Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore
Shri Vaishnav Institute of Technology and Science
Choice Based Credit System (CBCS) in the Light of NEP-2020
M.Tech. in Renewable Energy
(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*				
MTRE101	DCC	Applied Power Electronics and Drives	60	20	20	30	20	2	0	2	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs):

The course is designed to meet the following objectives:

1.To gather knowledge on power electronics equipment used for non-conventional energy systems.

2.To work on electrical machine drives in various non-conventional energy generation techniques.

Course Outcomes (COs):

Upon completion of this course students will be able to:

1.Design of power electronics converters for various renewable energy systems.

2.Design and develop consumer products for the betterment of humankind.

Syllabus

UNIT I **9 Hrs.**

Energy Management Introduction: Power Electronics, requirements and application areas,Brief idea of Power Electronics application in areas like Power System, Motion Control, Heating, Automotive, Electric Welding, Renewable energy sources etc., Concept of power processing. Signal Processing: Concept of Signal Processing and its requirements in PES

Analog signal processing circuits like precision rectifier, Log and Antilog Amplifier, Voltage multiplier, Divider, peak detector etc., Switched Capacitor circuits concept and realization of simple circuits, Analog computation, solution of simultaneous equations and differential equations through analog circuits, ADC and DAC, V/F, F/V Converters, PLL,Timing Circuit, Multivibrators, Timer, PWM techniques.

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UNIT II **8 Hrs.**

Filters Circuits: Analog filter circuits, Filter response types, BP, HP, Notch, LP, Band Stop filter and basic circuits, Special filter circuits like state variable filter, biquad filter etc, Switched Capacitor filter circuit, Basic Power Modulator: (Basic power Diagram, working, advantages and disadvantages and classification only), Controlled& Uncontrolled rectifier Circuits, Inverter, Cyclo-converter DC to DC converter.

UNIT III **9 Hrs.**

Power System Applications Introduction: Power system problems Concept and working of HVDC Transmission, Power factor correction, Static VAR Compensation,
Active power filter, Interconnection of renewable energy sources and Energy storage system to the utility grid. Heat Recovery Systems.
Sources of waste heat, guidelines to identify waste heat, grading of waste heat, feasibility study of waste heat recovery, gas to gas heat recovery, rotary generators, heat pipes, gas to liquid heat recovery, waste heat boilers.

UNIT IV **6 Hrs.**

Power Supply and energy storage: Concept, working and types of SMPS and UPS Battery principle, Battery types, construction, applications, Charging methods and charging circuits for battery, Power Supply applications in various electronics systems, Industrial Applications: Induction Heating and dielectric heating, Electric Welding, Electroplating Ultrasonic

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UNIT V **8 Hrs.**

Consumer Electronics Applications: High Frequency Fluorescent lighting, LED lighting, fan regulator, Space Heating, Air Conditioning, Induction Cooking, Motor Drives and Applications: Working principle of AC and DC Motor drives. Automation in industry and motor drives applications like flow control, robot control, Electric Train, battery operated vehicles, conveyer belt, elevator, hoist etc.

Textbooks:

1. Mc Pherson George, "Introduction to Electric Machines and transformers", John Wiley and Sons, 1980
2. Sen., P.C., "Thyristor DC Drives", New York Wiley, 1991.
3. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter,Application and Design", Third Edition, John Willey & Sons, 2004.

References:

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press, Delhi, 2001.
2. B. K. Bose, "Power Electronics and Variable Frequency Drive", Standard Publishers Distributors, 2000.
3. Bin Wu, "High-Power Converters and AC Drives", IEEE Press, A John Wiley & Sons, Inc Publication, New York,2006.
4. R. C. Duagan, M. F. Mcgranaghan and H. W. Beaty, "Electric Power System Quality", McGraw-Hill, 2001, 1221 Avenue of the Americas, New York.
5. J. Arrillaga, Y. H. Liu and N. R. Waston, "Flexible Power Transmission-The HVDC Options", John Wiley & Sons, Ltd, Chichester, UK, 2007

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List of Experiments:

1. Determination of complete torque speed characteristics of three phase induction machine in braking, motoring and generation regions and its calibration.
2. Understating the effect of rotor resistance on the load characteristics of a wound – rotor induction motor.
3. Determination of equivalent circuit parameters, prediction of performance. Verification from actual load rest. (b) Separation of losses of induction motor and estimation of efficiency.
4. Speed control of induction motor-Conventional, electronic. Solid state speed control using (i) V constant, (ii) V/f constant, (iii) slip –energy injection.
5. Load characteristics of induction generator working in (i) Grid connected mode (ii) Self Determination of equivalent circuit parameters of a single-phase Induction motor. Prediction of torque-speed characteristics. Verification from load test.
6. Determination of torque step rate characteristics of a stepper motor. Determination of operating range.
7. Load characteristics of universal motor, operating and ac supply comparison of performance.
8. Experimental determination of performance characteristics of two-phase servo motor.
9. Load characteristics of hysteresis motor and shaded pole motor.
10. Characteristics of switched reluctance motor.

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MTRE102	DCC	Solar Power Generation	60	20	20	30	20	3	0	2	4

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Course Educational Objectives (CEOs):

To develop capability in the students to design solar thermal and solar photovoltaic power generating units in various modes for example: standalone, grid connected, hybridization.

Course Outcomes (COs):

Upon completion of this course students will be able to:

1. Understand Solar Photovoltaic Systems.
2. Understand both theoretically and practically to use this subject for the application in solar power generation systems.

UNIT I **6 Hrs.**

Solar radiation – Review. Models for radiation analysis and beam radiation calculations. Solar concentrators: Parabolic trough, parabolic dish: continuous type and Fresnel type Tracking mechanisms: single axis and double axis trackings.

UNIT II **8 Hrs.**

Solar thermal technologies: Solar Parabolic trough: design considerations, tracking and control systems, thermal design of receivers, Solar parabolic dish: design considerations, Sterling engine, Brayton cycle, tracking and control systems, Solar tower concepts: tower design, heliostat design, receiver types, tracking and control systems, Material and product/technology overview for the above technologies. Advanced collectors and solar concentrators, Selective coatings.

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UNIT III **6 Hrs.**

Emerging technologies: Linear Fresnel reflector, Solar chimney Solar PV power plants: Performance study, site selection and land requirement. Sizing and Reliability

UNIT IV **8 Hrs.**

Solar PV power plants: Solar PV technologies overview - stationary and concentrated PV, inverter and control technologies, master slave inverter system design, standalone systems, grid connected systems, hybridization, synchronization and power evacuation, site selection and land requirements. Charge Conditioners, Interface Components, Balance of System Components.

UNIT V **7 Hrs.**

Techno-economic analysis of solar thermal and solar PV power plants, Environmental considerations, greenhouse gas calculations. Application of softwares: TRNSYS, RETScreen, Solar advisor, Design of one each solar thermal and solar PV power.

Textbooks:

1. Renewable Energy Engineering and Technology – A Knowledge Compendium, ed. VVN Kishore (TERI Press, 2008).
2. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, (PHI Learning)
3. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition (John Wiley & Sons)
4. S Sukhatme and J Nayak: Solar Energy: Principles of Thermal Collection and Storage, Third Edition (Tata McGraw Hill, 2008)

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References:

1. Duffie .J.A, Beckman W.A. "Solar Engineering of Thermal Processes, 3rd ed., Wiley, 2006.
2. De Vos .A, Thermodynamics of Solar Energy Conversion, Wiley-VCH, 2008.
3. Kalogirou .S, Solar Energy Engineering, Processes and Systems, Elsevier, 2009.

List of Experiments:

1. Determining the intensity of solar radiation.
2. Arrangement of Photovoltaic cells.
3. Setting up of the Photovoltaic panel with the help of the given settings to get the maximum exposure of the sunlight.
4. Measurement of V/I Characteristics of the mono-crystalline cells
5. Measurement of V/I Characteristics of Polycrystalline cells
6. Connecting of Photovoltaic cells in series and measuring their V/I Characteristics.
7. Connecting of Photovoltaic cells in Parallel and measuring their V/I Characteristics.
8. Connecting of Monocrystalline and polycrystalline cells in series and parallel and measuring their characteristics
9. Connecting a battery to the inverter and measuring the output using a meter
10. Connecting a battery to the inverter and observing the waveform using a oscilloscope
11. Doing exp no 8 & 9 with different loads.
12. Connecting a solar panel with inverter and measuring the output using meter.
13. Connecting a solar panel with inverter and observing the output using Oscilloscope

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MTRE113	DSE	Grid Connectivity and Smart Grid	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):
To provide students with a working knowledge of fundamentals, design, analysis, and development of Smart Grid, from the basic concepts of power systems to the inherent elements of computational intelligence, communication technology and decision support system.

Course Outcomes (COs):
Upon completion of this course students will be able to:
1. Know what a function of smart grid is, what is the futuristic grid.
2. Understand the fundamental element of the smart grid.
3. Understand and analysegrid connectivity.

UNIT I **6 Hrs.**
Introduction: Introduction to grid connectivity of Renewable Energy systems, smart grid and emerging technologies, Operating principles and models of smart gird components, Key technologies for generation, networks, loads and their control capabilities.

UNIT II **8 Hrs.**
Decision-making tools: Non-conventional energy source models grid integration, Micro-turbine model and grid integration, Fuel cell model and grid integration, Energy storage and electric vehicle models and grid integration,

UNIT III **10 Hrs.**
Distribution line models: Communication infrastructures for smart grid operation, Advanced metering infrastructure and advanced control methods, Economic dispatch, Demand response

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and demand management, Distribution feeder analysis, Continuous voltage and frequency control, Contingencies and their management, Unit commitment (selection of generators & loads to operate)

UNIT IV **8 Hrs.**

Energy constraints: hydro, fuel management and maintenance scheduling, the operational challenges of distributed energy resources, Operation and control issues associated with intermittent generation, Electricity industry operation in a carbon constrained and smart grid future

UNIT V **8 Hrs.**

Impact of smart grid component integration on distribution network operation, Artificial Intelligence based approaches for estimation, scheduling, management and control of next generation smart grid.

Textbooks:

1. JamesMomoh, Smart Grid Fundamentals of Design and Analysis, Wiley, 2012
2. Clark W. Gellings, The Smart Grid: Enabling Energy Efficiency and Demand Response, CRC Press.
3. Janaka Ekanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, Smart Grid:Technology and Applications ,Wiley

References:

1. A. Keyhani, Smart Power Grid Renewable Energy Systems, Wiley 2011.
2. Jean Claude Sabonnadiere, NouredineHadjsaid, Smart Grids, Wiley Blackwell.

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MTRE114	DSE	Converters for Renewable Energy System	60	20	20	0	0	3	0	0	3

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Course Educational Objectives (CEOs):

1. This subject gives an introduction to the recent developments of power electronics from components, topology and control techniques.
2. This course drives on the application requirements of power electronics.
3. This is a higher level of subject that will help to work in demanding areas of power electronics in renewable energy systems

Course Outcomes (COs):

At the end of the course student will be able to

1. Understand the principles of operation of advanced PWM converters.
2. Appraise various advanced converter topologies and the suitable control schemes.
3. Recognize recent developments in design aspects of renewable power conversion systems.

Syllabus

UNIT –I **8 Hrs.**

Advanced Converters

Drawbacks of conventional converters & Inverters, Multi-pulse converters & Inverters, Improved power quality ac-dc converters such as single-phase buck, boost, buck-boost ac/dc converters, PWM (Pulse width modulated) based single- phase, three-phase VSC (Voltage source converters), Current Source Inverters.

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UNIT-II **8 Hrs.**

Multilevel Converters/ Inverters

Advance converter topologies for PEE - Interleaved converters, multilevel converters (Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor) multi pulse PWM current source converters, advanced control schemes, Capacitor unbalance

UNIT-III **6 Hrs.**

PWM Schemes

Conventional PWM schemes & their performance, Multilevel PWM Schemes, Hybrid PWM schemes, Power converter topologies for solar and wind.

UNIT-IV **6 Hrs.**

Control of dc-dc converter, voltage mode control, current mode control, PID controller, sliding mode controller, Control of inverters.

UNIT-V **8 Hrs.**

Case Studies

Literature- MLI Applications in Drives and power quality, Hybrid converters- Inverters- Closed Loop Renewable Energy conversion systems- PV power conversion using MLIs.

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Textbooks:

1. N. Mohan, T. M. Undeland and W. P. Robbins, Power ElectronicsConverter Application and Design, Third Edition, John Willey & Sons, 2004.
2. M. H. Rashid, Power Electronics, Circuits, Devices and Applications, Pearson, 2002, India.

References:

1. K. Billings, Switch Mode Power Supply Handbook, McGraw-Hill, 1999, Boston.
2. Bin Wu, High-Power Converters and AC Drives, IEEE Press, A John Wiley & Sons, Inc Publication, New York,2006.

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MTRE115	DSE	Power Sources for Electric Vehicles	60	20	20	0	0	3	0	0	3

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Course Educational Objectives:
To prepare the students to have basic knowledge of different power sources for electric vehicle
To prepare the students to have knowledge of different fuel cells

Course Outcomes: Upon completion of this course students will be able to:
1. Understand about different batteries
2. Conduct Different test on batteries.
3. Understand and analyze fuel cells.

UNIT I **6 Hrs.**
The Electric Vehicle Debate, Primary Energy Sources and Alternative Fuels for Transportation, History of Electric Vehicles, Electrochemical Power Sources – Secondary

UNIT II **8 Hrs.**
Batteries: Battery characterization, math modeling and designs, Battery sizing for various vehicle applications, Battery monitoring and charging control, Fuel cells: principles of operation, design, and modeling.

UNIT III **9 Hrs.**
Batteries and Fuel Cells Sources- Aqueous Electrolyte Batteries –Lead Acid, Nickel – Iron, Nickel – Zinc, Metal – Air Zinc – Halogen Non-Aqueous Electrolyte Batteries- High Temperature Batteries, Organo Electrolyte and Solid State Batteries

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Shri Vaishnav Institute of Technology and Science
Choice Based Credit System (CBCS) in the Light of NEP-2020
M.Tech. in Renewable Energy
(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*				
MTRE115	DSE	Power Sources for Electric Vehicles	60	20	20	0	0	3	0	0	3

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UNIT IV **8 Hrs.**

Overview of Performances of Candidate Secondary Battery Systems-Fuel Cells – Acid Systems, Direct Methanol / Air Systems, Alkaline Systems-Overview of Performances of candidate Fuel Cell Systems, Battery / Fuel cell.

UNIT V **6 Hrs.**

Combustion Engine Hybrid Electric Vehicles, Laboratory Test of Electric Vehicle Batteries, Vehicle tests with Electric Vehicle Batteries, Future of Electric Vehicles

Textbooks:

1. B.D. McNicol and D.A.J. Rand, Power Sources for Electric Vehicles, Elsevier Publications.1998.
2. John Voelcker, Lithium Batteries for Hybrid Cars, IEEE Spectrum, 1990.

References:

1. David Linden and Thomas.B. Reddy,Hand Book of Batteries and Fuel cells, 3rd Edition, McGraw Hill Book Company, N.Y. 2002
2. Viswanathan, B. and Scibioh, AuliceM,Fuel Cells, Principles and Applications, Universities Press, 2006.
3. Nick Yost, The Essential Hybrid Car Handbook: A Buyer's Guide (Paperback), TheLyons Press, N.Y. 2006.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

SEMESTER-III

MBAI301C ADVANCED HUMAN VALUES AND PROFESSIONAL ETHICS

SUBJECT CODE	SUBJECT 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*				
MBAI301C	Advanced Human Values and Professional Ethics	60	20	20	-	-	4	-	-	4

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Course Objective

The objective of the course is to disseminate the theory and practice of moral code of conduct and familiarize the students with the concepts of "right" and "good" in individual, social and professional context

Examination Scheme

The internal assessment of the students' performance will be done out of 40 Marks. The semester Examination will be worth 60 Marks. The question paper and semester exam will consist of two sections A and B. Section A will carry 36 Marks and consist of five questions, out of which student will be required to attempt any three questions. Section B will comprise of one or more cases / problems worth 24 marks.

Course Outcomes

1. Help the students to understand right conduct in life.
2. To equip students with understanding of the ethical philosophies, principles, models that directly and indirectly affect personal and professional life.

COURSE CONTENT

Unit I: Inculcating Values at Workplace

1. Values: Concept, Sources, Essence
2. Classification of Values.
3. Values in Indian Culture and Management: Four False Views, Value Tree
4. Eastern and Western Values; Values for Global Managers

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Unit II: Professional Ethics

1. Ethics: Concept, Five P's of Ethical Power, Organisational Tools to Cultivate Ethics
2. Theories of Ethics: Teleological and Deontological
3. Benefits of Managing Ethics in an Organisation
4. Ethical Leadership

Unit III: Indian Ethos and Management Style

1. Indian Ethos and Workplace
2. Emerging Managerial Practices
3. Ethical Considerations in Decision Making and Indian Management Model
4. Core Strategies in Indian Wisdom and Ethical Constraints

Unit IV: Human Behavior – Indian Thoughts

1. Guna Theory
2. Sanskara Theory
3. Nishkama Karma
4. Yoga: Types, Gains; Stress and Yoga

Unit V: Spirituality and Corporate World

1. Spirituality: Concept, Paths to Spirituality
2. Instruments to achieve spirituality
3. Vedantic Approach to Spiritual and Ethical Development
4. Indian Spiritual Tradition.

Suggested Readings

1. Kausahl, Shyam L. (2006). ***Business Ethics – Concepts, Crisis and Solutions***. New Delhi: Deep and Deep Publications Pvt. Limited
2. Murthy, C.S.V. (2012). ***Business Ethics –Text and Cases.*** Himalaya Publishing House: Mumbai
3. Chakraborty, S. K. (1999). ***Values and Ethics for Organizations***. Oxford university press
4. D.Senthil Kumar and A. SenthilRajan (2008). ***Business Ethics and Values.*** Himalaya Publishing House: Mumbai

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Shri Vaishnav Institute of Technology

Master of Technology

SEMESTER I

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTMAN 101	BS	Advanced Mathematics	60	20	20	-	-	3	0	0	3

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Course Educational Objectives (CEOs):

To introduce the students to advanced mathematics.

Course Outcomes (COs):

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

A. understand the concept of a vector space, subspace, basis, dimensions and their properties.
B. find solution/numerical solution of PDE.
C. explain fundamental principles of probability theory.
D. understand the concept of Markov process and Queuing theory.
E. demonstrate the ability to solve mathematical problem with fuzzy logic.

Syllabus

UNIT – I

Linear Algebra:

Vector Space , Subspace, Basis & dimensions, Change of Basis, Linear Transformation, Matrix Representation of Linear Transformation.

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MTMAN 101	BS	Advanced Mathematics	60	20	20	-	-	3	0	0	3

UNIT – II

Numerical Solution of Partial Differential Equations:

Classification of second order equations, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equation, Solution of Poisson's equations, Parabolic equations, Solutions of Heat equations, Hyperbolic equations.

UNIT – III

Probability & Statistics:

Probability, Compound probability, Discrete Random Variable, Binomial and Poisson distribution, Continuous random variable, Normal distribution, Sampling distribution, Theory of hypothesis.

UNIT – IV

Stochastic Process & Queuing Theory:

Introduction of random or stochastic processes, Markov processes, Markov chain, Queuing theory: M/M/1: ∞/∞/FCFS, M/M/1: N/∞/FCFS.

UNIT – V

Fuzzy Set and Theorems:

Fuzzy sets, Fuzzy relation, Fuzzy arithmetic, Fuzzy logic.

Texts:

1. Higher Engg. Mathematics: B. S. Grewal, Khanna Publishers, Delhi
2. Higher Engg. Mathematics: E. Kreyzig, John Wiley & Sons (Asia) Pvt. Ltd.
3. Operation Research: S. D. Sharma, Kedar Nath and Ram Nath, Delhi.
4. Probability, Random variables & Random processes: Schaum's outlines.
5. Stochastic processes: J. Medhi, New age international publishers.
6. Calculus of finite differences and Numerica Analysis: Gupta and Malik.
7. Fuzzy logic in Engineering: T. J. Ross.
8. Fuzzy set theory and its applications: H. J. Zimmersoms.

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