B6308 - Power Electronics Simulation Laboratory - II

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
0	4	0	56	2	40	60	100

1. Course Description

Course Overview

The course exposes students to operation and characteristics of power electronic converters. The student will have exposure to operating principles, design, simulate and synthesis of different power electronic converters.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6308.1 Use modern tool simulator to simulate and analyse the advanced power electronic converters.

B6308.2 Use modern tool simulator as a learning aid and gain understanding into the working of various power electronic converters.

B6308.3 Use modern tool simulator as an aiding tool to design power electronic converters.

B6308.4 Use modern tool to simulate and analyse the different modulation techniques to pulse width modulated inverters and identify the harmonic reduction methods.

3. Course Syllabus

1. MATLAB Simulation of Buck-Boost Converter with RLE load.
2. MATLAB Simulation of Interleaved DC-DC converter.
3. MATLAB Simulation of Bidirectional DC-DC Converter.
4. MATLAB Simulation of DC-DC Flyback Converter.
5. MATLAB Simulation of DC-DC Forward Converter
6. MATLAB Simulation of Converter for battery charging in PV systems.
7. MATLAB Simulation of Three-phase inverter with PWM controller.
8. MATLAB Simulation of Diode clamped multilevel inverter.
9. MATLAB Simulation of Flying Capacitor multilevel inverter.
10. MATLAB Simulation of Cascade type multilevel inverter.

4. Laboratory Equipment/Software/Tools Required

1. Matlab Software
2. Desktop Computer

5. Books and Materials

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins (2003), Power Electronics: Converters, Applications and Design, 3rd Edition, John Wiley & Sons.
2. M. H. Rashid (1998), Power Electronics: Circuits, Devices and Applications, 3rd Edition,Prentice Hall of India, New Delhi.

Reference Books:

1. P. C. Sen(2001), Power Electronics, 30th Edition, Tata Mc Graw Hill Publishing, New Delhi.
2. Vedam Subramanyam (1997), Power Electronics, New Age International (P) Limited, New Delhi.

Professional Electives

Course Structure

B6351 - Energy Storage Systems

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students to impart fundamental knowledge on energy storage systems considering the operation and design of various energy storage devices. This course provides a foundation for understanding the general principles and fundamentals of lithium-ion rechargeable battery engineering, fuel cells and super capacitors.

Course Pre/co-requisites

UG Courses - Engineering Physics, Basic Electrical Engineering

2. Course Outcomes (COs)

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

B6351.1 Apply the knowledge of concepts of science to understand the concepts of electrochemical cell.
B6351.2 Apply the knowledge of electrochemistry to describe the components and process in batteries.
B6351.3 Describe the electrical, thermal, and mechanical behavior of Li-Ion batteries under various operating conditions.
B6351.4 Apply the knowledge of basic science concepts to distinguish various types of fuel cells and their functionalities.
B6351.5 Apply the knowledge of science to interpret the operation and characteristics of super capacitors.

3. Course Syllabus

Module 1: Battery technology Overview: Battery definitions, terms and terminology, Primary cells, Secondary cells. Electrochemistry - Electrochemical energy sources, Voltage and potential energy, Reduction and oxidation, Reduction potentials and electrochemical couples, Electrochemical cell. Battery Construction - Cell mechanical structure, Resistance and polarization, Electrode design, Discharging and charging. Major Battery Chemistries and performance comparison.

Module 2: Lithium-ion Batteries: Lithium-ion cell reaction, construction - pouch cells, cylindrical, flexible foil. Principle of operation, Charge and discharge characteristics, State of charge (SOC), State of health (SOH), State of function (SOF), Charging procedures,

Safety of lithium-ion batteries, Lifetime. Types of Lithium-ion battery - Lithium Iron Phosphate Battery (LFP), lithium nickel manganese cobalt oxide (NMC), lithium nickel cobalt aluminium oxide (NCA), Lithium Polymer Battery.

Module 3: Battery Pack Design and Management Systems: Basic Battery Calculations, Converting Customer Requirements into Pack Designs, Power to Energy Ratios. BMS Typologies – Centralized and Distributed BMS, BMS Tasks, BMS Hardware, Cell supervision and charge equalization, Active and Passive Balancing, Internal Battery communication bus, battery control unit. Battery Thermal Management – Requirements, battery cooling and heating.

Module 4: Fuel Cells: Introduction – working, performance characteristics and efficiency, types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, Alkaline Fuel Cell, Polymer Electrolyte Membrane Fuel Cell, Molten Carbonate Fuel Cell, Solid-Oxide Fuel Cell, hydrogen fuel cells. Applications for power and transportation.

Module 5: Super capacitors: Introduction, Electrochemical Double-Layer Supercapacitors, Equivalent series resistance, Equivalent circuits during charging and discharging, Charge-Discharge characteristics, Energy and power density, Design Considerations, Stacking and Voltage cell balancing, Passively controlled hybrid system with Super capacitor-Battery and Super capacitor-Fuel cell.

4. Books and Materials

Text Books:

1. John Warner, The Handbook of Lithium-Ion Battery Pack Design: Chemistry, Components, Types and Terminology, 1st Edition, Elsevier Science, 2015.
2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, 1st Edition, Springer, 2018.

Reference Books:

1. R. O'hayre, S.W. Cha, W.G. Colella, F.B. Prinz, Fuel Cell Fundamentals, 3rd Edition, Wiley, 2016.
2. Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa, Lithium-Ion Batteries: Science and Technologies, 1st Edition, Springer, 2009.
3. Aiping Yu, Victor Chabot, Jiujun Zhang, Electrochemical Super capacitors for Energy Storage and Delivery: Fundamentals and Applications, CRC Press, 2013.

Course Structure

B6352 - PWM Converters and Applications

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

PWM converters and Applications is a theory course which deals with various pulse width modulation techniques like SPWM, SVPWM, bus clamping and etc. The switching losses of the converter in different applications are discussed in detail. This course also deals with speed control of electrical machines. Estimation of current ripple and torque ripple are very significant part of this course. As reactive power compensation and active filtering plays major role in power system, the advanced PWM techniques in active filtering and reactive power compensation discussed in this course.

Course Pre/co-requisites

UG Course-Power Electronics, Electrical Machines.

2. Course Outcomes (COs)

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

B6352.1 Analyse the rectifiers and inverter circuits.
B6352.2 Calculate switching losses in various power electronic circuits..
B6352.3 Analyse various multilevel inverters and select best converter for given application..
B6352.4 Apply different PWM techniques for a given converter to reduce current and torque ripple.
B6352.5 Apply suitable technique for harmonic compensation and reactive power compensation.

3. Course Syllabus

Module 1: AC/DC and DC/AC power conversion ,Overview of applications of voltage source converters and current source converters.

Module 2: Pulse width modulation techniques for bridge converters Bus clamping PWM. Space vector based PWM. Advanced PWM techniques.

Module 3: Practical devices in converter. Calculation of switching and conduction power losses.

Module 4: Compensation for dead time and DC voltage regulation. Dynamic model of PWM converter. Multilevel converters. Constant V/F induction motor drives.

Module 5: Estimation of current ripple and torque ripple in inverter fed drives. Line-side converters with power factor compensation.Active power filtering. Reactive power compensation. Harmonic current compensation. Selective harmonic elimination PWM technique for high power electric drives.

4. Books and Materials

Text Books:

1. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John's Wiley and Sons.
2. Erickson RW, "Fundamentals of Power Electronics", Chapman and Hall.

Reference Books:

1. Vithyathil. J, "Power Electronics: Principles and Applications", McGraw Hill.

Course Structure

B6353 - Power Quality

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course addresses various issues related to power quality in power systems. This course explains the concepts of transients, flickers, voltage sag, Voltage swell, limits for voltage sag and power quality monitoring.

Course Pre/co-requisites

UG Course - Power Systems - II

2. Course Outcomes (COs)

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

B6353.1 Analyse the severity of power quality problems in distribution system.
B6353.2 Analyse the various causes of voltage flicker and their effects and various means to reduce flickers.
B6353.3 Apply the advanced techniques to minimise sag/swell and interruptions for improve power quality.
B6353.4 Apply the knowledge of harmonic mitigating techniques to improve the performance of system.
B6353.5 Identify the best approaches followed in power quality monitoring.

3. Course Syllabus

Module 1: Introduction-power quality-voltage quality-overview of power, Quality phenomena classification of power quality issues. Power quality measures and standards-THD-TIF-DIN-C-message weights.Flicker factor transient phenomena-occurrence of power quality problems, Power acceptability curves-IEEE guides, Standards and recommended practices.

Module 2: Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics. Important harmonic introducing devices. SMPS, Three phase power converters-arcing devices saturable devices, Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Module 3: Modeling of networks and components under non-sinusoidal conditions, Transmission and distribution systems, Shunt capacitors-transformers. Electric machines. Ground systems loads that cause power quality problems. Power quality problems created by drives

and its impact on drive.

Module 4: Power factor improvement- Passive Compensation. Passive Filtering. Harmonic Resonance. Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End Control Methods for Single Phase APFC. Three Phase APFC and Control Techniques, PFC based on Bilateral Single Phase and Three Phase Converter.

Module 5: POWER QUALITY MONITORING: Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. Harmonic monitoring, transient monitoring, event recording and flicker monitoring.

4. Books and Materials

Text Books:

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000.

Reference Books:

1. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000.
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,"Power system Harmonic Analysis", Wiley,1997.

Course Structure

B6354 - Static VAR Controllers and Harmonic Filtering

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces power quality issues and necessity of compensators and controllers in power system. The concept and applications of static VAR controllers for reactive power control are detailed. This course also deals with active and passive harmonic filters for filtering and control applications.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6354.1 Apply fundamental principles of Passive and Active Reactive Power Compensation Schemes to Transmission and Distribution level in Power Systems.
B6354.2 Analyze analytical modeling and analysis of Static VAR compensator.
B6354.3 Analyze various single phase and three-phase Static VAR Compensation schemes and their controls.
B6354.4 Analyze analytical modeling and analysis of active and passive filters.

3. Course Syllabus

Module 1: Fundamentals of Load Compensation, Steady-State Reactive Power Control in Electric Transmission Systems, Reactive Power Compensation and Dynamic Performance of Transmission Systems.

Module 2: Power Quality Issues: Sags, Swells, Unbalance, Flicker, Distortion. Current Harmonics. Sources of Harmonics in Distribution Systems.

Module 3: Static Reactive Power Compensators and their control. Shunt Compensators. SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control. Series Compensators of thyristor Switched and Controlled Type and their Control. SSSC and its Control, Sub-Synchronous Resonance and damping. Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power System.

Module 4: Converters for Static Compensation. Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM).GTO Inverters. Multi-Pulse Converters and Interface Magnetics. Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM).Multi-level inverters of Cascade Type and their modulation. Current Control of Inverters.

Module 5: Passive Harmonic Filtering, Single Phase Shunt Current Injection Type Filter and its Control. Three Phase Three- wire Shunt Active Filtering and their control using p-q theory and d-q modeling. Three phase four wire shunt active filters. Hybrid Filtering using Shunt Active Filters. Dynamic Voltage Restorer and its control. Power Quality Conditioner.

4. Books and Materials

Text Books:

1. Ned Mohan et.al, "Power Electronics", John Wiley and Sons,2006.
2. G. Massobrio, P. Antognet," Semiconductor Device Modeling with Spice", McGraw-Hill,Inc.,1988.

Reference Books:

1. B. J. Baliga," Power Semiconductor Devices", Thomson, 2004.
2. V. Benda, J. Gowar, D. A. Grant," Power Semiconductor Devices. Theory and Applications", John Wiley & Sons1994.

Course Structure

B6355 - Electric and Hybrid Vehicles

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamental concepts, principles, analysis and design of electric vehicles. Student will explore the working principle of electric vehicles, delve into key roles played by motors as propulsion systems and requirements for battery and its management systems. This course also emphasizes the EV business and the future trends in the development of electric vehicles.

Course Pre/co-requisites

UG Course - Electrical Machines - II

2. Course Outcomes (COs)

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

B6355.1 Infer the electric vehicle system and its impact on environment.
B6355.2 Analyze the various hybrid vehicle configurations and its performance.
B6355.3 Interpret the electric drives used in hybrid and electric vehicles.
B6355.4 Choose proper energy storage systems for electric vehicle applications.
B6355.5 Analyse the significance of electric vehicle in Indian society.

3. Course Syllabus

Module 1: INTRODUCTION TO ELECTRIC VEHICLES: EV System, Components of an EV, EV History, the early years, recent EVs and HEVs ,EV Advantages, Efficiency Comparison, Pollution Comparison, Capital and Operating Cost Comparison.

Module 2: HYBRID ELECTRIC VEHICLES: Types of Hybrids Vehicles, Series and Parallel HEVs, Advantages and Disadvantages, Series-Parallel Combination, Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains.

Module 3: ELECTRIC PROPULSION SYSTEMS: Basic Principles of BLDC Motor Drives, BLDC Machine Construction and Classification, application to Electric Vehicles. Switched Reluctance Motor Drives, Basic Magnetic Structure, Torque Production, SRM Drive Converter, Modes of Operation, Generating Mode of Operation, application to Electric Vehicles.

Module 4: INTRODUCTION TO ENERGY STORAGE REQUIREMENTS: Requirements for Battery Systems in Electric Vehicles, Types of Batteries, Key Battery Management Technologies, Typical Structure of Battery Management Systems.

Module 5: BUSINESS: E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap. EVs in infrastructure system, social dimensions of EVs.

4. Books and Materials

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
2. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES: Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., 2003.
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC PRESS Boca Raton London New York Washington, D.C., 2009.
2. Shen, Weixiang Xiong, Rui, "Advanced battery management technologies for electric vehicles" 2019, John Wiley & Sons.

Course Structure

B6356 - Micro-Grid Technologies

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course deals with Microgrid Technologies and its applications. Microgrids are emerging as a cost-effective and scalable option for meeting global energy demand. Countries throughout the world are now exploring Microgrids as a reliable, low-cost, and timely option to electrify communities away from the grid, or with unreliable electrical power. This course explores localized electricity networks, typically harnessing energy from available solar, wind, hydro, and biomass, could hasten connectivity and reliability for millions of people, while the convergence of key factors such as cost reductions in power generation, storage technology, and use of smart meters, along with various financial models are bringing Microgrids with in reach.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6356.1 Classify different types of micro grids.
B6356.2 Apply power electronic converters and controllers in micro grid.
B6356.3 Analyze energy management system with micro grids.
B6356.4 Analyze protection schemes in micro grids.

3. Course Syllabus

INTRODUCTION TO MICROGRID: Microgrid Configurations – CERTS Microgrid Test Bed – DC Microgrid- HFAC Microgrid – LFAC Microgrid – Hybrid DC- and AC- Coupled Microgrid.

POWER ELECTRONICS IN MICROGRID: Grid Connected Mode – Islanded mode – Battery Charging mode – design of power converters–Brick Busses Software Frame work-Multi Function grid Connected inverters.

CONTROL IN MICROGRID: Impact of load characteristics – Local control – Centralized Control- Decentralized Control-islanded operation – PQ Control - Droop control

methods – requency/Voltage Control –Inverter Output Impedance.

MICROGRID ENERGY MANAGEMENT SYSTEMS: Load Sharing and Power Management Strategy - Stand-alone – Grid connected – energy storage - Voltage Control and Active Power Management.

PROTECTION IN MICROGRID: Device Discrimination-Islanding detection, Effect on Feeder Reclosure, Protection for an Islanded Microgrid having IIDG Units- Adaptive relaying scheme.

4. Books and Materials

Text Books:

1. Suleiman M,Sharkh, Mohammad A.Abu-Sara Georgios I. Orfanoudakis, Babar Hussain, "Power Electronic Converters for Microgrid", Wiley-IEEE Press, 2014.
2. A.Mahmoud, A.L- Sunni and Faud,M, "Control and Optimization of Distributed Generation Systems", Springer, 2015.

Reference Books:

1. Nikos Hatziargyiou, "Microgrids: Architectures and Control", Wiley-IEEE Press, 2013.
2. S.Chowhury, S.P.Chowdury and Peter Crossley, "Microgrids and Active Distribution Networks", IET renewable Energy series, 2011.
3. Ritwi K Majumder, "Microgrid: Stability Analysis and Control" VDM Publishing, 2010.
4. Shin'ya Obara, "Optimum Design of Renewable Energy Systems: Microgrid and Nature Grid Methods", AEEGT Book Series, 2014.

Course Structure

B6357 - Switched Mode and Resonant Converters

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course is a theory course which deals with various converter configurations for switched mode resonant operation and also deals with various pulse width modulation techniques which are useful in reducing switching losses. It also deals with transformer design and filter design for various applications with different frequencies. As zero voltage switching and zero current switching are very important for smooth operation of the converter circuit, the same concepts are discussed in this course. This course also deals with various PWM ICs to generate gating signal to the switching devices present in the SMRC circuits.

Course Pre/co-requisites

UG Courses - Power Electronics, Integrated electronic circuits, Pulse and digital circuits.

2. Course Outcomes (COs)

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

B6357.1 Understand soft switching techniques and its applications.
B6357.2 Apply suitable PWM control IC for a given requirement.
B6357.3 Apply pulse width modulated techniques to various converters.
B6357.4 Analyse and design switched mode power converters.
B6357.5 Design a transformer and filter as per the requirement in the converter circuit.

3. Course Syllabus

Module 1: Buck, Boost, Buck-Boost SMPS Topologies. Basic Operation-Waveforms - modes of operation -switching stresses. Switching and conduction losses. Optimum switching frequency. Practical voltage, current and power limits - design relations. Voltage mode control principles. Push-Pull and Forward Converter Topologies - Basic Operation, aveforms. Flux Imbalance Problem and Solutions.

Module 2: Transformer Design. Output Filter Design. Switching Stresses and Losses. Forward Converter Magnetics. Voltage Mode Control. Half and Full Bridge Converters. Basic Operation and Waveforms. Magnetics, Output Filter, Flux Imbalance, Switching Stresses and Losses, Power Limits, Voltage Mode Control.

Module 3: Classification of Resonant Converters. Basic Resonant Circuit Concepts. Load Resonant Converter, Resonant Switch Converter, Zero. Voltage Switching Clamped Voltage Topologies. Resonant DC Link Inverters with Zero Voltage Switching. High Frequency Link Integral Half Cycle Converter. Fly back Converter- discontinuous mode operation, waveforms, control. Magnetics- Switching Stresses and Losses, Disadvantages – Continuous. Mode Operation, waveforms, control, design relations.

Module 4: Voltage Mode Control of SMPS- Loop Gain and Stability Considerations. Error Amp– frequency Response and Transfer Function. Trans-conductance Current Mode Control of SMPS. Current Mode Control Advantages, Current Mode Vs Voltage Mode.

Module 5: Current Mode Deficiencies. Slope Compensation. Study of a typical Current Mode PWM Control IC UC3842. Modeling of SMPS. Small Signal Approximation- General Second Order Linear Equivalent Circuits. Study of popular PWM Control ICs (SG 3525,TL 494,MC34060 etc.).

4. Books and Materials

Text Books:

1. Abraham I Pressman, "Switching Power Supply Design,". McGraw Hill PublishingCompany,2001.
2. Daniel M Mitchell,"DC-DC Switching Regulator Analysis," McGraw Hill Publishing Company-1988.

Reference Books:

1. Ned Mohan et.al, "Power Electronics," John Wiley and Sons 2006.

Course Structure

B6358 - Industrial Load Modelling and Control

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamental concepts of modelling of industrial loads and its control. This course concentrates on electricity demand by industrial customers and the specific load management alternatives and pricing that can be adopted by industry. Case studies of cooling load and heating loads are explored. Captive power units and selection of optimal operating strategies of industries are analysed.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6358.1 Develop models of various industrial loads.
B6358.2 Analyse electricity pricing and demand side management of industrial loads.
B6358.3 apply control strategies for cooling loads, heating loads, reactive power management.
B6358.4 Analyse captive power units, optimal operating strategies for industrial loads.

3. Course Syllabus

Module 1: Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modeling.

Module 2: Electricity pricing – Dynamic and spot pricing –Models. Direct load control-Interruptible load control. Bottom up approach- scheduling- Formulation of load models-Optimization and control algorithms - Case studies.

Module 3: Reactive power management in industries-controls-power quality impacts application of filters Energy saving in industries.

Module 4: Cooling and heating loads- load profiling- Modeling. Cool storage-Types- Control strategies. Optimal operation- Problem formulation- Case studies.

Module 5: Captive power units- Operating and control strategies- Power Pooling-Operation models. Energy banking- Industrial Cogeneration. Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation- Case study. Integrated Load management for Industries.

4. Books and Materials

Text Books:

1. C.O. Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, theNetherlands,1989.
2. C.W. Gellings and S.N. Talukdar, “Load management concepts,” IEEE Press, New York, 1986,pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe," Physically based Industrial load", IEEE Trans. on PAS, April 1981.

Reference Books:

1. H. G. Stoll, "Least cost Electricity Utility Planning”, Wiley Interscience Publication, USA, 1989.
2. I.J. Nagarath and D.P. Kothari, .Modern Power System Engineering., Tata McGraw Hillpublishers, New Delhi, 1995.
3. IEEE Bronze Book- “Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities”, IEEE Inc, USA.

Course Structure

B6359 - Digital Control Systems

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamental concepts, principles and application of digital control system.Sampling operation, Z – transforms in discrete time nature are discussed. The course goes deeper into the various aspects of digital control engineering such as controllability, observability and stability in state space model.

Course Pre/co-requisites

UG Course-Control Systems.

2. Course Outcomes (COs)

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

B6359.1 Apply the Sampling quantization and reconstruction in ADC conversion and DCA conversion.
B6359.2 Analyse a discrete system in time domain, frequency domain and Z domain.
B6359.3 Inspect Controllability and Observability of digital systems.
B6359.4 Analyse the stability methods of Z - Transform in digital systems.

3. Course Syllabus

SAMPLING OPERATION AND Z - TRANSFORMS: Introduction, Examples of Data control systems, Digital to Analog conversion and Analog to Digital conversion, sample and hold operations, Principle features of discrete time control system, Signal sampling, quantizing and coding, Data acquisition, conversion and distribution system, Reconstruction of original signal from sampled signal.

Z - PLANE ANALYSIS OF DISCRETE - TIME CONTROL SYSTEM: Introduction to Z-transforms, Linear difference equations, pulse response, Z - transforms, Theorems of Z - Transforms, the inverse Z - transforms, Modified Z – Transforms, Z - Transform method for solving difference equations, Pulse transforms function, block diagram analysis of sampled data systems, mapping between S - plane and Z - plane.

STATE SPACE ANALYSIS: State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix

and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.

CONTROLLABILITY AND OBSERVABILITY: Concepts of Controllability and Observability in digital control, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

STABILITY ANALYSIS: Mapping between the S - Plane and Z – Plane, Primary strips and Complementary Strips, Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z – Plan, Jury stability test, Stability Analysis by Bilinear Transformation and Routh's Stability.

4. Books and Materials

Text Books:

1. K. Ogata (2011), Discrete-Time Control systems, 2nd Edition, Pearson Education/Prentice Hall of India, New Delhi.
2. Kuo (2003), Digital Control Systems, 2nd Edition, Oxford University Press, New Delhi.

Reference Books:

1. M. Gopal (2009), Digital Control and State Variable Methods, 3rd Edition, Tata McGraw Hill Publications, New Delhi.

Course Structure

B6360 - Applications of Power Electronic Converters

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course focuses on presenting concepts for conversion and control of electrical energy using power electronic converters. The principles for designing power electronic converters, including their power semiconductors and passive elements are established. The application of power electronic converters in lighting systems and induction heating are presented. Furthermore, the application of power electronic converters in the fields of sustainable energy technologies such as wind energy, solar power, and electrified transportation are described.

Course Pre/co-requisites

UG Course - Power Electronics

2. Course Outcomes (COs)

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

B6360.1 Analyze the requirements of power electronic converters in lighting systems.
B6360.2 Identify and analyze converter configurations used in induction heating applications.
B6360.3 Identify suitable power converter for electric vehicles from the available configurations.
B6360.4 Identify configuration of power converters required for a given renewable energy system.
B6360.5 Develop power converters for utility application requirements.

3. Course Syllabus

Power Converters for Lighting Systems: Buck-Based LED Drivers, Non-isolated PFC based LED drivers, Isolated PFC based LED drivers, Selecting Components for LED Drivers, EMI and EMC Issues.

Power Supplies for Induction Heating: Analysis of Induction heating load, Power-frequency combinations, Two-stage induction heating power supply, Single-stage Induction heating power supply, Multi-frequency Induction Heating power supply, Considerations for induction heating power supplies

Power Converters for Electric Vehicles: Electric traction, Bidirectional Converter Topologies, Non-isolated converters, Isolated converters, Multi-input DC-DC Converters, Multi-phase converters..

Power Converters in Renewable Energy Systems: Fixed Speed Wind Energy Conversion Systems, Variable Speed Wind energy conversion systems with partial-scale and full-scale power converters, Stand-alone PV Systems, Grid-Connected PV Systems.

Utility Applications of Power Converters: Converters for HVDC systems, Solid State Transformers, Static transfer switches, solid state circuit breakers, Active power filters.

4. Books and Materials

Text Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design, 3rd Edition, Wiley.
2. Bimal K. Bose, Power Electronics in Renewable Energy Systems and Smart Grid: Technology and Applications, Wiley-IEEE Press, 2019.

Reference Books:

1. Steve Winder, Power Supplies for LED Driving, 2nd Edition, Newnes, 2017.
2. Valery Rudnev, Don Loveless, Raymond L. Cook, Handbook of Induction Heating, CRC Press, 2003.

Course Structure

B6361 - Distributed Generation

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course has been designed to help students to understand the concept of distributed generation, distributed generation technologies, their interconnection in grid, to understand relevance of power electronics in DG, to understand concept of micro grid. It will also enhance the skill of students to analyze the impact on grid integration & modelling of micro grid.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6361.1 Find the size and optimal placement DG.
B6361.2 Analyze the impact of grid integration and control aspects of DGs.
B6361.3 Model and analyze a micro grid taking into consideration the planning and operational issues of the DGs to be connected in the system.
B6361.4 Describe the technical impacts of DGs in power systems.

3. Course Syllabus

Module 1: Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation.

Module 2: Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.

Module 3: Technical impacts of DGs. Transmission systems Distribution Systems Deregulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.

Module 4: Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality

issues, Reliability of DG based systems.

Module 5: Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modeling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

4. Books and Materials

Text Books:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. S. Chowdhury .S. P. Chowdhury ,P. Crossley ,'Micro Grid and Active Distribution Networks'IET Publication, 2009.

Reference Books:

1. Gevorg Gharehpetian Mohammad Mousav,' Distributed Generation Systems' Butterworth-Heinemann,2017.

Course Structure

B6362 - Smart Grids

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course covers the basics of smart grids, the main difference between the smart grid and traditional grids. The course starts with an overview of smart grid systems and covers the standards and communication technologies applied to smart grids. Next, the challenges related to the smart grid and IOT for Smart Grid Applications are.

Course Pre/co-requisites

UG Course- Power Systems - I

2. Course Outcomes (COs)

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

B6362.1 Describe about smart grid and internet of Energy Systems.
B6362.2 Describe different measuring methods and sensors used in smart grid.
B6362.3 Introduce advanced architectures used in Smart Grid Network.
B6362.4 Evaluate technology options pertaining to renewable energy generation, data handling and communications for Smart Grids.

3. Course Syllabus

Module 1: Introduction to Smart Grid, Evolution of Electric Grid. Concept of Smart Grid, Definitions, Need of Smart Grid. Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid.

Module 2: Introduction to Smart Meters, Real Time Prizing, Smart Appliances. Automatic Meter Reading (AMR). Outage Management System (OMS). Plug in Hybrid Electric Vehicles(PHEV). Vehicle to Grid, Smart Sensors. Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

Module 3: Geographic Information System (GIS). Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro. Compressed Air Energy Storage. Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Module 4: Concept of micro-grid, need & applications of micro-grid. Formation of micro-grid, Issues of interconnection. Protection & control of micro-grid. Plastic & Organic solar cells, Thin film solar cells. Variable speed wind generators, fuel-cells, micro-turbines. Captive power plants, Integration of renewable energy sources.

Module 5: Power Quality & EMC in Smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for Smart Grid. Web based Power Quality monitoring, Power Quality Audit.

4. Books and Materials

Text Books:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012.

Reference Books:

1. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions "CRC Press.
2. A.G. Phadke , "Synchronized Phasor Measurement and their Applications", Springer.

Course Structure

B6363 - SCADA Systems and Applications

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course introduces SCADA technology which is an acronym for Supervisory Control and Data Acquisition. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation. This course explores SCADA Architecture, SCADA Communication technology and its applications.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6363.1 Identify fundamental concepts of SCADA applications in a Bulk Electrical System setting.
B6363.2 Select SCADA system components for industry applications.
B6363.3 Analyze SCADA architecture and communications methods.
B6363.4 Apply different SCADA techniques for industry applications.

3. Course Syllabus

Module 1: Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies.

Module 2: Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

Module 3: Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

Module 4: SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture –IEC 61850.

Module 5: SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. open standard communication protocols.

4. Books and Materials

Text Books:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004.
3. William T. Shaw, "Cyber security for SCADA systems", Penn Well Books, 2006.

Reference Books:

1. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
2. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well 1999.

Course Structure

B6364 - FACTS and Custom Power Devices

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

FACTS and custom power devices is a theory course intended to enhance the knowledge of students in various reactive power electronic devices which are used in both transmission and distribution systems. To learn the concept of power flow control through various power electronic controllers including state of art FACTS controllers, operational aspects and their capabilities and their integration in power flow analysis. The merits and demerits of all active filters and reactive compensation devices are discussed in this course.

Course Pre/co-requisites

UG Courses-Power Electronics, Power Systems.

2. Course Outcomes (COs)

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

B6364.1 Distinguish the performance of Transmission line with and without FACTS Devices.
B6364.2 Compare the SVC and STATCOM.
B6364.3 Understand the operation and control of various Static Series Compensators.
B6364.4 Analyse the control techniques of Unified Power Flow Controller.
B6364.5 Distinguish various power quality issues and how are they mitigated by various FACTS Devices.

3. Course Syllabus

Module 1: Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System. Power flow control -Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation. Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation at transmission and distribution level.

Module 2: Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control. Comparison between SVC and STATCOM.

Module 3: Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation – GCSC,TSSC, TCSC and Static synchronous. Series compensators and their Control.

Module 4: SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF. Basic Principle of P and Q control- Independent real and reactive power flow control- Applications.

Module 5: Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control.

4. Books and Materials

Text Books:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, 2006.
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC
4. Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.

Reference Books:

1. K.S. Sureshkumar, S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
2. G. T.Heydt, "Power Quality", McGraw-Hill Professional, 2007.
3. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

Course Structure

B6365 - High Voltage DC Transmission

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course deals with the modeling of HVDC systems, selection of Converters and their control. Also deals with design of various filter and multi-terminal HVDC System.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6365.1 Identify the HVDC technology and conversion principles used in power transmission.
B6365.2 Analyze the converters used in HVDC transmission systems.
B6365.3 Construct Multi-terminal HVDC systems and various harmonics filter and their control.
B6365.4 Develop dynamic Model for HVDC Systems.

3. Course Syllabus

Module 1: Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

Module 2: Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

Module 3: Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non- characteristics harmonics filter design. Fault development and protection.

Module 4: Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems.

Module 5: Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

4. Books and Materials

Text Books:

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.

Reference Books:

1. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

Audit Courses

Course Structure

B6091 – Disaster Management

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course has been framed with an intention to provide a general concept in the dimensions of disasters caused by nature beyond human control as well as the disasters and environmental hazards induced by human activities with emphasis on Natural disaster, Man-made disaster, vulnerability and risks of disasters, Disaster Management Mechanism, Capacity Building and disaster coping Strategies and Disaster management planning.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6091.1 Identify concepts, hazards and vulnerabilities of different types of disasters.
B6091.2 Examine the components of disaster management mechanism.
B6091.3 Select suitable capacity building framework for disaster management.
B6091.4 Interpret various disaster coping strategies.
B6091.5 Develop Strategies for disaster management planning.

3. Course Syllabus

Introduction: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **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.

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.

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.

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.

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. Books and Materials

Text Books:

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

Course Structure

B6092 – Value Education

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The present education system does not prepare students well for dealing with life. Primarily, it prepares them for profession or jobs. It concentrates on providing "How to do" rather than "What to do" or "Why to do?". This course will be helpful for students to develop critical ability, commitment and courage in real life problems. Students will learn about happiness, character development, self control, honesty, time management.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6092.1 Identify the importance of value based living for character development.
B6092.2 Emerge as responsible citizens with clear conviction to practice values and ethics in life.
B6092.3 Interpret their role in nation building for a better tomorrow .
B6092.4 Develop a sense of commitment and decision making capability.

3. Course Syllabus

Values and Self - Development: Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgments.

Importance of Cultivation of Values: Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truth fullness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature Discipline.

Personality and Behavior Development: Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.

Achieving Happiness: 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.

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, and Studying effectively.

4. Books and Materials

Text Books:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.
2. David N. Aspin, Judith D. Chapman, "Values Education and Lifelong Learning: Principles, Policies, Programmes" Springer, 2007

Course Structure

B6093 – Constitution of India

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course enables the students to understand the constitution of India as the Supreme law of India. The student will also gain knowledge about the parliament of India and how it functions. This course will survey the basic structure and operative dimensions of the Indian constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian constitution.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6093.1 Identify the important components of Indian Constitution.
B6093.2 Explore the basics of Constitutional right in various domains .
B6093.3 Illustrate the evolution of Indian Constitution.
B6093.4 Analyze the Administrative process in India from grass-root level.
B6093.5 Relate the basic concepts of democracy, liberty, equality, secular and justice.

3. Course Syllabus

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble, Salient Features.

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.

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

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. Books and Materials

Text Books:

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

Reference Books:

1. M. P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis, 2014
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Structure

B6094 - Stress Management by Yoga

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

Stress has been determined to be a key factor of illness and disease. Prolonged stress in any person can lead to negative thinking, depression and worse. The course is based on managing stress by practice of yogic principles that are proven to be highly effective and easy to learn. In this course the students will learn about different types of yoga practices, Meditation, Yoga asanas, Pranayama for stress, anger and fear management.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6094.1 Make use of yoga for stress management in educational environments.
B6094.2 Improve emotional intelligence to better deal with stress.
B6094.3 Develop flexibility through participation in yoga.
B6094.4 Learn methods of performing asanas, pranayama, mudras and bandhas.
B6094.5 Practice meditation for holistic living.

3. Course Syllabus

Meaning and Definition of Stress: Eutress, Distress, Anticipatory Anxiety, Intense Anxiety and Depression. Necessity of Stress Management, Concept of Stress according to Yoga.

Introduction to Yoga: Definition and Meaning of Yoga, Historical Perceptive on yoga – yoga before the time of Patanjali (Indus valley civilization, Vedas, Brahmnas, Upanishads, Epics, Puranas).

Schools of Yoga: Eight Limbs of Yoga: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana & Samathi. General principles of practicing Asana, Pranay- ama, Meditation, Kriyas Bandhas and Mudra.

Essentials of yoga practices: Prayer, Disciplines in Yogic Practices, Place & Timing, Diet & Schedule for Yoga Practitioner. Obstacles in the Path of Yoga Practice, Sequence for yogic

practices, Different between yogic & non yogic system of exercise. Do's and donts during Yoga

Personality development by yoga: Yoga and development of Social qualities of personality, Co-operation, Simplicity, Tolerance, Social adjustments, Yoga and personal efficiency. Improvement of personal efficiency through yoga.

4. Books and Materials

Text Books:

1. Wasmer Linda Andrews, Stress Control For Peace of Mind, Barnes & Noble Publisher, 2005
2. H.R. Nagendra, and R. Nagarathana, Yoga practices for anxiety & depression. Bangalore: Swami Sukhabodhanandha Yoga Prakashana 2004.

Reference Books:

1. BKS Iyengar, The Art of Yoga. New Delhi: Harper Collins Publishers, 2003.

Course Structure

B6095 - Personality Development through Life Enlightenment Skills

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course aims to provide a basic awareness about the significance of Life Enlightenment skills in all-round development of personality. Personality development boosts confidence level in students and help them achieve high esteem. In this course the holistic development of personality in students will be done by practicing some basic Veres of Srimad Bhagavath Geetha by explaiing the true meaning of Wisdom, Pride, Virtue, Happiness, Pain.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6095.1 Create Holistic development of personality.
B6095.2 Exercise the role model in the Bhagavath Geetha by practicing it.
B6095.3 Develop a sense of spirituality and heart fullness in mind and body.
B6095.4 Demonstrate knowledge of beliefs and values to continuing personal reflection and reassessment.

3. Course Syllabus

Neetisatakam - Holistic Development of Personality:

Verses- 19, 20, 21,22 (Wisdom)

Verses- 29, 31, 32 (Pride & Heroism)

Verses- 26, 28, 63, 65 (Virtue)

Do's and Dont's

Verses- 52, 53, 59 (Dont's)

Verses- 71, 73, 75, 78 (Do's)

Approach to Day to Day Work and Duties:

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.

Statements of basic knowledge :

Chapter 2: Verses 56, 62, 68

Chapter 12: Verses 13, 14, 15, 16,17, 18

Personality of Role Model

Chapter 2: Verses 17

Chapter 3: Verses 36,37,42

Chapter 4: Verses 18, 38,39

Chapter 18: Verses 37,38,63

4. Books and Materials

Text Books:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.

Reference Books:

1. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Samskrit Sansthanam, New Delhi.

Course Structure

B6096 - Pedagogy Studies

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

Pedagogy is the relationship between learning techniques and culture. It requires meaningful classroom interactions between educators and learners. The objective of this course is to help students build on prior learning and develop skills and attitudes. Furthermore it can improve the quality of your teaching and the way students learn, helping them gain a deeper grasp of fundamental material.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6096.1 Develop a positive attitude towards life and teaching profession
B6096.2 Critically analyze the classroom teaching, learning and behavior.
B6096.3 Compare the teaching and learning practices in educational institutes in the past decade.
B6096.4 Summarize the aspects of effective teaching process.

3. Course Syllabus

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic Overview: Pedagogical practices in formal and informal classrooms in developing countries, Curriculum development, Teacher education.

Evidence on the Effectiveness of Pedagogical Practices : Quality assessment of included studies, 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 pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

Professional Development: Alignment with classroom practices and followup support. Peer support, Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.

Research Gaps and Future Directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment. Dissemination and research impact.

4. Books and Materials

Text Books:

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 of Curriculum 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.

Reference Books:

1. 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.
2. Alexander RJ (2001) Culture and Pedagogy: International Comparisons in Primary Education. Oxford and Boston: Blackwell.
3. Chavan M (2003) Read India: A mass scale, rapid, 'Learning to Read' campaign.

Open Electives

Course Structure

B6081 - Business Analytics

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course addresses the scope of business analytics, process and tools used to get competitive advantages of business analytics. It covers the forecasting techniques to predict the given data for various decision making. Apart from prediction it also establishes the relationship between the given data to formulate the strategies for business decisions.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

B6081.1	Demonstrate knowledge of data analytics.
B6081.2	Demonstrate the ability of think critically in making decisions based on data and deep analytics.
B6081.3	Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making,
B6081.4	Demonstrate the ability to translate data into clear, actionable insights.

3. Course Syllabus

Theory

Business analytics and Statistical Tools: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Forecasting Techniques and Monte Carlo Simulation and Risk Analysis: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model,Overbooking Model, Cash Budget Model.

Decision Analysis and recent trends: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

4. Books and Materials

Text Books:

1. Varshney & Maheswari , Business analytics Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, 1st Ed., Pearson FT Press, 2014
2. Jamesh R Evans, Business Analytics, Global Edtion, Pearson Higher Education & Professional Group, 2020

Course Structure

B6082 - Waste to Energy

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course deals with the production of energy from different types of wastes through thermal, biological and chemical routes. This course provides insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production. This course is explores Biomass Pyrolysis, Biomass gasification, Biomass combustions and Bio energy systems.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6082.1 Classify different waste material produces from all sources.
B6082.2 Analyze Bio energy systems resources, process and application.
B6082.3 Apply emerging methods for Bio mass Pyrolysis, gasification and combustion to improve the efficiency.
B6082.4 Analyze different case studies for understanding success and failure of waste to energy technologies.

3. Course Syllabus

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers - Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,

fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

4. Books and Materials

Text Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Structure

B6083 - Operations Research

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The courses in Operational Research offer a unique blend of traditional coursework, practical skills, and real-world problem-solving experience designed to position students for success in today's competitive world. This course covers Linear Programming, Non-Linear Programming Problem, Mathematical Models and problems.

Course Pre/co-requisites

Industrial Management concepts

2. Course Outcomes (COs)

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

B6083.1 Gain knowledge in concepts and techniques of Operations Research.
B6083.2 Determine the optimal solution for Linear Programming problems.
B6083.3 Formulate and obtain the optimal solution for non- Linear Programming problems.
B6083.4 Solve to get optimal solution using queuing and inventory models .
B6083.5 Determine solution for non- Linear Programming problems using dynamic programming

3. Course Syllabus

Linear Programming Problem & Its Application I: Introduction, Formulation of LPP. Slack Variable, Surplus Variable and Artificial Variables. Standard Form and Matrix Form. Concept of Duality. Graphical Method. Simplex Method. Big - M method & Two - Phase Method. Problems of Degeneracy.

Linear Programming Problem & Its Application II: Parametric Programming introduction . Types of Linear Variations. Graphical and Analytical Sensitivity Analysis.

Non-Linear Programming Problem I: Introduction, Formulation and Graphical Method, Kuhn-Tucker Conditions, Quadratic Programming Problems by Wolfe's and Beale's Method.

Non-Linear Programming Problem II: Geometric programming introduction and analytical methods , Fractional programming introduction and analytical methods, Dynamic

programming introduction and analytical methods.

General Mathematical Models: Sequencing - n Jobs and m Machines, Inventory Control - introduction and its analytical methods. Single server queuing model.

4. Books and Materials

Text Books:

1. S.D. Sharma, Operations Research Theory, Methods and Applications, 18th Edition, Kedarnath Ramnath Publishers, Delhi 2017
2. H.A. Taha, Operations Research- An Introduction,8th Edition PHI, 2008.
3. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

Reference Books:

1. J.C. Pant, Introduction to Optimization: Operations Research, 7th Edition,Jain Brothers, Delhi, 2008.
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009.
3. Pannerselvam, Operations Research:2nd Edition, Prentice Hall of India 2010.
4. Harvey M Wagner, Principles of Operations Research:2nd Edition, Prentice Hall of India 2010.

Course Structure

B6084 - IoT and Applications

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

The course introduces you to advance concepts and design methodologies to design IoT systems and developing IoT applications programming languages and tools optimized for IoT domain. The course covers python languages in great detail with set of packages which makes it obvious choice as a leading IoT language. It also exposes participants to communication technologies and legacy protocols as well as newly developed IoT specific application and physical layer protocols. The course covers Cloud based service in great detail with set of packages which makes it obvious choice as a leading IoT Technology.

Course Pre/co-requisites

The course has no specific prerequisite and co-requisite

2. Course Outcomes (COs)

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

B6084.1 Identify the basic Architecture of IoT and its characteristics
B6084.2 Determine the most appropriate IoT Devices and communication system management
B6084.3 Utilize Python standard libraries for implementing various IoT Applications
B6084.4 Analyze the appropriate protocol for establishing communication between various IoT Devices
B6084.5 Analyze cloud infrastructure, services, APIs and architectures of commercial and industrial cloud platforms

3. Course Syllabus

Introduction to Internet Of Things : Introduction, Definition & Characteristics of IoT,Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Templates DOMAIN SPECIFIC IOTS - Introduction, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle.

IoT , M2M and IoT System Management with NETCONF-YANG : Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT IoT System Management with NETCONF-YANG - Need for IoT Systems Management, Simple Network Management

Protocol (SNMP), Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG.

IoT Platforms Design Methodology : IoT Platforms Design Methodology - Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring, Motivation for Using Python IoT SYSTEMS - LOGICAL DESIGN USING PYTHON - Introduction, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations, Classes,Python Packages of Interest for IoT.

IoT Physical Devices & Endpoints : What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interface, Programming Raspberry Pi with Python, Other IoT Devices IoT PHYSICAL SERVERS & CLOUD OFFERINGS - Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework,Designing a RESTful Web API, Amazon Web Services for IoT, SkyNet IoT Messaging Platform.

Case Studies Illustrating IoT Design : What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interface, Programming Raspberry Pi with Python, Other IoT Devices IoT PHYSICAL SERVERS & CLOUD OFFERINGS - Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework,Designing a RESTful Web API, Amazon Web Services for IoT, SkyNet IoT Messaging Platform.

4. Books and Materials

Text Books:

1. Arshdeep Bahga,Vijay Madisetti(2015), "Internet of Things A Hands-On Approach", University Press, India.
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011

Course Structure

B6085 - Cyber Security

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This course drawing upon a wealth of experience from academia, industry, and government service, Cyber Security details and dissects, in current organizational cyber security policy issues on a global scale—taking great care to educate students on the history and current approaches to the security of cyberspace. It includes thorough descriptions of Cyber Offences, Cyber Crime, tools and methods used in Cyber Crime. It also delves into organizational implementation issues, and equips students with descriptions of the positive and negative impact of specific policy choices.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6085.1 Demonstrate the basics of cybercrime in computer, networked device or a network.
B6085.2 Identify various cyber offences in real time.
B6085.3 Identify the different attacks in cybercrime.
B6085.4 Use various methods and tools to control cybercrimes and cyber offences.
B6085.5 Examine how to protect organizations from intruders, attackers and cyber criminals.

3. Course Syllabus

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, who are Cybercriminals, Classifications of Cybercrimes. The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing

Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Tools and Methods: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications. Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

4. Books and Materials

Text Books:

1. Nina Godbole and Sunil Belapure., Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley INDIA. 2011.

Reference Books:

1. James Graham, Richard Howard and Ryan Otson., Cyber Security Essentials, 1st Edition, CRC Press, 2011.
2. Chwan-Hwa(John) Wu,J.David Irwin., Introduction to Cyber Security, , 1st Edition, CRC Press T&F Group, 2013.
3. Richard A. Clarke, Robert Knake., Cyberwar: The Next Threat to National Security & What to Do About It, Ecco, 2010.

Course Structure

B6086 - Mobile Cloud Computing

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	42	0	3	40	60	100

1. Course Description

Course Overview

This Course provides a comprehensive overview of how to integrate cloud and mobile technology. It is an emerging field and this course explores how distributed resources can be shared by mobile users in different ways and issues arising there from. This course also provides understanding of Architecture, Applications of Mobile Cloud Computing along with Offloading concept and Resource allocation techniques. This also introduces concept called Green Mobile Computing and also discusses about the security issues in Mobile Cloud Computing. This course enables the student to choose as research area of interest.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

B6086.1 Identify the architecture, issues and applications in mobile cloud computing.
B6086.2 Make use of remote cloud and offloading techniques for storage and computation.
B6086.3 Choose a resource allocation method in mobile cloud computing.
B6086.4 Use green mobile computing for an energy efficient mobile network.
B6086.5 Identify the trust and privacy requirements in a mobile cloud computing environment.

3. Course Syllabus

Mobile Cloud Computing: : Introduction to cloud computing, Basic cloud architecture, Motivation to MCC, Architecture, Platform and Technologies, Mobile Augmentation approaches, Issues of Mobile Cloud Computing, Advantages and Applications of Mobile Cloud Computing.

Offloading in Mobile Cloud Computing: Introduction, Offloading Decision, Types of Offloading, offloading in CC and MCC: Similarities and Differences, Adaptive Computation offloading from Mobile Devices, Cloud Path selection for Offloading, Mobile Data Offloading Using Opportunistic Communication, Three-Tier Architecture of Mobile Cloud Computing,

Requirements of Data Offloading, Performance Analysis of Offloading Techniques, Multi-Cloud Offloading in Mobile Cloud Computing Environment.

Resource Allocation in MCC: Introduction, Significance of Resource Allocation, Resource-Allocation Strategies- Semi-Markov Decision Process (SMDP), Task Scheduling Using Activity-Based Costing Algorithm, Resource Allocation Using Middleware, Energy-Aware Resource Allocation, Resource Allocation in MCC Using Entropy-Based FIFO Method, Auction Mechanism for Resource Allocation in MCC.

Green Mobile Computing: Introduction, Green Mobile Computing, Green Mobile Network, Green Cloud Computing, Green Mobile Cloud Computing, Green Mobile Devices Using Mobile Cloud Computing, Green Femtocell Using MCC.

Privacy and Security in MCC: Introduction, Security Levels, Security Issues. Trust in MCC: Introduction, Properties, Components, types of Trust, Trust Issues, and Trust Establishment.

4. Books and Materials

Text Books:

1. Debashis De., Mobile Cloud Computing-Architectures, Algorithms and Applications, CRC Press, Taylor and Fransis group, 2016.

Reference Books:

1. Frank H.P. Fitzek and Marcos D. Katz., Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks, 1st Edition, WILEY publications, 2014.
2. Valentino Lee, Heather Schneider, and Robbie Schell., Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.