Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE401	Electronic Communication	3-0-0-3	2015

Course Objectives

To introduce the applications of communication technology.

To understand the methods and techniques used in communication field.

Syllabus:

AM and FM fundamentals-AM and FM transmitters and receivers-Television and radar systems-Digital communication-Satellite communication-Cellular telephone.

Expected outcome:

Upon successful completion of this course, students will gain the knowledge of various communication technologies.

Understand the need of modulation in transferring a signal through either wireless or wired communication systems

Apply analog modulation techniques and receiver fundamentals in analog communication.

Apply baseband digital encoding & decoding techniques in the storage / transmission of digital signal through wired channel

Understand the performance of communication systems in the presence of noise and interference

Text Books:

1.Kennedy G., *Electronic Communication Systems*, McGraw-Hill, New York, 2008.
2. Roody and Coolen, *Electronic Communication*, Prentice Hall of India LTD., New Delhi, 2007.

References:

1. William Scheweber, *Electronic Communication Systems*, Prentice Hall of India LTD, New Delhi, 2004.
2. Wayne Tomasi, *Electronic Communication Systems*, Prentice Hall of India LTD, New Delhi, 2004.
3. Frank R. Dungan, *Electronic Communication Systems*, 3/e, Vikas Publishing House, 2002.
4. Simon Haykins, *Communication Systems*, John Wiley, USA, 2006.
5. Bruce Carlson. *Communication Systems*, Tata McGraw Hill, New Delhi, 2001.
6. Taub and Schilling, *Principles of Communication Systems*, McGraw-Hill, New York, 2008.
7. Anokh Singh, *Principles of Communication Engineering*, S. Chand and Company Ltd., Delhi.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	**AM and FM fundamentals** AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB FM – frequency spectrum – power relations	6 hrs	15%
II	**AM and FM transmitters and receivers** Block diagrams of low power and high power AM transmission - AM receivers: straight receivers superhetrodyne receiver - choice of intermediate frequency -	8 hrs	15%

	simple AVC circuit Block diagrams of direct FM transmitter and Amstrong transmitter - FM receivers (balanced - slope detector and Foster-Seely discriminator only).		
FIRST INTERNAL EXAMINATION			
III	**Television and radar systems** Principles of television engineering - Requirements and standards – need for scanning - types of camera tubes and picture tubes - B/W and colour systems - PAL - CCTV - Cable TV-high definition television. Radar and navigation: principle of radar and radar equation, block schematics of pulsed radar.	8 hrs	15%
IV	**Digital communication:** Principles of digital communication – - Sampling process-pulse modulation Techniques- sampling process-PAM, PWM and PPM concepts - PCM encoder and decoder Applications of data communication	6 hrs	15%
SECOND INTERNAL EXAMINATION			
V	**Satellite communication** Multiple access (MA) techniques-FDMA, TDMA, CDMA, SDMA -applications in satellite communication wire, MA techniques applications in wired communication. in satellite communication, earth station; Fibers – types: sources, detectors used, digital filters, optical link	8hrs	20%
VI	**Cellular telephone -** Basic concepts, frequency reuse, interference cell splitting, sectoring, cell system layout, cell processing.Fibers – types: sources, detectors used, digital filters, optical link: Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication	6 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

COURSE NO.	COURSE NAME	L-T-P-CREDITS	YEAR OF INTRODUCTION
EE 403	**DISTRIBUTED GENERATION AND SMART GRIDS**	3-0-0-3	2015

Course objective.

Objective of the course is to develop a conceptual introduction to various distributed generation systems, micro grids, smart grids and their control

Syllabus: Introduction to distributed generation and smart grids - Distributed Energy Resources – Micro Grids and their control – Protection issues for Microgrids - Smart Grids: Components – NIST Reference architecture – Smart meters - Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU) - demand response- Demand Side Management - Smart Substations, HAN, NAN, SANET, Cloud computing in smart grid – Power Quality issues with smart grid

Expected Outcome:

After the successful completion of these course student will be able to:

- Explain various distributed generation systems
- Understand the microgrids and their control schemes
- Understand various developments happening in the field of Smart Grids.

TEXT BOOKS AND REFERENCE BOOKS:

1. S. Chowdhury, S.P. Chowdhury and P. Crossley, Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009

2. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, ISBN: 978-0-470-62761-7, Wiley

3. 1. R. C. Durgan, M. F. Me Granaghen, H. W. Beaty, “Electrical Power System Quality”, McGraw-Hill

4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, ISBN: 978-0-470-05751-3, Wiley

5. James Momoh, Smart Grid: Fundamentals of Design and Analysis, ISBN: 978-0-470-88939-8, Wiley

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Distributed generation – Introduction - Integration of distributed generation to Grid – Concepts of Micro Grid - Typical Microgrid configurations - AC and DC micro grids - Interconnection of Microgrids - Technical and economical advantages of Microgrid - Challenges and disadvantages of Microgrid development Smart Grid: Evolution of Electric Grid - Definitions and Need for Smart Grid, Opportunities, challenges and benefits of Smart Grids	7	15
II	Distributed energy resources: Introduction - Combined heat and power (CHP) systems - Solar photovoltaic (PV) systems – Wind energy conversion systems (WECS) - Small-scale hydroelectric power generation - Storage devices: Batteries: Lead acid, nickel metal hydrate, and lithium ion batteries , ultra-capacitors, flywheels Control of Microgrids: Introduction to Central Controller (CC) and Microsource Controllers (MCs) - Control functions for microsource controller, Active and reactive power control, Voltage control, Storage requirement for fast load tracking, Load sharing through power-frequency control	6	15
FIRST INTERNAL EXAM			
III	Protection issues for Microgrids: Introduction, Islanding, Different islanding scenarios, Major protection issues of stand-alone Microgrid - Impact of DG integration on electricity market, environment, distribution system, communication standards and protocols. Smart Grid: Components – NIST Smart Grid Reference Architecture Introduction to Smart Meters, Electricity tariff – one part tariff, two tariff and maximum demand tariff - Dynamic pricing: time-of-use (TOU) pricing, critical-peak pricing (CPP) and Real Time Pricing-Automatic Meter Reading(AMR), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation. Intelligent Electronic Devices (IED) and their application for monitoring & protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).	7	15
IV	Smart energy efficient end use devices-Smart distributed energy resources- Load Curves-Load Shaping Objectives-Methodologies - Peak load shaving - Energy management-Role of technology in demand response- Demand Side Management – Numerical Problems	7	15
SECOND INTERNAL EXAM			
V	Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood-Area Networks (NANs), Sensor and Actuator Networks (SANETs) Smart Substations, Substation Automation, IEC 61850 Substation Architecture, Feeder Automation.	7	20

VI	Cloud computing in smart grid: Private, public and Hybrid cloud. Cloud architecture of smart grid.	7	20
	Power quality: Introduction - Types of power quality disturbances - Voltage sag (or dip), transients, short duration voltage variation, Long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker - Harmonic sources: SMPS, Three phase power converters, arcing devices, saturable devices, fluorescent lamps, harmonic indices (THD, TIF, DIN, C – message weights) Power quality aspects with smart grids.		
END SEMESTER EXAM			

MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 405	Electrical System Design	3-1-0-4	2015

Course Objectives

- To gain the knowledge of acts and rules used for regulating the electrical supply in our country.
- To impart sound knowledge in the design and estimation of low voltage and medium voltage electrical installations.
- To gain the knowledge of selection of distribution transformers and their installations.
- To gain the knowledge of Earthing designs in different installations and the standard dimensions of earthing systems.

Syllabus - Electrical system design practices – general awareness of IS Codes, Electricity Acts & Rules, NEC etc. Domestic Installations, Motor Installations, 11 kV substation installations. Cinema theatre, auditorium and high rise building installations. Standby generator selection and their Installations. Underground cable installations and their accessories. Types of earthing, lightning arresters, fire fitting and lifts.

Expected outcome.

- Acquiring the basic Rules and regulations in electrical installations.
- To prepare the schematic diagram, installation plan, quantity of materials and estimate for different electrical installations.

Text Book:

1. K. B. Raina, S. K. Bhattacharya, Electrical Design Estimating Costing, NEW AGE; Reprint edition (2010).
2. J. B. Gupta, A Course in Electrical Installation Estimating and Costing, S.K. Kataria & Sons; Reprint 2013 edition (2013).

Data Book (Approved for use in the examination): Approved data and reference manuals

References:

1. National Electric Code, Bureau of Indian Standards publications, 1986.
2. Relevant Indian Standard – specifications (IS – 732, IS – 746, IS – 3043, IS – 900), etc.
3. S.L.Uppal, Electrical Wiring Estimating & Costing, Khanna Publishers (2008)

Course Plan

Module	Contents	Hours	Sem.Exam Marks
I	General awareness of IS Codes (IS 3043, IS 732, IS 2675, IS 5216-P1-2, IS 2309), The Indian Electricity Act 1910, The Indian Electricity supply Act 1948, Indian Electricity Rules 1956, The Electricity Regulatory Commission Act 1998, Electricity Act 2003, Bureau of Energy Efficiency (BEE) and its labeling. National Electric Code (NEC) - scope and safety aspects applicable to low and medium (domestic) voltage installations, Electric services in buildings, Classification of voltages, standards and specifications.	8	15%
II	Safety aspects applicable to low and medium voltage installations. General aspects of the design of electrical installations for domestic dwellings (low and medium voltage installations)–connected load calculation, sub circuit determination, selection of main distribution board, sub distribution board, MCB, ELCB, MCCB and cables for sub circuits. Pre-commissioning tests of domestic installations.	10	15%

FIRST INTERNAL EXAMINATION			
III	Medium and HV installations – selection of cables and cable glands, guidelines for cable installation in detail. Panel boards: LT & HT control panel boards. Installation of induction motors: Design of distribution systems with light power and motor loads. Design of automatic power factor correction (APFC) Panel. Selection and installation of transformers, switchgears and protective devices – Design of indoor and outdoor 11 kV substation upto 630 kVA.	10	15%
IV	Air-conditioning loads and its specifications. Energy conservation techniques. Selection of standby generator – installation and its protection. Introduction to Automatic Main Failure (AMF) System. Pre-commissioning tests of cables, transformers and generators.	8	15%
SECOND INTERNAL EXAMINATION			
V	Design of earthing system for an HT consumer, Dimensions and drawings of typical earth electrodes (1) Pipe Earthing, (2) Plate Earthing. Touch, Step and Transfer potentials at EHT Sub-Stations, Earth-mat, installations of special equipment like X-Ray, Neon-Sign, Basics of lightning arresters.	8	20%
VI	Design of illumination systems – Yard lighting, street lighting and flood lighting. Kerala Cinema Regulation Act – 1958, design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators.	10	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 407	DIGITAL SIGNAL PROCESSING	3-0-0-3	2015

Course Objectives

To impart knowledge about digital signal processing and its applications in engineering

Syllabus:

Expected Outcome:

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

1. Analyse DT systems with DFT
2. Design digital filters IIR and FIR filters
3. Analyse finite word length effects in signal processing
4. Design filters using Matlab FDA tool box
5. Understand Digital Signal Controllers and their Applications

Text books:

1.
John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms &A pplications", Fourth edition, Pearson education / Prentice Hall, 2007.
2. Emmanuel.C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", Second edition, Pea rsonEducation / Prentice Hall, 2002.
3. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, "Discrete Time Signal Processing", Pearson Education, 2nd edition, 2005.

References:

1. S.K. Mitra, Digital Signal Processing, A Computer Based approach, Tata Mc GrawHill, 1998.
2. P.P.Vaidyanathan, Multirate Systems & Filter Banks, Prentice Hall, Englewood cliffs, NJ, 1993.
3. Johny R. Johnson, Introduction to Digital Signal Processing, PHI, 2006.

Course Plan

Module	Contents	Hours	Sem.Exam Marks
I	Introduction to signals and systems - Discrete Fourier transform: Frequency domain sampling, Discrete Fourier transform (DFT): DFT pair, properties of DFT, frequency response analysis of signals using the DFT, circular convolution using DFT , linear filtering based on DFT Fast Fourier transform(FFT); Introduction, Radix -2 decimation in time FFT algorithm, Radix-2 decimation in frequency algorithm.	7	15%
II	Introduction to FIR and IIR systems : Structures for realization of discrete time systems – structures for FIR and IIR systems – signal flow graphs, direct-form, cascade-form, parallel form, lattice and transposed structures and linear Phase FIR filters.	7	15%
	FIRST INTERNAL EXAMINATION		
III	Design of digital filters – general considerations – causality and its implications, characteristics of practical frequency selective filters IIR filter design : Discrete time IIR filter (Butterworth and	7	15%

	Chebyshev) from analog filter – IIR filter (LPF, HPF, BPF, BRF) design by Impulse Invariance, Bilinear tr ansformation, Approximation of derivatives. filter design		
IV	FIR filter design : Structures of FIR filter- Linear phase FIR filter - Filter design using windowing techniques, Frequency sampling techniques	7	15%
SECOND INTERNAL EXAMINATION			
V	Finite word length effects in digital Filters : Fixed point and floating point number representations - Comparison - Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error - Product quantization error - Overflow error – Round-off noise power - limit cycle oscillations due to product round-off and overflow errors - signal scaling **Introduction to FDA Toolbox in MATLAB:** Design of filters using FDA toolbox (**Demo/Assignment only**)	7	20%
VI	Introduction to TMS320 Family: Architecture, Implementation, C24x CPU Internal Bus Structure, Memory Central Processing unit , Memory and I/O Spaces , Overview of Memory and I/O Spaces, Program control Address Modes System Configuration and Interrupts clocks and low Power Modes Digital input / output (I/O), Assembly language Instruction , Instruction Set summary , Instruction Description, Accumulator, arithmetic and logic Instruction , Auxiliary Register and data page Pointer Instructions , TREG, PREG, and Multiply Instruction ,Branch Instructions , Control Instructions I/O and Memory Instruction **Design & Implementation and Filter Structures:** MATLAB functions and TMS320 Implementation (**Demo/Assignment only**) **Introduction to Code Composer Studio** (**Demo only**)	7	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 409	**Electrical Machine Design**	**3-0-0-3**	**2015**

Course Objectives

To impart knowledge on principles of design of static and rotating electrical machines.

To give a basic idea about computer aided design (CAD) and finite element method.

Syllabus Machine design basic principles, Heating and cooling of electrical machines, Magnetic circuit design, Design of - Dc machine, Synchronous machine , Three phase induction motor, Computer aided design, Finite element method.

Text Book:

1. *A K Sawhney, " A Course In Electrical machine design", Dhanpatrai and sons, Delhi.*

References:

1. *M. V. Deshpande, "* Design And Testing Of Electrical Machines", Wheeler Publishing.
2. *R. K. Agarwal, "* Principles Of Electrical Machine Design", Essakay Publications, Delhi.
3. *Ramamoorthy M, "*Computer Aided Design of Electrical Equipment", East-West Press.
4. M. N. O. Sadiku, " Numerical techniques in Electromagnetics", CRC Press Edition-2001.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Principles of electrical machine design - General design considerations - specifications of machines - types of enclosures - types of ventilation - heating - short time rating - overload capacity - temperature rise time curve - hot spot rating. Magnetic circuit calculation - calculation of field ampere turns - air gap mmf - effect of slot and ventilating duct - active iron length - mmf for teeth - real and apparent flux densities - mmf per pole Magnetic Leakage Calculation- Effects of Leakage. Armature Leakage –Components.Unbalanced Magnetic Pull-Practical aspects of unbalanced magnetic pull	8	15%
II	Design of transformers - single phase and three phase transformers - distribution and power transformers - output equation - core design - window area - window space factor - overall dimensions of core. Windings – no. of turns - current density - conductor section - Cooling of transformers	6	15%
FIRST INTERNAL EXAMINATION			
III	Design of DC machines - output equation - specific loading - choice of speed and no of poles - calculation of main dimensions - choice of type of winding - number of slots - number of conductors per slot- current density - conductor section - slot insulation - length of air gap - design of field winding - conductor cross section - height of pole - design of interpole - flux density under interpole - calculation of turns of	8	15%

	interpolar winding – design of compensating winding – brushes and commutators.		
IV	Design of synchronous machines - specific loading - output equation - main dimensions - types of winding - number of turns - number of slots and slot design - field design for water wheel and turbo alternators - cooling of alternators.	6	15%
SECOND INTERNAL EXAMINATION			
V	Design of three phase induction motors - main dimensions - stator design - squirrel cage and slip ring types - number of stator and rotor slots - rotor bar current - design of rotor bar - end ring current - design of end ring - design of slip ring rotor winding.	7	20%
VI	Introduction to computer aided design. Analysis and synthesis methods -hybrid techniques. Introduction to Finite element method - historical background, applications, advantages. Study of new computer aided machine software using Finite Element Case study: Complete design of an ac machine – steps.(Assignment only)	7	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 461	**Modern Operating Systems**	**3-0-0-3**	**2015**

Course Objectives

To impart the knowledge on the need and requirement of an interface between Man and Machine.

To teach the features of operating systems and the fundamental theory associated with process, memory and file management components of operating systems.

Syllabus : Operating System Structure, Operating system services, Process management, Memory management, File management, Storage structure, security issues.

Expected outcome.

By the end of the course you should be able to

- describe the general architecture of computers
- describe, contrast and compare differing structures for operating systems
- understand and analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files

Text Book: William Stallings, Operating Systems: Internals and Design Principles, 6 th Ed., Pearson Education

Data Book (Approved for use in the examination):Nil

References:

1. Silberschatz, Galvin, & Gagne, Operating System Concepts, 8 th Ed., Wiley
2. Tanenbaum A.S., Modern Operating Systems, 3 rd Ed., Prentice Hall
3. Nutt G.J., Operating Systems, 3 rd Ed., Pearson Education.

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Introduction-Definition– Operating System Structure- Operating System Operations, Process Management- Memory Management- Storage Management- Protection and Security- Distributed Systems-	7	15%
II	Computing Environments- Open Source Operating Systems- Operating-System Services- User Operating-System Interface- System Calls- Types of System Calls- System Programs	7	15%
FIRST INTERNAL EXAMINATION			
III	Process Management- Process Concept- Operations on Processes-ThreadsOverview- Multithreading Models- Thread Libraries- Threading Issues - CPU Scheduling- Basic Concepts- Scheduling Criteria- Scheduling Algorithms- Thread Scheduling- Multiple-Processor Scheduling- Process Synchronisation-	6	15%
IV	Memory Management-Swapping- Contiguous Memory Allocation- Paging Segmentation- Virtual Memory- Demand Paging	6	15%

SECOND INTERNAL EXAMINATION			
V	- File Management- File-System Interface- File Concept- Access Methods - Directory and Disk Structure - File-System Mounting - File Sharing- Protection- File-System Implementation- File-System Structure- File-System Implementation- Directory Implementation- Allocation Methods Free-Space Management - Efficiency and Performance	8	20%
VI	Mass Storage Structure- Disk Scheduling- Disk Management- RAID Structure - Stable Storage Implementation- Protection and Security- Protection- Goals of Protection- Principles of Protection- Domain of Protection- Access Matrix Implementation of Access Matrix- Access Control- Revocation of Access Rights Security- The Security Problem -Program Threats- System and Network Threats	8	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE463	Computer Aided Power Systems Analysis	3-0-0-3	2015

Course Objectives

To introduce computer applications in the analysis of power systems

To understand the solution methods and techniques used in power system studies

Syllabus: Development of network matrices from Graph theory-Formulation of Bus Impedance matrices-Load Flow Analysis-Optimal Power Flow-Network fault calculations-Contingency analysis in Power systems.

Expected outcome:

Upon successful completion of this course, students will gain the ability to critically analyze the solution methods used in power system studies.

Text Book:

1. G.L.Kusic, Computer Aided Power System Analysis, PHI, 1989
2. Arthur R. Bergen, Vijay Vittal, Power Systems Analysis (English) 2nd Edition,Pearson Higher Education
3.M. A. Pai, Computer Techniques in Power Systems Analysis, Tata McGraw-Hill, Second edition 2005
4. John J. Grainger, William D. Stevenson, Jr., Power System Analysis, Tata McGraw-Hill Series in Electrical and Computer Engineering.

References:

1. LP. Singh, "Advanced Power System Analysis and Dynamics", 3/e, New Age Intl, 1996.
2. J. Arriliga and N.R. Watson, Computer modelling of Electrical power systems, 2/e, John Wiley, 2001
3. Stagg and El Abiad, "Computer methods in Power system Analysis", McGraw Hill,1968.
4. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw Hill, 1980

Course Plan

Module	Contents	Hours	Sem.ExamMarks
I	Overview of Graph theory -tree, co-tree and incidence matrix, Development of network matrices from Graph theoretic approach. Review of solution of Linear System of equations by Gauss Jordan method, Gauss elimination, LDU factorization.	9 hrs	15%
II	Bus Reference Frame: Injections and Loads. Zbus and Y bus. Formulation of Bus Impedance matrix for elements without Mutual Coupling.	9 hrs	15%
	FIRST INTERNAL EXAMINATION		
III	Inversion of YBUS for large systems using LDU factors, Tinney's Optimal ordering. Review of Gauss-Seidel Iteration using YBUS, Newton-Raphson method, Fast Decoupled Load Flow (FDLF) DC load flow, Three-phase Load Flow.	hrs	15%
IV	Adjustment of network operating conditions, Optimal power flow: concepts, active/reactive power objectives (Economic dispatch, MW and MVAr loss minimization) – applications-security constrained optimal power flow.	8 hrs	15%
	SECOND INTERNAL EXAMINATION		

V	Network fault calculations using ZBUS and YBUS Table of Factors, Algorithm for calculating system conditions after fault – three phase short circuit, three phase to ground, double line to ground, line to line and single line to ground fault.	8hrs	20%
VI	Contingency analysis in Power systems : Contingency Calculations using ZBUS and YBUS Table of Factors. State estimation – least square and weighted least square estimation methods for linear systems.	9 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE465	**Power Quality**	**3-0-0-3**	**2016**

Course Objectives:

1. To discuss various power quality issues and different methods to control them.

Syllabus:

Power quality issues in distribution systems, Need for power quality monitoring, IEEE guides, standards and recommended practices, Modelling of networks and components under non sinusoidal conditions, Harmonic Analysis, Effects of Power System harmonics on Power System equipment and loads, Harmonic elimination, Power Quality Management in Smart Grid, Electromagnetic Interference.

Expected Outcome:

Upon successful completion of this course, students will be able to identify the power quality problems, causes and suggest suitable mitigating techniques.

References:

1. R. C. Durgan, M. F. Me Granaghen, H. W. Beaty, *'Electrical Power System Quality',* McGraw-Hill
2. Jose Arillaga, Neville R. Watson, *'Power System Harmonics',* Wiley, 1997
3. C. Sankaran, *'Power Quality',* CRC Press, 2002
4. G. T. Heydt, *'Power Quality',* Stars in circle publication, Indiana, 1991
5. Math H. Bollen, *'Understanding Power Quality Problems'*
6. *Power Quality Handbook*
7. J. B. Dixit & Amit Yadav, *'Electrical Power Quality'*
8. Recent literature

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Power quality phenomenon - Sources and Effects of power quality problems, types of power quality disturbances - Voltage sag (or dip), Swell, Transients, short duration voltage variation, Long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker	6	15%
II	IEEE guide lines, standards and recommended practices. Harmonics -mechanism of harmonic generation-harmonic indices (THD, TIF, DIN, C – message weights - Power Quality Costs Evaluation -. Harmonic sources – Switching devices, arcing devices, saturable devices. Effects of Power System harmonics on Power System equipment and loads.	7	15%
FIRST INTERNAL EXAMINATION			
III	Harmonic Analysis - Fourier series and coefficients, the Fourier transforms, discrete Fourier transform, fast Fourier transform, Window function- numerical problems. .	5	15%
IV	Power quality Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic spectrum analyzer, flicker meters, disturbance analyzer	7	15%
SECOND INTERNAL EXAMINATION			
V	Harmonic elimination - Design and analysis of filters to reduce harmonic distortion – Power conditioners ,passive filter, active filter - shunt , series, hybrid filters,	7	20%

VI	Power Quality Management in Smart Grid: Power Quality in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid. Electromagnetic Interference (EMI -introduction -Frequency Classification - Electrical fields-Magnetic Fields - EMI Terminology - Power frequency fields - High frequency	11	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE467	**Nonlinear Control Systems**	**3-0-0-3**	**2015**

Course Objectives: To introduce the need and concept of nonlinear system. To impart knowledge about different strategies adopted in the analysis of nonlinear systems. To familiarize with the design of different types of nonlinear controllers.

Syllabus: Characteristics of nonlinear systems-equillibrium points-phase plane analysis-periodic orbits-stability of nonlinear systems-Lyapunov stability-variable gradient method-centre manifold theorem-circle criterion-Popov criterion-Feedback linearization-Exact Feedback linearization.

Expected outcome.

On successful completion, students will have the

1. Ability to design controllers for nonlinear systems.
2. Ability to analyse the stability of nonlinear systems using various approaches.

Text Book:

1) Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
2) Alberto Isidori, "*Nonlinear Control Systems: An Introduction*", Springer-Verlag, 1985
3) Jean-Jacques E. Slotine and Weiping Li, "*Applied Nonlinear Control*", Prentice-Hall, NJ, 1991.

Data Book (Approved for use in the examination):

References:

1) M. Vidyasagar, "*Nonlinear Systems Analysis*", Prentice-Hall, India, 1991,
2) Shankar Sastry, "*Nonlinear System Analysis, Stability and Control*", Springer, 1999.

Course Plan

Module	Contents	Hours	Sem.Exam Marks
I	Introduction - Characteristics of nonlinear systems - Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis.	7 hrs	15%
II	Periodic orbits - limit cycles-Poincare-Bendixson criterion-Bendixson criterion. Existence and uniqueness of solutions, Lipschitz condition.	7 hrs	15%
FIRST INTERNAL EXAMINATION			
III	Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method.	7 hrs	15%
IV	Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilisation-Analysis of feedback systems- Circle Criterion – Popov Criterion.	7 hrs	15%
SECOND INTERNAL EXAMINATION			
V	Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling.	7 hrs	20%
VI	Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control.	7 hrs	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

Part A: 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 8 questions
3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60

Course No.	Course Name	L-T-P -Credits	Year of Introduction
EE 469	Electric and Hybrid Vehicles	3-0-0-3	2015

Course Objectives

To present a comprehensive overview of Electric and Hybrid Electric Vehicles

Syllabus

Introduction to Hybrid Electric Vehicles, Conventional Vehicles, Hybrid Electric Drive-trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor, Energy Storage Requirements in Hybrid and Electric Vehicles, Sizing the drive system, Design of a Hybrid Electric Vehicle , Energy Management Strategies.

Expected outcome.

Upon successful completion of this course, students will be able to

- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicle applications
- Identify various communication protocols and technologies used in vehicle networks.

Text Book:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

Data Book (Approved for use in the examination): Nil

References:

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Course Plan

Module	Contents	Hours	Sem.Exam Marks
I	Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	7 hrs	15%
II	Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	7 hrs	15%
FIRST INTERNAL EXAMINATION			
III	Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives	7 hrs	15%
IV	Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.	7 hrs	15%
SECOND INTERNAL EXAMINATION			

V	Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology,	**7 hrs**	20%
VI	Communications, supporting subsystems: In vehicle networks- CAN, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies	**7 hrs**	20%
END SEMESTER EXAM			

EVALUATION SCHEME

- **INTERNAL EVALUATION:**

  MARKS FOR ASSIGNMENTS/SEMINARS/PROJECTS/CASE STUDY: 20

  MARKS FOR TESTS : 30

- **EXTERNAL EVALUATION:**

  Maximum Marks: 100 Exam Duration: 3Hrs.

QUESTION PAPER PATTERN:

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One question from each module of Module I - IV; and two each from Module V & VI.
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3 questions from each 2 module set; at least one question from each module.
Student has to answer any 2 from 3 questions: (2 x 10) x 3=60