Shri Vaishnav Vidyapeeth Vishwavidyalaya

Master of Technology (Power System)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPS 201		ADVANCED POWER SYSTEM PROTECTION	2	1	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To facilitate the students understand the basic concepts and recent trends in power system protection.
2. To enable the students design and work with the concepts of digital and numerical relaying.

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to:

1. Skilled enough to work with various type of relaying schemes used for different apparatus protection.
2. **Express** the concept of static distance protection and pilot relaying schemes.
3. Express the concept of digital protection used in transmission line, synchronous generator and power transformers.
4. **Elucidate** the concepts of microprocessor based protective relays and digital relaying algorithms

Syllabus:

UNIT I

Numerical Protection

Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference Wave, least error squared (LES) technique, digital filtering, and numerical over- current protection. Vector surge and df/dt digital relays.

UNIT II

Digital Protection of Transmission line

Introduction, Protection scheme of transmission line, distance relays, traveling wave relays, digital protection scheme based upon fundamental signal, hardware design, software design, digital protection of EHV/UHV transmission line based upon traveling wave phenomenon, new relaying scheme using amplitude comparison.

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Master of Technology (Power System)

SEMESTER II

UNIT III

Digital protection of Synchronous generator

Introduction, faults in synchronous generator, protection schemes for synchronous generator, digital protection of synchronous generator.

UNIT IV

Digital Protection of Power Transformer

Introduction, faults in a transformer, schemes used for transformer protection, digital protection of transformer

UNIT V

Distance and over current relay setting and co-ordination

Directional instantaneous IDMT over current relay, directional multi-zone instantaneous relay, distance relay setting, co-ordination of distance relays, co-ordination of over current relays, computer graphics display, man-machine interface subsystem, integrated operation of national power system, application of computer graphics. Short circuit studies in designing relaying scheme Types of faults, assumptions, development of algorithm for S.C. studies, PC based integrated software for S.C. studies, transformation to component quantities, S.C. studies of multiphase systems. Ultra high speed protective relays for high voltage long transmission line.

Text Books:

1. Digital Protection - L. P. Singh, (New Age International (P) Limited Publishers, New Delhi, 2nd Edition)
2. Fundamentals of Power System Protection Paithankar & Bhide (Prentice Hall of India Pvt. Ltd.,New Delhi)
3. Digital Relay / Numerical relays – T.S.M. Rao, Tata Mc Graw Hill, New Delhi
4. Digital Protection IEE Monograph, John and Salman, Peter Teregruins Publishers, London

List of Practical's: (If Practical Credit Shown in Syllabus)

1. Ratio Test of a C.T and determination of error.
2. Determination of knee point voltage of a CT. 3 Summation Transformer characteristics.
3. Study of CT Connection for E/F protection.
4. Study of Open delta PT Connection for earth fault indication.
5. Protection of 3 ph. Alternater (simulation study).
6. Protection of 3 ph. Induction Motor (simulation study).
7. Over current / under voltage / Negative seq Relay Characteristics (simulation study).
8. Simulation of Transmission line protection.
9. Study of differential protection of transformer (simulation study).

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SEMESTER II

Common for Power System / Power Electronics

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPE 201	EE	POWER QUALITY	2	1	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The Students (A) Will Be Able to familiarize with different power quality issues (B) with emphasis on their analysis and application to practical engineering problems(C) efficiently & effectively (D)

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Identify various power quality disturbances in engineering.
2. Identify, formulate, and solve harmonics in electrical engineering.
3. Demonstrate and analyze the active power filters.
4. Demonstrate the knowledge of various solution of power quality improvement.
5. Demonstrate the knowledge of grounding and wiring.

Syllabus

UNIT - I

Introduction - power quality, voltage quality, overview of power quality phenomena, Classification of power quality issues, power quality measures and standards, THD -TIF-DINC-message weights-flicker factor-transient phenomena, occurrence of power quality problems, power acceptability curves, IEEE guides, standards and recommended practices.

UNIT - II

Harmonics, individual and total harmonic distortion, RMS value of a harmonic waveform, triplex harmonics, important harmonic introducing devices, SMPS, Three phase power converters, arcing devices, saturable devices, harmonic distortion of fluorescent lamps, effect of power system harmonics on power system equipment and loads. Modeling of networks and components under non-sinusoidal conditions, transmission and distribution systems, shunt capacitors, transformers, electric machines, ground systems, loads that cause power quality problems, power quality problems created by drives and its impact on drives

UNIT - III

Power factor improvement, Passive Compensation, Passive Filtering, Harmonic Resonance, Impedance Scan Analysis, Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter. Static VAR compensators, SVC and

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UNIT - IV

Active Harmonic Filtering, Shunt Injection Filter for single phase, three -phase three -wire and three-phase four-wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies-constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation . Dynamic Voltage Restorers for sag, swell and flicker problems.

UNIT - V

Grounding and wiring, introduction, NEC grounding requirements, reasons for grounding, typical grounding and wiring problems, solutions to grounding, and wiring problems

Reference Books:

1. J. Arrillaga, .Power System Quality Assessment., John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,.Power system Harmonic .Analysis, Wiley, 1997 'Selected Topics in Power Quality and Custom Power', Course book for STTP, 2004, Ashok S.Surya Santoso, H. Wayne Beaty, Roger C. Dugan, Mark F. McGranaghan, Electrical Power System Quality , MC Graw
3. Electric power quality by G.T.heydt
4. Understanding Power Quality Problems by Math H. Bollen

List of Practical's: (If Practical Credit Shown in Syllabus)

1. Simulation of Power quality disturbance using MATLAB/SIMULATION.
2. To measure the performance like THD. PF of a three phase fully controlled converter feeding a resistive load.
3. To measure the performance like DF & CF of a single phase fully controlled converter feeding a RL load.
4. To measure and analyze the harmonic contents of a three phase inverter fed non line load.
5. To study and simulate power filter.
6. To study and simulate active power filter.
7. Application of FFT/wavelet techniques for power quality analysis using MATLAB/ SIMULATION.

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SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPS 203	EE	ADVANCED POWER SYSTEM ANALYSIS	3	1	0	4	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The Students will be able to familiarize (A)with the power network matrix (admittance and impedance matrices) and (B)impart in-depth knowledge on different methods of power flow solutions. (C) They will be able to understand the fundamental concepts of power system stability and its classificationand factors influencing stability(D).

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. To analyze multi-node power networks using an admittance matrix or impedance matrix representation of the power system and develop admittance matrix using singular transformation.
2. To perform optimal power flow solutions in detail and impart in-depth knowledge on different methods of power flow solutions (Gauss Seidal, Newton Raphson and FDLF methods).
3. To gain knowledge on solution techniques of power system stability and develop solution of swing equation and equal area criteria.
4. To understand the basic knowledge about the dynamic mechanisms behind power system stability (angle and voltage stability) problems in electric power systems, including physical phenomena and modeling issues.

Syllabus

UNIT -I

Network matrix: Physical interpretation of bus admittance and impedance matrices, introduction to admittance matrix formulation, formation of admittance matrix due to inclusion of regulating transformer, development of admittance matrix using singular transformation, modification of admittance matrix for branch addition/ deletion.

UNIT -II

Complex power flow: Analytical formulation of complex power flow solution, Gauss-Seidal method of power flow, Newton Raphson method of power flow, algorithm for solving power flow problem using N-R method in rectangular form, algorithm forsolving power flow problem using N-R method in polar form, fast decoupled load flow method.

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SEMESTER II

UNIT -III

Power System Stability: Definitions, classification of stability-rotor angle and voltage stability, synchronous machine representation for stability study.

UNIT - IV

Transient stability: Assumptions for transient stability, derivation of swing equation, swing equation for synchronous machine connected to infinite bus, swing equation for a two machine system, solution of swing equation by Euler and Runge Kutta method, equal area criterion, critical clearing angle, application of critical clearing angle to transient stability of synchronous machine. Methods of improving transient stability: reducing fault clearance time, automatic reclosing, single phase reclosing, electric braking, voltage regulators, fast governor action, high speed excitation system.

UNIT - V

Voltage stability: Definition and classification of voltage stability, mechanism of voltage collapse, analytical concept of voltage stability for a two bus system, expression for critical receiving end voltage and critical power angle at voltage stability limit for at wo bus power system, PV and QV curves, L index for the assessment of voltage stability.

Reference Books:

1. A. Chakrabarti,M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", DhanpatRai and Co.
2. Power system Analysis by HadiSaadat: Tata McGraw-Hill Publishing Company Limited.
3. Power system Analysis by Charles A. Gross: John Wiley & Sons.
4. Power system Analysis by John J. Grainger & William D. Stevenson, JR: Tata McGraw-Hill Edition

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SEMESTER II

Common for Power System / Power Electronics

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPS 215		POWER SYSTEM STABILITY AND CONTROL	2	0	0	2	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

This course aims to give basic knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modelling issues.

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Analyze various types of stability properties of power systems
2. Develop mathematical models of power system for dynamic studies
3. Analyze the performance of single and multi-machine systems under transient, steady state and dynamic conditions.
4. Demonstrate how the transient stability of a power system can be analyzed by using Equal Area Criterion.

Syllabus

UNIT I

Power System Structure: Operating states, control problem, control loops. Power System Stability – classification, terms and definitions.

Power system components: Hydraulic and steam turbine, Effect of exciter and governor. Excitation system – requirements, functions, types and modeling of excitation systems, IEEE standards and models.

UNIT II

Control of Power and Frequency: Power, Frequency characteristics, Division of load, Load frequency control, Generator, load and Prime mover models, Governor models, AGC in a two area system, AGC in a multi area system parameter setting constants, Tie- line bias control, AGC with optimal dispatch of Generation, AGC including Excitation system, Conventional PI and PID controllers for AGC, AI applications automatic generation control.

UNIT III

Control of voltage and Reactive Power: Relation between voltage, power and reactive

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power, Generation and absorption of reactive power, voltage control and voltage stability analysis, V-Q curves and sensitivity analysis, Voltage stability indices, Factors affecting voltage instability and voltage collapse.

UNIT IV

Stability Studies: Concepts, steady state and transient stability, small signal stability analysis, excitation system, Dynamic and transient stability analysis of single machine and multi -machine systems, power system stabilizer design and analysis for stability problem. Transient Stability: Solution of swing equations, swing curves, stability criterion.

UNIT V

Techniques for the improvement of stability: operation under abnormal and distressed condition, Enhancement of small signal stability: use of power system stabilizers, supplementary control of Static VAr compensators, supplementary control of HVDC links, Techniques for improvement of transient stability, Integrated analysis of Voltage and Angle stability, Control of voltage instability, concepts of load shedding.

Text Books:

1. Prabha Kundur, "Power System Stability and Control" Mc-Graw Hill Inc, New York, 1993.
2. Taylor C.W.," Power System Voltage Stability" Mc-Graw Hill Inc, New York, 1993.
3. K.R.Padiyar,.Power System Dynamic . Stability and Control., Inter Publishing (P) Ltd., Bangalore, 1999 .
4. P.S.R. Murthy , " Power System Operation and Control," Tata Mc-Graw ,New Delhi 1984.
5. Nagrath IJ, Kothari ., " Power System Engineering ," Tata Mc-Graw ,New Delhi 1994.
6. Weedy B.M. " Electric Power System" John Wiley and Sons ,3 rd edition .
7. Elgerd," Electric Energy System Theory : an Introduction ," Mc-Graw Hill, NX, 1983.

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPS 225	EE	ADVANCED CONTROL THEORY	2	0	0	2	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The Students (A) will be able to design mathematical modelling and control systems (B) Understanding PID controller design and implementation issues (C) Control system design using state space models(D) State feedback controller design. Observer design. State estimate feedback control system design.

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. Develop mathematical models and understand the mathematical relationships between the sensitivity functions and how they govern the fundamentals in control systems.
2. design and fine tune PID controllers and understand the roles of P, I and D in feedback control
3. design pole-assignment controller and the specific design procedures
4. develop state-space models
5. design state feedback controller and state observer

Syllabus

UNIT I

Review of classical and modern control concepts: PID control and tuning approaches, State space method, analysis and design of control system in state space, pole placement, state observer, design of control system with Luenberger observer.

UNIT II

Optimal control:

Parameter optimization and optimal control problems, quadratic performance index, analysis and design of finite and infinite time Linear Quadratic Regulators, Introduction to Linear Quadratic Gaussian approach.

UNIT III

Robust Control:

Concept of robust control, description and categorization of system uncertainities. System and signal norms, small gain theorem, robust stability, design of robust control, Introduction to H-∞ control.

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SEMESTER II

UNIT IV

Nonlinear Control:

Nonlinear Systems and Equilibrium Points , Concepts of Stability, Linearization, Stability analysis of nonlinear systems, Feedback Linearization, Input-output linearization, Input-State Linearization.

UNIT V

Sliding mode control

Notion of variable structure system and variable structure control, Introduction to sliding mode control, features of sliding mode control, sliding mode control design, concept of sliding surface,control design using reaching laws, stability analysis. Applications to power system/power electronics:Transfer functions of various power electronic devices like converters (switching model, averaging model), Applications of control theory for control of converters, renewable systems, distribution generation, power quality devices.

Text Books:

1. 'Control of Power Inverters in Renewable Energy and Smart Grid Integration', Qing-Chang Zhong, Tomas Hornik, Wiley Publication, 2013
2. 'Sliding-mode Control: Theory and applications' by Sarah K. Spurgeon, Taylor & Francis, 1998
3. 'Digital Control and State Variable Methods' by M. Gopal, Tata-McGraw-Hill Publishing
4. Company Limited
5. 'Optimal Control: Linear Quadratic Methods' Brian D. O. Anderson, John Barratt Moore, Dover Publications, 2007
6. 'Modern Control Engineering'- Katsuhiko Ogata, Prentice Hall India, 5th edition 2010.
7. 'Applied Non Linear Control', Jean-Jacques E. Slotine, Prentice Hall Englewood Cliffs, New Jersey.
8. 'Non-linear Systems', by Hassan Khalil, Prentice Hall.

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTPS 235		ADVANCED PROCESSORS AND APPLICATION	2	0	0	2	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The Students (A) will be able to learn the generalized architecture of digital signal processors/controllers (B) develop algorithm/program of the digital signal controllers for a particular task (C) interface digital signal controllers with external peripherals.

Course Outcomes:

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes. The students will be able to

1. Understand different processor architectures and system-level design processes.
2. Understand the principles of I/O in computer systems, including viable mechanisms for I/O and secondary storage organisation.
3. Develop systems programming skills in the content of computer system design and organisation
4. Understand various ADC modules.

Syllabus

UNIT-I

Introduction to the concept of digital signal processor, digital signal controller, basic architectures, essential features of digital signal processor/controller, Texas families of processors C2000, C5000, C6000, their features and applications.

UNIT -II

Evolution of C2000 family, TMS 320F2812 block diagram, math units, data memory access,internal bus structure, ALU, instruction pipeline, memory map, code security module, interrupt response.

UNIT -III

Digital input/output interface: GPIO register structure, digital I/O registers, clock module, watchdog timer, system control and status register.

UNIT -IV

Interrupt system: Interrupt lines, reset boot-loader, interrupt sources, maskable interrupt processing,peripheral interrupt expansion, C28x CPU timers, applications.

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UNIT -V

Event manager: Block diagram, timer operating modes, interrupt sources, GP timer registers, GP timer interrupts, event manager compare units, capture units, QEP unit, and applications.
Analog Digital Converter: ADC module overview, ADC in cascaded mode, ADC in dual sequencer mode, ADC conversion time, ADC register block, applications.

Reference Books:

1. 'Programming and Use of TMS320F2812 DSP to Control and Regulate Power Electronic Converters'by Baris Bagci, Grin Verlag, 2007.
2. 'Digital Signal Processing' by Avatar Singh, S. Srinivassan, Cengage Learning, 2004.
3. 'TMS320F2812 Digital Signal Processor: Implementation Tutorial' by Texas Instruments.
4. 'TMS320x281x DSP Event Manager (EV) Reference Guide' by Texas Instruments.

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Choice Based Credit System (CBCS) in Light of NEP-2020

M. Tech (Common for all Engineering branches)

(2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. To analyze and evaluate research works and to formulate a research problem to pursue research.
3. To develop skills related to professional communication and technical report writing.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding and formulation of research problem.
2. Apply quantitative and qualitative methods used in engineering research.
3. Analyze interpret and evaluate data that relate to engineering problems.
4. Develop skills related to professional communication, technical report writing and publishing papers.
5. Act professionally, autonomously, ethically and in teams to produce a professional product.

Syllabus

Unit-I

Introduction to Research Methodology: - An overview of Research process, Types of research; Approaches to research, Importance of criticism in Literature review, identifying research gaps; Formulation of research problem; Research design,

Data: Primary and secondary data-sources, advantages/disadvantages; Sampling and primary data collection, sampling size, random and structured sampling

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Choice Based Credit System (CBCS) in Light of NEP-2020

M. Tech (Common for all Engineering branches)

(2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit;
*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Unit-II

Measurement and Scaling Techniques: - Types of scales, Criteria for good measurement, Attitude measurement - Likert's scale, Semantic differential scale, Thurstone-equal appearing interval scale.

Statistical Tools for Data Analysis: - Measure of central tendency, Measures of dispersion, Correlation and Regression, Formulation of hypothesis, Type I & Type II error, Parametric test, non-parametric test.

Unit-III

Research Methods I - Use of computer software in research and understanding the limitations. Multi-attribute decision making methods, Data envelopment analysis, Grey relational analysis etc., Multidisciplinary research problems, Synthesis of disciplinary research findings; Reliability and sensitivity analysis.

Unit-IV

Research Methods II - Modeling and simulation of engineering problem; Mathematical modeling-formulation, calibration, validation, application; measurement design – validity, reliability, scaling and sources of error. Mathematical programming methods, Numerical analysis, Optimization techniques, Design of laboratory experiments and field tests.

Unit-V

Academic Writing Skills and Presentation - Layout of a Research paper, research report, Thesis structure, Impact factor of Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Reference Management Software like Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism. Guidelines on how to write research papers. Content of Poster presentation, Power point presentation, Oral presentation

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Choice Based Credit System (CBCS) in Light of NEP-2020

M. Tech (Common for all Engineering branches)

(2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Text Books -

1. C.R. Kothari, 2012. Research Methodology Methods and Techniques, 3/e, Vishwa Prakashan,
2. Montgomary, Douglas C., 2007. Design and Analysis of Experiments (Wiley India).
3. Chawla, D. and Sodhi, N., 2011. Research methodology: Concepts and cases. Vikas Publishing House.

Reference:

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