Faculty of Engineering & Technology
P.K.University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
M. Tech- Electrical & Electronics Engineering (EEE)
(Effective from Session: 2019-20)

M.TECH- ELECTRICAL & ELECTRONICS ENGINEERING (EEE)

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTEN-101	ADVANCED MICROPROCESSOR ITS APPLICATIONS	30	70	25	25	150
MTEN-102	POWER CONVERTERS	30	70	25	25	150
MTEN-103	POWER SYSTEM OPERATION & CONTROL	30	70	NA	NA	100
MTEN-104	MODELING & DYNAMICS OF ELECTRICAL MACHINES	30	70	NA	NA	100
MTEN-105	RESEARCH PROCESS & METHODOLOGY	30	70	NA	NA	100

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTEN-201	ADVANCED DIGITAL SIGNAL PROCESSING	30	70	25	25	150
MTEN-202	POWER QUALITY & FACTS DEVICES	30	70	NA	NA	100
MTEN-203	ADVANCED PROTECTING RELAYING	30	70	NA	NA	100
MTEN-204	EHV AC & DC TRANSMISSION	30	70	NA	NA	100
MTEN-205	NON CONVENTIONAL ENERGY AND ENERGY CONVERTERS	30	70	NA	NA	100
MTEN-206	Seminar-I	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTEN--301	Dissertation phase-I	NA	NA	200	200	400
MTEN--302	Seminar-II	NA	NA	25	25	50

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTEN--401	Dissertation phase-II	NA	NA	300	300	600

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I Year I Semester

MTEN-101: ADVANCED MICROPROCESSOR & ITS APPLICATIONS

1 **Introduction:**

Review of basic microprocessors, architecture and instruction set of 8085 microprocessor.

2. **Evolution of advanced microprocessors:**
Introduction to 16, 32 and 64 bit microprocessors. Concepts of CISC, RISC, multi-processing, multi- user, multi-tasking, Virtual Memory, Segmentation, Cache Memory. Hyper Threading and Burst mode of operation. Parallel processors, dual and multi-core processors and supercomputers.

3. Architecture of 16 bit 8086 microprocessor and its working. Minimum and Maximum mode configuration. Memory organization. Its addressing mode, Instruction set and template. Interrupt structure. Assembly language programming and applications. Motorola 68000 processor & its architecture.

4. **MASM/TASM assembler:**
Statement syntax, common assembler directives, creating a source file, assembly and linking, loading and execution.

5. **Programmable Peripherals, their working and Interfacing:**
Parallel I/O (8255 PPI), Serial I/O (8251), RS-232C, and Modem, 8253/8254 Timer/counter, 8259 Interrupt controller and 8237 DMA, controller, 8287 Math Co-processor, AD and DA converters.

6. **Microcontrollers:**
Introduction to 8051 micro-controller family, pin description, its internal structure, Special Function registers, memory organization, addressing modes, and its syntax, Instruction set and its format. Working of its timer, interrupts and serial I/O Atmel microcontroller 89C51 and 89C2051.

   Introduction to 8096/8097 family and essential difference with 8051.

7. **32 – bit microprocessor:**
Introduction to 80386 DX microprocessor, essential pin description, Internal registers, virtual memory, Segmentation and paging system. Internal and external cache memory and its organization.

References :

1. R.S. Gaonkar, "Microprocessor Architecture, programming and applications", Wiley Eastern Limited.
2. Liu Gibson, "Micro-computer Systems the 8086/8088 family architecture". Prentice Hall of India
3. D.V. Hall, "Microprocessors and Interfacing Programming" Revised 2nd Edition, Tata Macgraw Hill.
4. W.A. Triebel & Avatar Singh "The 8088 and 8086 Microprocessors" Fourth Edition, 2003 Prentice Hall India.
5. A.V. Desh Mukh "Microcontrollers- Theory and Applications" Tata Mc Graw Hill.
6. Mohammed Rafiquzzaman "Microprocessor and Micro-controller Based System Design" Universal Books Stall, New Delhi.

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I Year I Semester

MTEN-101: MICROPROCESSOR & MICROCONTROLLER LAB

LIST OF EXPERIMENTS

1. To study 8085 microprocessor kit and all IC chips.
2. To study 8086 based microprocessor kit and all IC chips.
3. To develop and run a program for arranging in ascending/descending order of a set of number.
4. (a) To perform conversion of temperature ^{o}F to ^{o}C and vice-versa,
   (b) To perform computation of square root of given number.
5. To write a program for generating square wave with 8253/8254. The periodic time of the wave is 2 msec & 10msec.
6. To write a program for generating square wave with 8255, the periodic time of the wave is 2 msec & 10 msec.
7. To write a program to convert analog input to 0809 ADC to the digital output.
8. Study of Intel 8051 microcontroller kit and its commands.
9. Generation of triangular wave using 8051 kit.
10. Generation of square wave form using 8051 kit.
11. Rotating of stipple motor using 8051 kit.
12. Reading input through DIP switches and their display using LED / 7-segment display.

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I Year I Semester

MTEN-102: POWER CONVERTERS

1. **Power Semiconductor Devices :**
   Review of power semiconductor devices, i.e. SCR, Triac, GTO Thyristor, Power Transistor, Power MOSFET, Insulated Gate Bipolar Transistor (IGBT), MOS Controlled Thyristor (MCT); trigger techniques, protection.

2. **Line Commutated Converters:**
   Full and half controlled converters, effect of load and source inductances; performance parameters, dual converters, power factor improving techniques.

3. **AC Voltage Controllers:**
   Operation and performance of single phase and three phase ac voltage controllers, solid state ac and dc transfer switches.

4. **DC-DC Converters :**
   Commutation techniques of SCR, chopper control techniques, step down chopper with RL& RLE load, step-up chopper, multi-phase configuration. Impulse commutated and resonant pulse choppers, introduction to speed control of dc motors.

5. **Inverters:**
   Single phase series resonant inverter, single phase and three phase bridge inverters, voltage control and harmonics reduction techniques, current source inverter, Introduction to speed control of induction motors.

References:

1. M.H. Rashid, "Power Electronics: Circuits, devices and Applications"' Prentice Hall of India, 1996
2. N. Mohan, T.M.Undeland and W.P. Robbins, "Power Electronics; Converters, Applications and design"' John Wiley and Sons, 1995
3. M.D. Singh and K.B. Khanchandani, "Power Electronics",Tata McGraw Hill, 2001
4. S.N. Singh, " A Text Book of Power Electronics"' Dhanpat Rai & Co, 2000
5. A.K. Gupta, L.P. Singh, "Power Electronics: An Introduction to Drives", Dhanpat Rai Publishing Co.,2001
6. V. Subrahmanyam, 'Power Electronics"' New Age International Publishers, 1997.

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I Year I Semester

MTEN-102: POWER CONVERTER LAB

Experiments and computer simulations on:

1. Single phase, three phase Semi converters and Full converters,
2. DC-DC Choppers using SCRs and Self communicating Devices.
3. Single phase and three phase inverters using IGBTs,
4. AC-AC voltage regulators.
5. DC and AC drives

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I Year I Semester

MTEN-103: POWER SYSTEM OPERATION AND CONTROL

1. **Introduction:**
   Large scale power systems-their interconnections and operation; load dispatch centre and control centre, introduction to centralized and decentralized controls; various operational stages of power system; power system security.

2. **Economic Operation:**
   Problem of unit commitment, system constraints, incremental fuel cost, economic load scheduling with and without transmission losses, penalty factor, loss coefficient, incremental transmission loss ; optimal power flow problem ; optimal operation of hydro-thermal system.

3. **Load Frequency Control:**
   Concept of load frequency control, speed governing systems and its representation, automatic control, modeling of single area and multiarea systems, tie line control, supervisory control ; automatic generation control including excitation system; optimum load frequency controller, PID controller.

4. **Voltage Reactive Power Control:**
   Concept of voltage control, methods of voltage control, reactive power injection, control by tap changing transformer, series compensation, static VAR compensation, Excitation system & stabilizer, rate feedback controller, PIDcontroller.

5. **State Estimation:**
   State estimation, linear and nonlinear models, detection and identification of measurement errors.

6. **Flexible AC Transmission System :**
   Concept and objectives, basic FACTS controllers: TCR,FC-TCR, TSC, SVC, STATCOM, TCSC, SSSC, PAR and UP FC

References:

1. O.I. Elgerd, "Electric Energy System Theory", Mc Graw Hill, 1971
2. Leon K. Kirchmayer, "Economic operation of Power Systems" Wiley Eastern Ltd.,
3. A. Chakrabarti, D.P. Kothari and A.K. Mukhopadhyay, "Performance Operation and Control of EHV Power Transmission Systems", Wheeler Publishing Co.
4. A. J. Wood & B.F. Wolfenberg "Power Generation Operation and control" Second Edition John Wiley & Sons.
5. D.P. Kothari & J.S. Dhillon "Power System Optimization" Prentice Hall, 2004.
6. HG Hingorani and L Gyugyi "Understanding FACTS", New York, IEEE Press 2000.

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I Year I Semester
MTEN-104: MODELING & DYNAMICS OF ELECTRICAL MACHINES

1. Introduction:
Challenges in computer simulations, Mechanics of simulation, solution techniques for time domain analysis, introduction of widely used circuit- oriented simulators like Pspice, MATLAB, PSIM, equation solvers, simulation of power electronics circuits and converters.

2. Dynamic Conditions:
Concept, constraints and considerations; modeling and performance simulation methods, concept of reference frame, generalized transformation, formulation of dynamic equations of a generalized machine in arbitrary reference frame.

3. D.C. Machine Dynamics:
Ideal machine; dynamic equation; transfer function and block diagram; linear analysis of D.C. generators; effects of saturation; analysis and performance under disturbances. Switching and surge voltage transients in transformers.

4. Induction Machines:
Transients and dynamics; basic electro mechanical equations; linearized and non-linearized analysis; operation on harmonic supplies; unbalanced operation.

5. Synchronous Machine Transients:
Coupled circuit viewpoint; approximate physical picture, equivalent circuit under transient conditions and its applications; synchronous motor operation with variable/fixed load torque and excitation; equal-area criterion for the study of transient stability.

Reference Books:
1. Krause P.C., Electric Machinery, McGraw Hill
2. Kimbark E.W., Power System Stability Vol 3 Synchronous Machine, John Wiley & Sons
3. Concordia C., Synchronous machines, Theory and Performance, John Wiley & Sons.
4. Adkins B. and Harley R. G., The General theory of Alternating Current Machines, Chapman & Hall

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I Year I Semester
MTEN-105: RESEARCH PROCESS AND METHODOLOGY

UNIT 1:

Introduction to Research and Problem Definition-Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem

UNIT 2:

Research Design-Research design, Methods of research design, research process and steps involved, Literature Survey

UNIT 3:

Data Collection-Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

UNIT 4:

Data Analysis and interpretation-Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

UNIT 5:

Technical Writing and reporting of research-Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013.

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I Year II Semester
MTEN-201: ADVANCED DIGITAL SIGNAL PROCESSING

1. Discrete-Time Signals and Systems:
Discrete-Time Signals, Discrete-Time Systems, Analysis of Discrete-Time Linear Time-Invariant Systems, Discrete Time systems described by Difference Equation, Implementation of Discrete-Time Systems, Signal flow Graph representation of digital network, matrix representation.

2. The z-Transform:
The Direct z-transform, Properties of the z-transform, Rational z-transforms, Inversion of the z transform, analysis of Linear Time-Invariant systems in the z- domain.

3. Discrete Fourier Transform:
Frequency Domain Sampling: The Discrete Fourier Transform Frequency- Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT. Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT.

4. **Basic IIR Filter Structures**:
Direct forms (I & II), cascade and parallel realizations. Signal flow graph,
Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure.
Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equiripple filter design Differentiators. Design of Hilbert Transformers.

5. Design of IIR Filters From Analog Filters:
IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance. IIR Filter Design by the Bilinear Transformation. The Matched-z Transformation, Characteristics of Commonly Used Analog Filters, Application of above technique to the design of Butterworth & Chebyshev.

MTEN-201: DIGITAL SIGNAL PROCESSING LAB

1. Study of Code Composer Studio of TMS320C6713 DSP Starter Kit (DSK).
2. Study of TMS320C6713 DSP Starter Kit (DSK) and its chip set.
3. Generation of Sinusoidal waveform / signal based on recursive difference equations.
4. To find DFT / IDFT of given DT signal.
5. Implementation FFT of given sequence.
6. Implementation of LP FIR filter for a given sequence.
7. Implementation of LP IIR filter for a given sequence.
8. Generation of sinusoidal signal through filtering.
9. Implementation of Interpolation Process.
10. Impulse response of first order and second order systems.

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MTEN-202: POWER QUALITY AND FACTS DEVICES

1. Overview:
Sources of pollution and regulations, various power quality problems, transmission problems and needs, the emergence of FACTS, FACTS controller & consideration.

2. Harmonics:
Effects-within the power system, Interference with communication Harmonic measurements, Harmonic elimination, Harmonic distortion due to various sources, Effects of harmonic distortion, THD calculation, Harmonic filter design, Active and Passive Filters.

3. Monitoring power quality:
Monitoring essentials, reliability indices, Power quality measuring equipment, Current industry trends, Fourier series, Fourier transform and wavelet transform.

4. Series and shunt compensation:
Fundamental of series compensation, principle of operation, TCSC operation in power system, SSSC :principle of operation, Shunt SVC principles, configuration & control, STATCOM, Modeling and applications of series and shunt compensating devices.

5. Phase shifter:
Principle of operation, steady state model of static phase shifter, operating characteristics of SPS, power current configuration of SPS applications.

6. Unified power flow controllers:
Basic operating principles & characteristics, control UPFC installation applications, UPFC model for power flow studies.

Reference Books:
1. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
2. Hingorani N.G. and Gyragyi L., "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers & Distributors, Delhi.
3. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
4. Mathur R.M. and Verma R.K., "Thyristor based FACTS controllers for Electrical Transmission Systems", IEEE Press.
5. M.H.J. Bollen, Understanding Power Quality and Voltage Sag, IEEE Press.

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MTEN-203: ADVANCED PROTECTIVE RELAYING

1. **Introduction**
   Essential qualities of protection, zones of protection, classification of relays, basic protective schemes.

2. **Comparators**
   Transfer impedance, mixing circuits, amplitude and phase comparators and their duality, static realization of amplitude and phase comparators, multi-input comparators.

3. **Static Relays :**
   Basic construction, input-output devices, merits and demerits of static relays, application of solid state devices.

4. **Static Protection:**
   Over current relaying schemes, differential relaying schemes, distance relaying schemes, power swing, carrier protection of long lines, protection of multiterminal lines, new type of relaying criteria, quadrilateral relay, elliptical relay, restricted distance relays.

5. **Digital Protection:**
   Concept of digital protection, microprocessor based over current and distance relay schemes, generalized interface for distance relays.

References :

1 A.R. Van C. Warrington, "Protective Relays- Their theory and practice Vol.I II", John Wiley Sons, 1977

2 B.D. Russel and M.E. Council, "Power System Control and Protection" Academic Press, 1982,

3 T.S.M. Rao, "Power System Protection with Microprocessor Applications" Tata Mc. Graw Hill, 1989

4 B.Ravindranath and M.Chander, "Power System Protection and Switchgear" Wiley Eastern, 1977

5 S.S. Rao, "Switchgear and Protection" Khanna Publishers, 1986

6 B.Ram and D.N. Vishwakarma, "Power system Protection and Switchgear" Tata McGraw Hill, 1995

7 W.A. Elmore (Editor) "Protective Relaying – Theory and applications", Coral Spring Florida. (ABB Power and T&D Co.)

8 A.G. Phadke and J.S. Thorp "Computer based relaying" Research Studies Press John Wiley 1988.

9 A.T. John and S.K. Salman "Digital Protection of Power System" Peter Paregrinus, IEE Pub 1995.

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MTEN-204: EHV AC AND HVDC TRANSMISSION

Objective & Outcome of learning.
To provide an in-depth understanding of the different aspects of Extra High Voltage A.C. and D.C. Transmission system design and Analysis. At the end student will be able to design commercial transmission systems.

1. **Introduction :**Need of EHV transmission, comparison of EHV AC & HVDC transmission, mechanical considerations of transmission line.

2. **EHV AC Transmission:**
Parameters of EHV lines, Voltage gradient in bundle conductors lines, conductor sizing, over-voltages due to switching, ferro resonance. Insulation coordination line insulators and clearances, Corona & its effects, power loss, audible noise and radio-interference, long distance transmission with series and shunt compensations, principle of half wave transmission, flexible ac transmission.

3. **HVDC Transmission :**
Types of dc links, terminal equipments & their operations, HVDC control system, reactive power control, harmonics and filters, multiterminal dc (MTDC) system, ac/dc system analysis, protection of terminal equipments. HVDC transmission based on voltage source-converters.

References :
1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering" Revised Second Edition, John Wiley.
2. K.R. Padiyar, "HVDC Power Transmission System", Second revised Edition, New Age Int. 2012
3. S. Rao, "EHV-AC and HV DC Transmission Engineering Practice", Khanna Publishers.
4. Arrillaga J "High Voltage Direct current Transmission" 2nd Edition (London) Peter Peregrinus, IEE, 1998.
5. Hingorani HG and Gyugyi L "Understanding FACTS-concepts and Technology of Flexible AC Transmissions Systems" New York, IEEE Press,2000.
6. Padiyar K R "FACTS controllers in Power Transmission and distribution" New Delhi, New Age Int. publishers 2007.

Related e-Journals & books: for advanced work.
(i) IEEE Transmissions on Power Delivery
(ii) IEEE Transmission on Power System
(iii) IET Research Journal on Generation Transmission and Distribution
(iv) NPTEL Course on Electrical Engg.

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MTEN – 205: NON-CONVENTIONAL ENERGY RESOURCES AND ENERGY CONVERTERS

1. Objective & Outcome of learning.

This course is designed for the development of self-study and seminar delivery skills in Non-conventional Energy Sources. The total course structure covers wind energy, Solar Energy and Fuel Cell Technologies. Subparts of each topic will be allotted to each student who will then deliver the talk during scheduled lecture hours to be evaluated by participants & the teacher.

2. Introduction :

Various non-conventional energy resources-importance, classification, relative merits and demerits.

3. Solar Energy :

Solar photovoltaics: Introduction, solar radiation & its relation with photovoltaic effect. Solar cell material; silicon mono & poly crystalline, raw material other than silicon. Different types of solar cell construction and design, flat plate arrays:-optimal system sizing & protection. Photovoltaic concentration, photovoltaic systems-standalone, PV-hybrid, grid-interactive. Stationary and tracking panels, maximum power point tracking, energy storage, converter & inverter systems & their control. Application-water pumping & power plants, cost & economics, recent developments.

Solar thermal**:** Thermal characteristics of solar radiation, solar collectors:-materials, types, focussing. Solar thermal power plant-layout and arrangement, solar cooling, recent developments.

4. Wind Energy:

Wind power and its sources, site selection criterion, wind characteristics, momentum theory, Classification of wind machines. Wind mills-different design & their control, wind generators-different types, wind farms & grid. Wind generation in India. Issues of wind integrations-intermittent supply, economics, governmental regulations & subsidies. Wind penetration & its effects, economic issues, recent developments, international scenario.

5. Fuel Cell:

Basic construction & principle of operation of fuel cell, Gibbs-Helmholtz equations, thermodynamic free energy and conditions of equilibrium, classification of fuel cell, different types of fuel cell:- direct type-low or medium temperature alkaline type, low temperature ion exchange membrance, direct high temperature fuel cells, Redox fuel cells, operation characteristic. Fuel cell power plants & its integration with wind and solar photovoltaic systems, smart grids. Applications, recent developments.

References:

1. F.C. Treble, “Generating electricity from sun”, pergamon press, U K
2. Tapan Bhattacharya, “Terrestrial solar photovoltaics”, Narosa publishing house, New Delhi, 1998.
3. G.D. Rai, “Non-conventional energy resources”, Khanna Publishers, New Delhi, 2003.
4. S.P. Sukhatme, “Solar energy principles of thermal collection and storage”, McGraw-Hill publishing company, limited, New Delhi, 1984.