UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VII SEMESTER

ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME -2013

VII SEMESTER

ELECTRICAL AND ELECTRONICS ENGINEERING (E)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.701	Embedded Systems (E)	3	2	1	-	50	3	100	150
13.702	Digital Signal Processing (E)	3	2	1	-	50	3	100	150
13.703	Power Semiconductor Drives (E)	3	2	1	-	50	3	100	150
13.704	Communication Systems (E)	3	2	1	-	50	3	100	150
13.705	Industrial Engineering & Management (E)	3	3	-	-	50	3	100	150
13.706	ELECTIVE III	3	3	-	-	50	3	100	150
13.707	Seminar	2	-	-	2	50		0	50
13.708	Electrical Machines Lab II (E)	4	-	-	4	50	3	100	150
13.709	Power Systems Lab (E)	4	-	-	4	50	3	100	150
13.710	Industrial Visit & Project Preliminary Work (E)	1	-	-	1	50		0	50
	Total	**29**	**14**	**4**	**11**	**500**		**800**	**1300**

13.706 Elective III

13.706.1	Object Oriented Programming (E)
13.706.2	Modern Operating Systems (E)
13.706.3	Power System Operations and Control (E)
13.706.4	Power Quality (E)
13.706.5	Design of Digital Control Systems (E)
13.706.6	High Voltage Engineering (E)
13.706.7	Nano Technology (E)

13.701 EMBEDDED SYSTEMS (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *Introduce the concept of embedded system.*
- *Identify the unique characteristics of real time systems.*
- *Define the unique design problems and challenges of real time systems.*
- *Design, implement and test an embedded system*
- *Assembly, C language programming and interfacing of peripherals.*

Module – I

Introduction to Embedded Systems- An embedded system, features, current trends and challenges, Product life cycles, Processors, Tool chain, Hardware Design Issues, System memory Layouts, Real time Systems, Hard and Soft.

Programming concepts- Review of C-Programming, Data Structures, Software Life Cycle Models, Embedded Systems Design, Implementation and Testing, Project Management.

Embedded System Programming – Embedded system Design issues, challenges and trends in Embedded Systems. Assemblers, Compilers, linkers, loaders, debuggers, profilers & Test Coverage tools..

Module – II

Microcontroller basics, Terminology & Principles- 8051 microcontroller architecture: function and description of 8051 components to include Special Function Registers(SFRs), Pin out of 8051 microcontroller, Memory mapping, Stack operation, Instructions and Addressing modes, Basic programs(Binary & BCD Arithmetic).

Module – III

Timers of 8051– Operating modes, Assembly language & Embedded C programs.

Counters of 8051– Operating modes, Assembly language & Embedded C programs.

Serial Communication – Assembly language & Embedded C programs, Baud rate doubling.

Module – IV

Interrupts of 8051(Theory). Interfacing and programming of 8051 with DAC, ADC, Stepper motor, LCD, 7-segment LED display & Keyboard. Interfacing of 8051 with 8255. An application based on 8051 micro controller.

References:

1. Mazidi, *The 8051 Microcontrollers & Embedded Systems*, Pearson Education Asia
2. Raj Kamal, *Embedded Systems*, Tata McGraw Hill, 2003.

3. Ayala K. J., *The 8051 Microcontroller: Architecture, Programming and Applications*, Prentice Hall, 1993.
4. Stewart J. W., *The 8051 Microcontroller: Hardware, Software and Interfacing*. Prentice Hall, 1993.
5. Shultz T.W., *C and 8051:Programming for Multitasking*, Prentice Hall,1993.
6. Shibu K. V., *Introduction to Embedded Systems*, McGraw Hill education,2009.
7. Yeralan S. and A. Ahluwalia, *Programming and Interfacing 8051 Microcontroller*, Addison-Wessley, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Explain the characteristics of an embedded system and describe the different software tools used in the design*
- *Interpret the current trends and challenges in the field of embedded systems*
- *Identify the different steps involved in designing an embedded system and point out the issues related to each step.*
- *Write Arithmetical, logical, timer/counter, serial programs of 8051 in assembly and C*
- *Summarize the logic and programming of real world objects like LCD, Keyboard, Stepper motor, ADC/DAC in Assembly and C*

13.702 DIGITAL SIGNAL PROCESSING (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

- *To introduce the discrete time signals and their mathematical manipulations*
- *To represent the periodic and aperiodic signals in the frequency domain and to introduce the concept of frequency domain sampling, computation of DFT and FFT.*
- *To impart thorough knowledge of the analysis and implementation of Linear Time Invariant Discrete Time systems and the design of Digital Filters.*

Module – I

Review of continuous and discrete time systems. Signals- Classification- Sampling of continuous time signals- Sampling theorem – Aliasing. Reconstruction of band limited signal from its samples-sample and hold-zero order and first order hold. Analog to digital and digital to analog conversion – quantization - coding.

Analysis of Discrete time LTI systems- systems described by constant coefficient difference equation - Response of discrete LTI systems using convolution and solution of difference equation- Impulse response- Significance of impulse response – causality – stability.

Module – II

Representation of periodic and aperiodic signals in frequency domain: Fourier series and Fourier Transforms- Continuous Time periodic signals – Continuous Time Fourier Series (CTFS) – power spectral density. Continuous Time aperiodic signals – Continuous Time Fourier Transform (CTFT) – Energy spectral density. Discrete Time periodic signals- Discrete Time Fourier Series (DTFS) - Properties of DTFs. Discrete Time aperiodic signals- Discrete Time Fourier Transform (DTFT) - Properties of DTFT - Frequency domain sampling -Discrete Fourier transform (DFT), 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 and decimation in frequency algorithm - applications of FFT algorithms.

Module – III

The Z transform - Region of convergence – Properties - Inverse Z transform - analysis of LTI Systems using Z Transforms - Transient and steady state response - causality and stability using Z transform - Schur Cohn stability test - stability of second order systems.

Structures for realization of discrete time systems: Block diagram representation and signal flow graphs. Basic structures for IIR systems - direct forms - cascade form - parallel form -

transposed structures. Basic structures for FIR systems – direct form - cascade form - linear phase FIR filters.

Module – IV

Design of digital filters – general considerations - causality and its implications - characteristics of practical frequency selective filters, Design of FIR filters – symmetric and antisymmetric FIR filters, design of linear phase filters using windows – Rectangular – Bartlet – Hamming windows.

Design of IIR filters from analog filters (Butterworth and Chebyshev) – using impulse invariance - bilinear transformation, characteristics of standard filters and their designs, Frequency transformations in the analog and digital domains.

References

1. Proakis and Manolakis, *Digital Signal Processing – Principle, Algorithms and Applications*, 4/e, Prentice Hall of India, 2000.
2. Alan. V. Oppenheim, Alan. S. Wilsky and Lan T Young, *Signals and Systems*, 2ndedition, Pearson Education.
3. Sanjit K. Mitra, *Digital Signal Processing a Computer Based Approach*, Tata McGraw Hill, 2010.
4. Li Tan, *Digital Signal Processing-Fundamentals and Applications*, Academic Press Elsevier, 2008.
5. Emmanuel Ifeachor and Barrie Jervis, *Digital Signal Processing*, 2ndedition, Pearson Education.
6. Somanathan Nair B., *Digital Signal Processing and Filter Design*, Prentice Hall of India, 2003.
7. Johny R Johnson, *Introduction to Digital Signal Processing*, Prentice Hall of India, 1992.
8. Alan. V. Oppenheim and Ronald W Schafer, *Digital Signal Processing*, 2ndedition, PearsonEducation.
9. S.Poornachandra, B.Sasikala, *Digital Signal Processing*, Tata McGraw Hill, 2008.
10. Lonnie C. Ludeman, *Fundamentals of Digital Signal Processing*, John Wiley and Sons.
11. Ambardar, *Analog and Digital Signal Processing*, 2ndedition, Thomson Learning, 1999.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

After the successful completion of this course, the students will be able to:

- *Compute the Fourier series or Fourier transform of periodic or aperiodic signals respectively*
- *Compute DFT and FFT*
- *Determine and analyze the response of LTI Systems to arbitrary time signals using Fourier transform.*
- *Analyze discrete-time systems using convolution and the z-transform*
- *Realize discrete time systems (IIR and FIR systems)*
- *Design digital filters meeting given specifications*
- *Design digital filters using transformation techniques from analog designs*
- *Design digital filters using windowing techniques.*

13.703 POWER SEMICONDUCTOR DRIVES (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

- *To provide fundamental knowledge in dynamics and control of Electric Drives.*
- *To justify the selection of Drives for various applications.*
- *To provide knowledge about cycloconvertors.*
- *To familiarize the various semiconductor controlled drives employing various motors.*

Module – I

Introduction to electric drives - Block Diagram - advantages of electric drives-- Dynamics of motor -load system, fundamental equations , types of load-classification of load torques , four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives.

Cycloconvertors - Basic principle , step up and step down cycloconvertor, single phase to single -hase, three phase to single phase and three phase to three phase cycloconverters. Applications of cycloconvertors- Frequency and voltage control - output equation of cycloconvertor.

Module – II

DC motor drives - using controlled rectifiers - single phase semi convertor and single phase fully controlled convertor drives. Three phase semi convertor and fully controlled convertor drives - Dual convertors, applications of dual convertors in speed control of DC motor. Chopper controlled DC drives -Analysis of single quadrant chopper drives -Regenerative braking control -Two quadrant chopper drives- Four quadrant chopper drives.

Module – III

Three phase induction motor speed control using semiconductor devices - stator voltage control - stator frequency control - stator voltage and frequency control (V/f control)- steady state performance- Rotor chopper speed control -slip power recovery scheme - sub synchronous and super synchronous speed variation - current source inverter control - voltage source inverter drives.

Module – IV

Stepper motor and Switched reluctance motor Drives **-** control requirements, converter circuits, modes of operation. Traction Drives - Brushless dc motor drives - sinusoidal type of brushless dc motor drives - Measures for energy conservation in Electric Drives.

References:

1. Dubey G. K., Power *Semiconductor Controlled Drives*, Prentice Hall, Englewood Cliffs, New Jersy, 1989.
2. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Pearson education Asia, 2003.
3. De N. K.and P. K. Sen, *Electrical Drives*, Prentice Hall of India, 2002.
4. Murphy J. M. D., *Thyristor Control of AC Drives*.
5. Bimbra P. S., *Power Electronics*, Khanna Publishers
6. Ned Mohan, Tore M. Undeland and William P. Robbins, *Power Electronic Convertors , Applications and Design*, John Wiley and sons.
7. Pillai S. K., *A First Course on Electric Drives*, Wiley Eastern Ltd., New Delhi.
8. Dewan S. B., G. R .Slemon and A. Straughen, *Power semiconductor Drives*, John Wiley and Sons.
9. Bimal Bose, *Power Electronics and Motor Drives -Advances and Trends,* Elsevier.
10. Krishnan, *Electric Motor Drives-Modeling, Analysis & Control*, Prentice Hall
11. Ali Emadi, *Energy Efficient Electric Motors*, 3rd Edition, Marcel & Dekker Inc., 2005.
12. Krishnan R. R., *Switched Reluctance Motor Drives, Modeling, Simulation, Analysis, Design and Applications*, CRC Press, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to

- *Elaborate on the advantages of electric drives.*
- *Analyse the stability of operating point.*

- *Select a suitable drive for a particular application.*
- *Explain the working of various cyclo-convertors.*
- *Explain the speed control methods of dc machines using controlled rectifiers, Dual convertors and choppers.*
- *Justify the speed control methods of induction motors using semiconductor devices for various applications.*
- *Explain the phenomenon of torque production in variable reluctance motors.*
- *Compare the various brushless dc motor drives.*

13.704 COMMUNICATION SYSTEMS (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *To impart knowledge about different modulation and demodulation schemes for analog communications*
- *To impart knowledge about the principles of digital communication*
- *To introduce the concepts of Television, Radar, Cellular and Satellite Communication systems*

Module – I

Theory of amplitude modulation (AM) : Generation of double sideband full carrier (block diagrams only) - double sideband suppressed carrier, single sideband - suppressed carrier - propagation of electromagnetic waves - block diagrams of low power and high power AM transmission - AM receivers: straight receivers superhetrodyne receiver - choice of intermediate frequency - simple AVC circuit.

Module – II

Theory of frequency modulation (FM): Sidebands –Carson's rule. FM broadcasting - block diagrams of direct FM transmitter and Amstrong transmitter - FM receivers (balanced - slope detector and Foster-Seely discriminator only).

Principles of digital communication – pulse modulation- sampling process-PAM – Quantization - pulse code modulation (PCM) (basic principles only)

Carrier communication: General principles of multi-channel system and power-line carrier - terminal equipment.

Module – III

Television: TV standards - frequency bands - TV Cameras -TV picture tube -interlacing and synchronization(block diagrams) – bandwidth-guard bands- composite video signal - TV receiver and transmitter block diagrams: black and white, color (PAL system only) - high definition television.

Radar and navigation: principle of radar and radar equation, block schematics of pulsed radar.

Module – IV

Evaluation of mobile telephone - two-way communication services - cellular telephone: basic concepts, frequency reuse, interference cell splitting, sectoring, cell system layout, cell processing.

Analog cellular telephone: Basic concept, block diagram of analog cellular tranceiver.

Digital cellular telephone (basic concept) - code division multiple accessing (CDMA) - block diagram of global system for mobile (GSM) architecture -overview of personal communication satellite system (PCSS).

References:

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

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Explain the block diagram of analog communication systems.*
- *Describe the various analog modulation techniques, their generation and detection, and illustrate the various functional blocks in analog communication*
- *Illustrate the Television receiver and transmitter systems*
- *Describe the various digital communication techniques used for Television and radar*
- *Explain the concepts of Cellular and Satellite Communication.*

13.705 INDUSTRIAL ENGINEERING & MANAGEMENT (E)

Teaching Scheme: 3L) - 0(T) - 0(P) **Credits:** 3

Course Objectives:

- *To develop theoretical knowledge, skills, and modern tools for Industrial Management*
- *To create awareness about social, health, safety, legal, psychological and cultural aspects in Industries.*
- *To understand the requirements while handling different types of projects*
- *To know Engineering and Management principles for effective Production and Management control on Industrial Projects*
- *To create awareness about effective communication and personnel management skills*
- *To have a proper understanding of professional ethics, social responsibilities and human aspects, while working in Industries.*

Module – I

Evolution of Scientific Management and Industrial Engineering. Activities of Industrial engineering –techniques of industrial engineering. Functions of Management - Brief description of each function. Types of Organization structures. Types of companies and their formation.

Personnel Management - Objectives and functions - Recruitment, Selection, Training, Induction; concepts and techniques. Production cost concept and break even analysis – simple problems.

Module – II

Introduction to financial management- scope of financial management - functions - objectives of financial management. Working capital- factors affecting working capital-working capital cycle. Depreciation - methods of calculating depreciation. Facility location : Factors influencing plant location- Plant layout- different types of layout-material flow pattern-layout planning -computerized layout planning techniques. Work study-Methods study and Time Measurement, Use of chart and diagrams.

Module – III

Performance rating and Methods- Types of Allowances, computation of basic time and Standard time -Examples. Wages and Incentives-System of Wage Incentive Plans, Job evaluation and Merit rating. Industrial relations- Fatigue and methods of eliminating fatigue.

Industrial disputes -collective bargaining-Trade unions. Production Planning and Control-Functions and Objectives-job, batch, mass and continuous production. Materials

Management – Inventory, Determination of Economic Order Quantity, inventory control techniques.

Module – IV

Quality Engineering-Quality control- Control chart for variables and attributes-Introduction to ISO-9000 series-ISO 14000 series- Total Quality Management, Six sigma concept - Quality Information systems. Bench marking and Documentation. Introduction to Marketing and its Environment -Marketing concept, market Segmentation methods- Product life cycle. Project management- Phases-Planning using PERT and CPM.

References:

1. Mahajan M., *Industrial Engineering and Production Management*, Dhanpat Rai & Co.
2. Martand Telsang, *Industrial Engineering and Production Management*, S Chand & Co.
3. Grant and Levenworth, *Statistical Quality Control*, TMH.
4. Krafewsk, *Operations Management*, 6/e, Pearson Education.
5. Introduction to Work Study- ILO
6. Besterfield, *Total Quality Management*, Pearson Education.
7. Richard L. Francis and John .A. White, *Facility Layout & Location*, Prentice Hall.
8. Kotler, *Marketing Management*, Pearson Education.
9. Roger G. Schroedu, *Operations Management*, McGraw Hill.
10. Khan and Jain, *Financial Management*, TMH.
11. Pandey I. M., *Financial Management*, VIkas Publishers.
12. Prasenna Chandra, *Project Planning Analysis Selection Implementation and Review*, TMH.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Apply theoretical knowledge, skills, and modern tools in Industrial Scenario*
- *Be aware of societal, health, safety, legal, and cultural aspects in Industries.*
- *Work as an individual and as a member or leader in a team while handling multidisciplinary tasks*
- *Apply Engineering and Management principles to have an effective Production and Management control over various Industrial Projects*
- *Effectively communicate and use personnel management skills while handling managerial jobs in Industries*
- *Realize the importance of professional ethics, social responsibilities, human aspects etc., while working in Industries*

13.706.1 OBJECT ORIENTED PROGRAMMING (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

To get a clear understanding of object-oriented concepts and to learn object oriented programming through C++.

Module – I

Introduction to object oriented programming – data abstraction – inheritance – polymorphism. Basic data types – operators – expressions input/output- manipulators. Decision making – if and else and switch case. Loops – for, while and do while. Arrays – structure – union. Functions – reference parameter- function overloading – default arguments – inline functions – recursion- storage classes.

Module – II

Pointers – array of pointers. Dynamic allocation of memory – command line arguments pointers to a function – array and pointers as arguments of a function -general purpose functions for handling two dimensional array as arguments

Classes- Data members – methods -.private, public and protected members. Scope resolution operator – this pointer- static data member and methods, 'const' arguments. Array of classes objects – pointer to a class object.

Module – III

Constructors and destructors – Copy constructor- overloaded methods – friend function and classes-overloading of binary and unary operators – type conversion.

Inheritance – Private, Public and protected derivation- constructers and destructors in derived classes – friend function and inheritance – over riding methods – pointers to base and derived classes – polymorphism – virtual functions -multiple inheritance .Classes with in classes.

Module – IV

Introduction to function templates and class templates. Exception handling – try- catch. File handling in C++ formatted and unformatted files -sequential and random processing of files. Introduction to Microsoft Foundation of Class library.

References:-

1. Robert Lafore, *Object Oriented Programming In C++*, Fourth Edition, Tech Media, 2002.

2. Venugopal K. R., Rajkumar Buyya and T. Ravishankar, *Mastering C++,* Tata McGraw Hill, 1999.
3. Balaguru Swami, *Object oriented Programming with C++*, TMH publishers
4. Bjarne Stroustrup, *Programming: Principles and Practice Using C+*, Addison Wesley, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Understand fundamentals of programming such as variables, conditional and iterative, execution, methods, etc.*
- *Understand the concept and underlying principles of Object-Oriented Programming*
- *Understand how object-oriented concepts are incorporated into the C++ programming language*
- *Develop problem-solving and programming skills using OOP concept*
- *Understand the benefits of a well-structured program*
- *Develop the ability to solve real-world problems through software development in high-level programming language like C++*

13.706.2 MODERN OPERATING SYSTEMS (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

To provide a clear understanding of the concepts of operating systems such as process management, memory management, virtual memory, input-output and device management, file management and file systems.

Module – I

Introduction - Operating system as an extended machine - Operating system as a resource manager – Operating system concepts – overview. System calls - for process management - file management - directory management Operating system structure - monolithic systems - layered systems.

Process Scheduling -Goals - First come first served scheduling - Shortest job first - Shortest remaining time next- Round robin scheduling - Priority scheduling.

Module – II

Introduction to processes - The process model - creation - termination - hierarchies - states - implementation of process. Threads - thread model, thread usage, Inter-process communication - race condition - critical sections -Mutual exclusion with busy waiting - sleep and wakeup - Semaphores, Mutexes

Deadlocks - Conditions for deadlock - deadlock modeling - ostrich algorithm - deadlock detection – recovery from deadlock - deadlock avoidance - resource trajectories - safe and unsafe states. Bankers algorithm for single and multiple resources - deadlock prevention.

Module – III

Memory management - mono-programming without swapping or paging - Multiprogramming with fixed partitions. Modeling multi-programming, Analysis of multiprogramming system performance, relocation and protection, Swapping - Memory management with bit maps

Virtual memory - Paging - Page tables – TLBs - Page replacement algorithms - Optimal page replacement algorithm - Not recently used algorithm - First-in first-out algorithm - Second chance page replacement algorithm - Clock algorithm - Least recently used algorithm - the working set page replacement algorithm -Beladys anomaly, local verses global policies - page size.

Module – IV

I/O - devices - device controllers - principles of I/O software - I/O software layers - Disks - formatting, disk arm scheduling algorithms, Error handling, RAID disks. File Systems - file structure - file "types - file access - file attributes - file operations - Directories - single level directory systems - Two-level directory systems - hierarchical directory systems - path names, Directory operations, File system implementation - implementing files - file system layout - implementing directories.

References:-

1. Andrew S. Tanenbaum, *Modem Operating Systems*, 3e, Prentice Hall 2008.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, *Operating Systems Concepts*, 8/e, Wiley, 2010.
3. William Stallings, *Operating Systems: Internals and Design Principles*, 6/e, Prentice Hall, 2009.
4. Stuart E. Madnick and John J. Donovan, *Operating Systems*, McGraw-Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Explain the key concepts of modern operating systems*
- *Analyze theory and implementation of process management technique including process scheduling, synchronization, and deadlock*
- *Critically evaluate the implementation of memory management techniques including virtual memory.*
- *Evaluate various I/O management methods and Disc scheduling algorithms*
- *Illustrate different file management methods.*

13.706.3 POWER SYSTEM OPERATION AND CONTROL (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

To make the students aware of the importance of Economic operation as well as control of power system.

Module – I

Introduction-Review of Thermal units.-The Lambda iteration method-First order gradient method base point and participation factors. Generation with limited supply-Take or pay fuel contract-composite generation production cost function- solution of gradient search techniques. Hard limits and slack variables.

Module – II

Hydro-thermal coordination-Long range and short range scheduling- Hydro-electric plant models - scheduling problems - types of scheduling problems. Scheduling energy -short-term hydrothermal scheduling problem- Pumped storage hydro plants- pumped storage hydro scheduling λ-γ iteration. Inter change evaluation and power pools-Economy interchange evaluation with unit commitments.

Module – III

Types of interchange. Energy banking-power pools. Power system security-system monitoring-contingency analysis- security constrained optimal power flow- Factors affecting power system security. monitoring-contingency analysis- security constrained optimal power flow- Factors affecting power system security. State estimation in power system - Introduction.

Module – IV

Control of generation-Automatic Generation control Review-AGC implementation - AGC features - Modelling exercise using SIMUL1NK. AGC with optimal dispatch of Generation-Voltage control-AGC including excitation system. MVAR control - Application of voltage regulator – synchronous condenser – transformer taps – static VAR compensators.

References:-

1. Allen J. Wood, Wollenberg B. F., *Power Generation Operation and Control,* 2/e, John Wiley & Sons, 1996.
2. Vadhera S. S., *Power System Analysis and Stability,* Khanna Publishers.

3. Kirchmayer L. K., *Economic Control of Interconnected Systems,* John Wiley & Sons, 1959.
4. Nagrath, I. J. and Kothari D. P., *Modern Power System Analysis,* TMH, New Delhi, 2006.
5. Weedy B. M., *Electric Power Systems,* John Wiley and Sons, New York, 1987.
6. Montieelli A., *State Estimation in Electric Power System-A Generalised Approach.*

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Dispatch a power system economically considering take unit commitment and security constraints.*
- *Model an AGC including excitation system and voltage regulators.*

13.706.4 POWER QUALITY (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

- *To study the production of voltages sags, interruptions and harmonics and methods of control.*
- *To study various methods of power quality monitoring.*

Module – I

Power Quality phenomenon-Terms and definitions-Various Power events in power quality - causes for reduction in power quality. Sources of sags – Magnitude & duration of sag-effect of sag on computer and consumer Electronics- Monitoring and mitigation of voltage sag.

Module – II

Origin of Long & Short interruption –influence on various equipments- Basic reliability indices -monitoring and mitigation of interruption. Sources of Transient Over voltages - Principles of overvoltage protection - Devices for overvoltage protection - Utility protection.

One dimensional FE analysis - discretisation of domain into elements - generalised coordinates approach - derivation of elements equations - assembly of element equations-Boundary conditions.

Module – III

Harmonic distortion: Voltage and current distortion- harmonic indices- harmonic sources from commercial and industrial loads- Effects of harmonics on various equipments-harmonic distortion evaluation- Devices for controlling harmonic distortion. Harmonics from distributed generation- power quality issues-operation issues - interconnection standards.

Module – IV

Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic spectrum analyzer, flicker meters, disturbance analyzer. Power Quality monitoring standards - IEEE and IEC.

References:-

1. Roger C. Dugan, Mark F. McGranagham, Surya Santoso and H. Wayne Beaty, *Electrical Power Systems Quality*, McGraw Hill, 2003.
2. Arindam Ghosh, *Power Quality Enhancement Using Custom Power Devices*, Springer, 2002.
3. Math H. J. Bollen, *Understanding Power Quality Problems-Voltage Sag & Interruptions*, IEEE Press, 2000.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Identify various causes for power quality issues.*
- *Analyse and determine the extent of damage to the power system due to power quality issues.*
- *Suggest effective remedial measures to overcome the power quality issues.*

13.706.5 DESIGN OF DIGITAL CONTROL SYSTEMS (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

- *To introduce the need and concept of digital control system.*
- *To impart knowledge about different strategies adopted in the design of digital controllers*
- *To familiarize with the design of different types of digital controllers.*

Module – I

Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate-principles of discretization - Mapping between s-domain and z-domain-Pulse transfer function- Different configurations for the design- Modified z-transform-Time responses of discrete data systems-Steady state performance.

Module – II

Stability analysis of Digital control systems. Digital PID-design of PID controller, Design of lag, lead and lag-lead compensators - based on frequency response method.

Module – III

Digital Controller Design for SISO systems: design by Emulation, design based on root locus in the z-plane, direct design - method of Ragazzini. Dead-beat response design- Deadbeat controller.

Module – IV

State variable model of discrete data systems -Various canonical form representations- Transfer function -Computation of state transition matrix using Cayley-Hamilton theorem and z-transform method- Complete state and output Controllability, Observability, stabilizability and reachability - Loss of controllability and observability due to sampling- Pole placement design using state feedback for SISO systems.

References:-

1. Gene F. Franklin, J. David Powell, Michael Workman, Digital Control of Dynamic Systems, Pearson, Asia.
2. Liegh J. R., *Applied Digital Control*, Rinchart & Winston Inc., New Delhi.

3. Benjamin C. Kuo, *Digital Control Systems*, 2/e, Saunders College Publishing, Philadelphia, 1992.
4. Ogata K., *Discrete-Time Control Systems*, Pearson Education, Asia.
5. C. L. Philips, H. T. Nagle, *Digital Control Systems*, Prentice-Hall, Englewood Cliffs, New Jersey, 1995.
6. R. G. Jacquot, *Modern Digital Control Systems*, Marcel Decker, New York, 1995.
7. M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw-Hill, 1997.
8. Sami Fadali M. and Antonio Visioli, *Digital Control Engineering -Analysis and Design*, Elsevier, 2013.
9. Frank L. Lewis, *Applied Optimal Control& Estimation*, Prentice-Hall, Englewood Cliffs, NJ, 1992.
10. Mohammed S. Satina, Allen R. Stubberud and Gene H. Hostetter, *Digital Control System Design*, 2/e, Saundess College Publishing, United States of America, 1994.
11. Constantine H. Houpis and Gary B. Lamont, *Digital Control Systems Theory, Hardware Software*, McGraw Hill Book Company, 1985.
12. Isermann R., *Digital Control Systems*, *Fundamentals, Deterministic Control*, V. I, 2/e, Springer Verlag, 1989.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Explain & model basic digital control systems.*
- *Determine pulse transfer function of digital control systems.*

- *Determine the steady state response of discrete data systems.*
- *Determine the stability of digital control systems.*
- *Design appropriate digital controller and compensator for a given system*
- *Explain the concept of deadbeat response and design a controller for obtaining such a response from a given system.*
- *Determine the state space model of a discrete data system and its solution*
- *Explain the concepts of controllability, observability, stabilizability and reachability for discrete data systems*
- *Design state feedback controllers by pole placement.*

13.706.6 HIGH VOLTAGE ENGINEERING (E) (Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

- *To Introduce the concepts of High voltage Generation and its application in Electrical Engineering*
- *To introduce the types of over voltage occurring in a power system network and how the system insulation is coordinated for protection against overvoltage*
- *To familiarize the testing methods applied to a Power apparatus*
- *To introduce the insulation design aspects of a EHV cable.*

Module – I

Generation of High dc voltages - Half wave and full wave circuits - Ripple voltages in HW and FW rectifiers. Voltage doubler circuits - Simple voltage doubler and cascade voltage doubler. Voltage multiplier circuits - Cockcroft-Walton Voltage multiplier circuits. Ripple and regulation. Electrostatics machines – principles - Van de Graaff generator.

Generation of High AC voltages: Cascade transformers, resonant transformers- parallel and series resonant test systems.

Generation of High frequency high voltages- Tesla coil.

Generation of impulse voltages- Standard impulse wave shape - Basic circuits for producing impulse waves - Analysis of commercial impulse generator circuits -Wave shape control. Multistage impulse generators - Marx circuit - modified Marx impulse generator circuit - Components of multi-stage impulse generator. simple numerical examples.

Generation of switching surges. Generation of impulse currents- Definition of impulse current waveform - Circuit for producing impulse current waves.

Module – II

Over voltages in power system –Over voltages and their significance- Switching over voltages - origin and characteristics - switching over voltages in EHV and UHV systems - Insulation requirements of EHV line. - Protection of power system apparatus against over voltages.

Surge arresters - dynamic volt-ampere characteristics and surge diverter operation characteristic. Connections and rated voltages of surge arresters. Thyrite and ZnO arresters.

Protective devices against lightning over voltages - rod - rod gaps – over-head ground wires. Control of over voltages due to switching - method of reducing switching over voltages.

Principle of insulation co- ordination on HV and EHV power systems: Insulation level of equipment. Volt-time characteristics. Insulation co-ordination of a substation. Insulation co-ordination of EHV system. Illustration with example.

Module – III

Non-destructive testing of dielectric materials-Measurement of resistance, dielectric constant and loss factor. Partial discharge phenomena - discharge detection using straight detectors.

HV testing of electrical apparatus- Definitions - Terms and conditions - Test on insulators, cables, transformers, surge arresters.

HV and EHV bushing design – selection - quality control - maintenance and diagnostic testing.

Biological and environmental aspects in EHV and UHV line design. Live line maintenance – Principles - common live line maintenance - Tools for live line maintenance.

Module – IV

EHV cable- classification and characteristics, Gas Insulated EHV Line-Principle, specification and application,

Statistical procedure for determination of breakdown and withstand electrical stresses in EHV cable- Weibull probability function for breakdown gradient- volt time characteristics of solid insulation

Design basis of EHV cable insulation-factors considered, determination of test voltage, Procedural Steps involved in cable insulation design.

Design of a 500kV XLPE cable (numerical examples).

References:-

1. Naidu M. S. and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, New Delhi. (Module(1,2,3)
2. Nagarath I. J. and D. P. Kothari, *Modern Power System Analysis*, TMH. 1994.
3. Kuffel E. and W.Zaengal, *High Voltage Engineering*, Pergamon Press, Oxford.
4. Dieter Kind, *An Introduction to High Voltage Experimental Techniques*, Wiley Eastern.
5. Rakosh Das Begamudre, *Extra High Voltage AC Transmission Engineering,* 3/e, New Age International Publishers, 2006. (MODULE 4)
6. Diesendrof W., *Insulation Co-ordination in High Voltage Electrical Power Systems*, Butterworth, London.
7. *Methods of High Voltage Testing*, IS 2021-1976, IEEE Std - 4 - 1978.

8. Wadhwa C.L., *High Voltage Engineering*, Wiley Eastern.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours　　　*Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Interpret the principles involved in generation of High dc and High Ac voltage and impulse voltage*
- *Be aware of the causes of over voltages in power system and its significance in insulation design of H V and EHV systems*
- *Be Familiar with the test procedures to be carried out on high voltage equipments.*
- *Classify EHV cable and design insulation parameters of cable for different test voltage.*

13.706.7 NANO TECHNOLOGY (E) Elective III)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objective:

- *To provide a clear understanding of the concepts of nanotechnology, different nanomaterials, the methods for their characterization and applications.*
- *To impart a thorough knowledge of the different nano devices for electronic applications.*

Module – I

Introduction: Introduction to Nanotechnology- present and future-threats and scope. Comparison of bulk and nano-materials. Design principles and implementation of nano-engineered materials in the development of nanotechnology- applications. Synthesis of nanomaterials- Classification of fabrication methods.

Module – II

Nanoscale materials: Novel structural functionality, sensory functionality, and information processing capabilities of nanomaterials. Molecular self-assembly phenomena, molecular materials and architectures; Carbon nanostructures- Structure, electrical, vibration and mechanical properties. Application of carbon nanotubes.

Module – III

Nanomaterial characterization : Electronic properties of atoms and solids, the isolated atom, bonding between atoms, giant molecular solids. Nanocrystalline materials, Nanoscale x-ray -electron and neutron diffraction techniques, Scanning electron microscopy, Transmission electron microscopy-Atomic force microscopy (AFM), Scanning tunneling microscopy (STM). Raman Spectroscopy.

Module – IV

Nanoelectronics and nanodevices: Nanoscale materials-characterization and metrology. Physical properties of nano-structured semiconductors critical to nanoscale optoelectronic devices. Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMs). Fabrication and applications. Nanodevices-resonant tunneling diode, quantum cascade lasers, single electron transistors- operating principles and applications.

References:-

1. Drexler K. E., *Engines of Creation*, Fourth Estate, London, 1990.

2. Regis E., Nano. *The Emerging Science of Nanotechnology: Remaking the World – Molecule.*
3. Sahu S. N., R. K. Choudhury and P. Jena, *Nano-scale Materials: From Science to Technology,* Nova Science Publishers, 2006.
4. Yannick Champion and Hans-Jörg Fecht, *Nano-Architectured and Nanostructured Materials: Fabrication, Control and Properties*, Wiley-VCH, 2005.
5. Robert K, Ian H, Mark G, *Nanoscale Science and Technology*, John Wiley & Sons, 2005.
6. Robert W. Kelsall, Ian W. Hamely and Mark Geoghegan, *Nano Scale Science and Technology*, John Wiley & Sons, 2004.
7. Farhrner W. R. (Ed), Nanotechnology and Nanoelectronics, Springer, 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- *Illustrate the need of nanotechnology in the field of electrical and electronics engineering*
- *Compare the properties of different nanomaterials.*
- *Explain the methods of characterization for nanomaterials using different microscopic techniques.*
- *Outline the process for the fabrication of NEMS devices*
- *Explain the operating principles and applications of nanodevices.*

13.707 SEMINAR (E)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

To impart the ability to choose a technically relevant paper from a peer reviewed/ refereed journal in the field of Electrical and Electronics Engineering and to acquire the confidence in presenting the topic.

Course Content

Each student shall conduct a literature survey and choose a technical paper which is of high relevance to Electrical and Electronics engineering field. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member by referring papers published in peer reviewed reputed international journals. The student shall comprehend the concepts/technologies in the chosen topic within the field and present a seminar on it. A committee consisting a minimum of three faculty members will evaluate the seminar. A report (which is not exactly the reproduction of the original paper) on seminar shall be submitted at the end of the semester. The certified seminar report should be available with the student for Project and Viva voce at the end of Eighth semester.

Internal Continuous Assessment *(Maximum Marks- 50)*

20% - Relevance of the topic and literature survey

50% - Presentation and Discussion

20% - Regularity in the class and active participation in seminar

10% - Report

Course Outcome:

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

- *Conduct literature survey and comprehend the existing concepts/technologies in a chosen field within the domain of electrical and electronics engineering.*
- *Conceive, consolidate and illustrate a technical paper with the help of state of the art technologies and the resources available*
- *Develop and enhance the presentation skills.*
- *Be aware of recent developments in the field of study.*
- *Develop the skill of preparing technical documents/reports.*

13.708 ELECTRICAL MACHINES LAB II (E)

Teaching Scheme: 0(L) - 0(T) - 4(P) **Credits**: 4

Course Objective :

To conduct various tests on Alternators, Three phase and Single phase Induction Motors and induction generators

List of Experiments:

1. Regulation of alternator by direct loading - Effect of prime mover speed and Generator Excitation.
2. Regulation of alternator by emf and mmf methods - Potier triangle Calculation
3. Regulation of alternator by Potier and ASA methods
4. Slip test - regulation of salient pole alternator using two reaction theory
5. Synchronization of alternator to mains by dark lamp and bright lamp methods and control of reactive power - effect of normal excitation, under excitation & over excitation in an alternator connected to infinite bus - V and inverted V curves as generator and motor
6. Study of induction motor starters
7. Variation of starting torque with rotor resistance in slip-ring induction motors
8. Direct load test on three phase induction motor
9. No load and block rotor test on three phase induction motor - predetermination of performance characteristics from circle diagram and determination of equivalent circuit.
10. Pole changing induction motor - predetermination of performance characteristics
11. Induction generator - Circle diagrams and Direct load test
12. Synchronous induction motor - V-curves and predetermination of field current
13. Single phase induction motor -equivalent circuit
14. V/f Control of Three phase Induction motor (optional).

Internal Continuous Assessment *(Maximum Marks- 50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed

80% - Circuit and design (30%);

Performance (30%)

Results and inference (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

- *Analyze and evaluate the regulation of alternators using pessimistic and optimistic methods*
- *Outline the synchronizing procedures for alternators and assess the performance of synchronous machines*
- *Assess the performance of induction machine and recommend for suitable application*
- *Evaluate the performance of induction machine and synchronous induction motor using predetermination tests.*

13.709 POWER SYSTEMS LAB (E)

Teaching Scheme: 0(L) - 0(T) - 4(P) **Credits**: 4

Course Objective :

- *To get a thorough knowledge of high voltage testing of power system components like insulators, transformers, and cables.*
- *To learn the principle of testing different types of relays.*
- *To learn the concept of power system simulation using dedicated softwares.*

List of Experiments:

Hardware Tests

1. Power frequency testing of electrical equipment like insulators, fuses, AB switches, lightning arresters etc.
2. Determination of string efficiency of string insulators.
3. Calibration of HV measuring equipment using sphere gap.
4. Impulse voltage test on insulators, lightning arresters etc..
5. Measurement of dielectric strength of air, solid and liquid insulating materials.
6. Determine the characteristic , pick up time etc. of different types of electromagnetic relays
7. Determine the characteristic, pick up time etc. of different types of static relays.
8. Measurement of earth resistance and soil resistivity.
9. Testing of insulation of 3 core and 4 core cable
10. Characteristics of Current Transformers and Potential Transformers
11. Power measurement using current transformer & potential transformer.
12. Power factor improvement with capacitor banks.
13. Testing of energy meters
14. Ferranti Effect and its mitigation
15. Transient stability study

Software Simulation Tests

16. Load flow analysis - Gauss Siedel Method, Newton Raphson Method, Fast decoupled method of test systems with buses not exceeding 6 numbers.
17. Short circuit studies – 3 phase LG, LL, LLG fault.
18. Simulation of AGC for single area and two area systems using SIMULINK.

19. Formulation of Ybus matrix with mutual coupling using MATLAB.
20. Simulation of FACTS devices (Shunt Compensation).
21. Analysis of Transient stability and Voltage stability of power systems (using Power angle and PV curves respectively).

Note: *Ten of the twelve Hardware Experiments and the first four Software Experiments are mandatory. All other experiments can be conducted as contents beyond syllabus.*

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours Maximum Total Marks: 100

Questions based on the list of experiments prescribed. Question paper will contain one hardware and one software question. Each student must answer both parts.

80% - Circuit and Design- (30%);

Performance - (30%)

Results and inference- (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

- *Conduct high voltage testing of power system components like insulators, transformers, and cables.*
- *Conduct testing of different types of relays.*
- *Simulate power system networks using softwares and analyse the system in steady state and transient state.*

13.710 INDUSTRIAL VISIT & PROJECT PRELIMINARY WORK (E)

Teaching Scheme: 0(L) - 0(T) - 1(P) **Credits**: 1

Course Objective :

To impart the ability for project planning and also to develop the skill of implementing the ideas generated from the curricular components.

Course Content

The students need to undergo a minimum of **three** industrial visits during IV to VII Semesters and submit a report at the end of the seventh semester. A certified report on industrial visits should be available with the student for Project and Viva voce at the end of Eighth semester.

The project work is for the duration of Seventh and Eighth semesters. Students groups may be formed with not more than five students in a group. Each group is expected to do the project planning and preliminary work in the domain of Electrical and Electronics Engineering using modern software/Hardware tools. The project evaluation committee consisting of the guide and other four members of the relevant subject group/ specialization will perform the screening/feasibility study based on the synopsis submitted within one month from start of the seventh semester. At the end of the semester the committee will evaluate the project progress based on a presentation by each group. Each group should also submit a preliminary project report at the end of the seventh semester.

Internal Continuous Assessment *(Maximum Marks-50)*

Industrial Visits: *40% weightage (20 marks). To be assessed by internal evaluation based on the certified reports of the industrial visits submitted by the student.*

Project Preliminary Work: *60% weightage (30 marks). To be assessed by the project evaluation committee using the following distribution of marks.*

30% - Technical relevance of the project
40% - Literature survey and project planning
30% - Progress of the project

Course Outcome:

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

- *Select, Plan and present a project proposal using the knowledge acquired from curricular components.*
- *Create awareness about the functioning, organization and management practices of industries related to the field of study through Industrial Visits.*