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ताळगांव पठार,
गोंय – ४०३ २०६
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(Accredited by NAAC)

GU/Acad –PG/BoS -NEP Engg./2024/618 Date: 30.10.2024

CIRCULAR

The University has notified Ordinance OA-43 governing the Master of Engineering Degree and Post-Graduate Engineering Certificate from the Academic Year 2024-2025 onwards.

The Syllabus of Semesters I of the **Master of Engineering (Power and Energy Engineering)** Programme approved by the Academic Council in its meeting held on 22nd August 2024 is attached.

The Dean, Faculty of Engineering and Principals of affiliated Colleges offering the **Master of Engineering (Power and Energy Engineering)** Programme are requested to take note of the above and bring the contents of the Circular to the notice of all concerned.

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2024.10.30 15:52:09 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,
1. The Dean, Faculty of Engineering, Goa University.
2. The Principals of affiliated Engineering Colleges.

Copy to,
1. The Director, Directorate of Technical Education, Govt. of Goa
2. The Chairperson, BoS in Electrical & Electronics Engineering.
3. The Controller of Examinations, Goa University.
4. The Assistant Registrar Examinations (Prof.), Goa University.
5. Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

MASTER OF ENGINEERING (POWER AND ENERGY ENGINEERING)
RC 2024-25

TWO YEAR PROGRAMME STRUCTURE						
Semester I						
Sr. No.	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**Credits**
Programme Specific Core (PSC) Courses						
1	EEL-500	Non-Conventional Energy Sources	3	0	0	3
2	EEL-501	Power & Energy Laboratory – I	0	0	1	1
3	EEL-502	Advanced Power Electronics	3	1	0	4
4	EEL-503	Photovoltaic System Design	3	1	0	4
Programme Specific Elective (PSE) Courses						
6	EEL-531	Artificial Intelligence Applications to Power Systems	3	1	0	4
OR						
7	EEL-532	High Voltage Alternating Current / Direct Current Transmission	3	1	0	4
Research Specific Elective (RSE) Courses						
8	REC-561	Engineering Research & Publication	3	1	0	4
OR						
9	REC-562	Literature Review & Technical Writing for Engineers	3	1	0	4
		Total	**15**	**3**	**2**	**20**

THREE YEAR PROGRAMME STRUCTURE						
Semester I						
Sr. No.	**Course Code**	**Title of the Course**	**L**	**T**	**P**	**TCr**
Programme Specific Core (PSC) Courses						
1	EEL-500	Non-Conventional Energy Sources	3	0	0	3
2	EEL-501	Power & Energy Laboratory – I	0	0	1	1
Programme Specific Elective (PSE) Courses						
3	EEL-531	Artificial Intelligence Applications to Power Systems	3	1	0	4
OR						
4	EEL-532	High Voltage Alternating Current / Direct Current Transmission	3	1	0	4
Research Specific Elective (RSE) Courses						
5	REC-561	Engineering Research & Publication	3	1	0	4
OR						
6	REC-562	Literature Review & Technical Writing for Engineers	3	1	0	4
		Total	**9**	**3**	**0**	**12**

Issued on: 30/10/2024

Semester I
Programme Specific Core (PSC) Courses
Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : EEL-500
Title of the Course : Non-Conventional Energy Sources
Number of Credits : 03 (3L)
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Describe the fundamentals and main characteristics of wind, solar PV, small hydro, fuel cell, Tidal, and other new renewable energy technologies. 2. Develop the basic technological idea about various New & Renewable energy Conversion Technology. 3. Design small scale PV and wind energy systems considering various aspects of site selection and load requirement.	
Content:		**No. of Hours**
Unit -1	**Introduction of Energy Sources:** Conventional, Nonconventional, Renewable, Non-renewable sources of Energy, prospects and perspectives, advantages, Energy Scenario, worlds production and reserves of commercial energy sources, Introduction to different sources of Nonconventional Energy, Solar energy, Fuel Cell, Wind Energy, Tidal Energy, Geothermal Energy, Hydrogen Energy.	**11**
Unit -2	**Solar Energy: Solar** energy alternatives, solar radiation, availability, measurement and estimation, solar geometry, solar thermal conversion devices and storage applications, Solar Photovoltaic conversion, basics of technology, PV-powered agricultural facility, micro-irrigation systems, remote area applications, portable applications, PV power for domestic use applications, BOS components of solar PV systems, Design & Economic considerations	**11**
Unit -3	**Wind Energy: -** Wind energy conversion principles, Types, and classification of WECS, Aerodynamic theories, Power, torque and speed characteristics, general concepts of airfoils and aerodynamics, Site Selection Criteria, Analysis of wind flow, measurement of wind speed, Power in wind, performance calculations of wind turbine, Electrical systems, Economics of wind energy utilization.	**12**
Unit- 4	**Other Non-Conventional Energy Sources: -**Biomass-Biomass as a source of energy, methods of obtaining energy from biomass, biomass gasification, classification of biogas plants, pyrolysis. Tidal- Basic principle of tidal power, components of tidal power plant, operation methods of utilization of tidal energy, estimation of single basin systems and double cycle systems,	**11**

	Fuel cells - Principle and classification, types, polarization curve and efficiency. Storage systems for renewable energy applications.	
Pedagogy:	Reflective Learning, Constructive learning and Collaborative & Inquiry based.	
References/ Readings:	1. Chetan Singh Solanki, "Solar Photovoltaics", PHI learning Pvt Ltd., New Delhi, 3rd Edition, 2015. 2. G D Rai, "Non-Conventional Energy Sources," Khanna Publications, 2011 3. John Twidell and Tony Weir, "Renewable Energy sources", Taylor and Francis, 3rd edition, 2015 4. S. P. Sukhatme, "Solar Energy- Principle of Thermal collector and storage," TMH publication, Third edition, 2017	
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand various aspects of renewable energy sources, various components used, and applications CO 2. Decide about the site selection based on the environmental parameters. CO 3. Analyse economic and environmental aspects of renewable energy sources CO 4. Decide the ratings and specifications of SPV and wind turbines based on the load requirements	

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Name of the Programme : **Master of Engineering (Power and Energy Engineering)**
Course Code : **EEL-501**
Title of the Course : **Power & Energy Laboratory-I**
Number of Credits : **01 (1P)**
Effective from AY : **2024-25**

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to: 1. Understand the power system components and interconnection. 2. Interpret the experimental results with practical power system. 3. Analyse different power converters and electrical devices. 4. Practice simulation and experimental studies in power system.	
Contents:	Minimum 8 experiments to be performed from the given list	**No. of Hours**
Sr No	**Title of the Experiment**	**30**
1	Single phase semi/ fully controlled converter circuit	
2	Single phase PWM Inverter circuit	
3	Design and Simulation of Buck, Boost, Buck-Boost converter with feedback	
4	Design and Simulation of Three phase PWM control based Inverter circuit	
5	V/F control of 3 phase induction motor using VFD	
6	Simulation study of Solar PV energy system	
7	Study and analyze the Solar radiation by using a Pyranometer and Pyro heliometer	
8	Determination of I-V and P-V Characteristics of solar PV module for different insolation and temperature conditions	
9	Performance assessment of Grid connected and Standalone 1kWp Solar power system	
10	Simulation study of Wind energy conversion system	
11	Formation of Y_{BUS} using any technique	
12	Load flow study of using Gauss Seidal method	
Pedagogy:	Constructive learning and Collaborative learning	
References/ Readings:	1. Chetan Singh Solanki, 'Solar Photovoltaic, Fundamentals, Technologies, Applications', PHI publishers, 2019, 3rd edition. 2. Jayant Baliga, 'Fundamentals of Power semiconductor devices', Springer, 2008, 1st edition. 3. Hadi Sadat, 'Power system analysis', McGraw Hill- international edition-1999 4. Stagg and EI-Abiad, 'Computer methods in power system analysis', McGraw Hill- international edition-1986.	
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand and learn different power system analysis techniques. CO 2. Develop software approach for power system studies. CO 3. Analyze the power system data for load flow studies	

	CO 4. Apply computational methods for large scale power system studies

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Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : EEL-502
Title of the Course : Advanced Power Electronics
Number of Credits : 04 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Electronics Devices, Circuit Analysis, Fourier Analysis	
Course Objectives:	The course will enable the students to: 1. To Develop power converters with better performance for challenging applications 2. To comprehend the concepts of different power converters and their applications 3. To analyze and design switched mode regulators for various industrial applications 4. To choose appropriate devices for a particular converter topology. 5. To Model existing and modified power converters under small signal and steady state condition	
Content:		**No. of Hours**
Unit -1	**Single & three phase converters:** Single phase converters Fully controlled converters – Evaluation of input power factor and harmonic factor – single phase dual converters – power factor Improvements Techniques– Extinction angle control – symmetrical angle control, PWM –single phase sinusoidal PWM – single phase series converters – overlap analysis – Applications & Problems. Three phase converters –fully controlled converters – Definition of THD and PF, Evaluation of input power factor and harmonic factor under various load current. **Design of Switching Power Converters:** Controller Design: Introduction - Design of Power Converters Components: Design of magnetic components-design of transformer - Design of Inductor and current transformer - Selection of filter capacitors - Selection of ratings for devices - input filter design.	**15**
Unit -2	**Pulse Width Modulated Inverters** (single phase): Principle of operation - performance parameters - single phase bridge inverter -evaluation of output voltage and current with resistive and inductive loads - Voltage control of single phase inverters - single PWM - Multiple PWM - sinusoidal PWM - modified PWM - phase displacement Control - Advanced modulation techniques for improved performance - Trapezoidal, staircase, stepped, harmonic injection and delta modulation - Advantage - application - numerical problems. Pulse Width Modulated Inverters (three phase). Three phase inverters - analysis of 180-degree condition for output voltage and current with resistive, inductive loads - analysis of 120-degree Conduction - voltage	**15**

	control of three phase inverters - sinusoidal PWM - Third Harmonic PWM – 60-degree PWM – space vector modulation - Comparison of PWM techniques - harmonic reductions - Current Source Inverter - numerical problems	
Unit- 3	**Multilevel Inverters:** Two level voltage source inverter - Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back-to-back intertie system – adjustable drives – Switching device currents – dc link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters. **Matrix converter:** Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters	**15**
Unit- 4	**Resonant Pulse Inverters**: Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter - evaluation of currents and voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter –For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters. Resonant converters: Resonant converters – Zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant dc-link Inverters – evaluation of L and C for a zero current switching inverter.	**15**
Pedagogy:	Constructivist, Collaborative and Reflective approach	
References/ Readings:	1. Abraham I. Pressman, Switching Power Supply Design, McGraw Hill International. IEEE Publications on Power Electronics, 2007. 2. Joseph Vithayathil, Power Electronics - Principles and Applications, McGraw Hill Inc., New York, 1995. 3. M. H. Rashid, Power Electronics - Circuits, Devices and Applications, P.H.I Private Ltd. New Delhi, Second Edition, 1994. 4. N. Mohan et.al. Power Electronics- Converters, Applications and	

	Design, John Wiley & Sons (Asia) Private Ltd., Singapore, 1996. 5. R W Erickson and D Makgimovic, Fundamental of Power Electronics Springer, 2nd Edition, 2020.
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand Principle of Operation Advanced Power Converters. CO 2. Develop and analyze various converter topologies. CO 3. Describe the operation of multilevel inverters with switching strategies for high power applications. CO 4. Comprehend the design of resonant converters and switched mode power supplies.

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Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : EEL-503
Title of the Course : Photovoltaic System Design
Number of Credits : 04 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Renewable Energy	
Course Objectives:	The course will enable the students to: 1. Understand the working of Photovoltaic System 2. Analyze Photovoltaic System 3. Design a Photovoltaic System and its applications. 4. Learn the grid connected PV systems.	
Content:		**No. of Hours**
Unit -1	A Historical perspective, PV cell characteristics and equivalent circuit, model of PV cell, open circuit voltage, short circuit current and peak power, data sheet study, cell efficiency, effect of temperature, fill factor, identical and non-identical cells in series and parallel, protection of cells and modules in series and parallel, Insolation and Irradiance, energy on a horizontal flat plate, energy on a tilted flat plate, Atmospheric effects, air mass, clearness index	**15**
Unit -2	Sizing PV for applications without Battery, Battery capacity, Battery C-rate, Battery efficiency, PV system design- load profile, days of autonomy, battery sizing, PV array sizing	**15**
Unit -3	Maximum power point tracking (MPPT) – concept, input impedance of Buck, Boost and Buck-Boost converter, MPPT Algorithms, PV-Battery Interface- Direct PV-Battery, Battery charger, slope compensation, Batteries in series, charge equalization, Batteries in parallel.	**15**
Unit- 4	PV and water pumping, hydraulic energy and power, total dynamic head, centrifugal pump, reciprocating pump, pv power pumped hydro application PV grid interface, grid connection principle, PV to grid topologies,3 -phase grid connected system, 1-phase grid connected system, PV-grid interface examples	**15**
Pedagogy:	Constructivist approach, Collaborative approach. Reflective approach	
References/ Readings:	1. Chetan Singh Solanki; Solar Photovoltaics Fundamentals, Technologies and Applications; Prentice Hall India ltd.,2015 2. Dr. B.H. Khan; Non-conventional; Tata McGraw Hill, 2009 3. Dr. VM Domkundwar; Solar energy and non-Conventional energy sources, Dhanpat Rai and company, 2022 4. Gilbert M, Masters; Renewable and efficient Electric Power Systems, Wiley Interscience, New Jersey, 2004 5. S. P. Sukhatme; Solar energy; Tata McGraw Hill Publishing Company	

	Ltd, PHI Learning Private Limited.2017
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the PV cell and PV power generation CO 2. Analyse the PV conversion system. CO 3. Design the PV system along with the application of water pumping CO 4. Study the analysis and the design of grid connected PV system.

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Programme Specific Elective (PSE) Courses
Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : EEL-531
Title of the Course : Artificial Intelligence Applications to Power Systems
Number of Credits : 04 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Power Systems	
Course Objectives:	The course will enable the students to: 1. Understand soft computing concepts and techniques and foster their abilities in designing appropriate techniques for a given scenario. 2. Analyze soft computing-based solutions for real-world problems. 3. Implementation of given problem using appropriate techniques 4. Evaluate the performance using different techniques studied	
Content:		**No. of Hours**
Unit -1	**Evolution of Computing: Soft Computing Constituents,** From Conventional AI to Computational Intelligence: Machine Learning Basics. Fuzzy logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy. Expert Systems, Fuzzy Decision Making.	**15**
Unit -2	**Neural Networks:** Introduction, Supervised Learning Neural Networks, Perceptron, Adaline, Back propagation Multilayer perceptrons, Radial Basis Function Networks, Unsupervised Learning and Other Neural Networks, Competitive Learning Networks, Kohonen Self Organizing Networks, Learning Vector Quantization, Hebbian Learning	**15**
Unit -3	**Evolutionary Computing:** Genetic algorithm: Basic concept, encoding, fitness function, Reproduction, Basic genetic programming concepts, differences between GA and Traditional optimization methods, Applications, Variants of GA. Simulated Annealing, Bio inspired algorithms - Particle Swarm optimization	**15**
Unit- 4	**AI applications to Power system:** Fuzzy logic-based controller for Electric Drive, ANN-based Speed control of Induction motor drives, Application of ANN and Fuzzy logic in power system: Load forecasting, Load scheduling. Application of GA in Economic load dispatch, Reactive power control and Power flow	**15**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Simon Haykin, Neural Network and Learning Machines, 3rd Edition, Pearson Education India, 2016. 2. Sivanandam and Deepa, Principles of soft computing, 3rdEdition, Wiley, 2018. 3. S. Rajasekharan and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, 2 nd Edition, PHI, 2017.	

	4. Timothy J.Ross, Fuzzy Logic with Engineering Applications, 3rd Edition Wiley, 2011.
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand soft computing concepts and techniques and foster their abilities in designing appropriate techniques for a given scenario. CO 2. Analyse soft computing-based solutions for real-world problems. CO 3. Implementation of given problem using appropriate techniques CO 4. Evaluate the performance using different techniques studied

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Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : EEL-532
Title of the Course : High Voltage Alternating Current / Direct Current Transmission
Number of Credits : 04 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Knowledge of Electrical Circuit Analysis and Power System	
Course Objectives:	The course will enable the students to: 1. To analyze the need of HV Power transmission using Line conductors and Cable. 2. To understand and calculate the Transmission Line Parameters 3. To understand HVAC power transmission and analyze the performance at No load and Load conditions 4. To understand DC HV Transmissions and its applications and Control.	
Content:		**No. of Hours**
Unit -1	**HV Transmission line Geometry and other Aspects**: Aspects of HV Transmission Line Design. Standard HVAC Transmission Voltages, percentage power loss and power handling capacity of HV transmission line, mechanical considerations in line performance. Line and ground Parameters. Calculations of line resistance, Inductance and Capacitance of three phase line. Corona effects, radio interference, audible noise due to HV Transmission.	**14**
Unit -2	**HVAC Power transmission**: Concept of Long Transmission line, Travelling Wave theory, Reflection and Refraction of travelling waves, No load voltage conditions and charging current, Ferranti effect, Static Reactive Compensating systems. Transmission Parameter (ABCD Parameters)	**16**
Unit -3	**HV Cable Transmission and over voltages**: Over voltages due to lightning and switching, lightning Arrestor. Aspects of HV Cable transmission, Types of HV Cables, properties of Cable Insulation materials. Electrical Characteristics of HV Cable, Electrical Stress in dielectric of cables, capacitance, insulation resistance and loss factor.	**15**
Unit- 4	**HVDC transmission**: Classification of HVDC systems, advantages of HVDC system.AC Interconnection and its limitations, DC Interconnection. Components of HVDC Transmission, Convertor stations, converter transformers. HVDC System Pole, Ground Electrode, two terminals and multiterminal DC systems. DC Circuit Breakers, Applications of HVDC Transmission	**15**
Pedagogy:	Reflective Learning, Constructive learning and Collaborative & Inquiry based.	
References/	1. Kuffel & Zaengel, High Voltage Engineering Fundamentals, Pergamon	

Readings:	Press, Second Edition, 1984 2. Lewis W. W. Protection of Transmission Lines against Lightning, Wiley and Sons publication, Second edition, 1992 3. K. R. Padiyar , HVDC Power transmission systems, New Age International 1996 4. Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering, New age International Publisher Third Edition 2006 5. W. Kimbark Vol I, Direct Current Transmission. Wiley InterScience Publications. 2017
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the different aspects of HV Power Transmission CO 2. Explain qualitative and quantitative methods of analyzing HV Power Transmission. CO 3. Analyse and compute HV power transmission using transmission Lines and HV Cables CO 4. Compare HV AC and HV DC power transmission and analyse their system configurations.

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Research Specific Elective (RSE) Courses

Name of the Programme : Master of Engineering (Power and Energy Engineering)

Course Code : REC-561

Title of the Course : Engineering Research & Publications

Number of Credits : 04 (3L+1T)

Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Understand the importance of literature review, defining the research objectives. 2. Explain qualitative and quantitative methods of data analyses and its importance. 3. Classify research publications, select appropriate journals based on research areas. 4. Practice ethics in publication and academic integrity	
Content:		**No. of Hours**
Unit -1	**Overview of scientific research in engineering**, foundational and fundamental concepts like types of research and considerations for research in specific domains, motivation to do research, critical thinking, assumptions and hypotheses, basic and applied research, importance of formulation of broad research objectives	**15**
Unit -2	**Purpose and Methodology of Literature Search and Review** of the scientific and engineering publications. Sources such as scholarly databases, public domain, open access, current literature, review articles, critical review and gap analysis, defining research objectives	**15**
Unit -3	**Quantitative and qualitative Data –** importance of data in research, types of data, data collection techniques, Quantitative methods for analysis of data – statistical tools, mathematical modeling, simulation, experimental data, optimization methods; Qualitative data collection, preparing questioners, rating scale, conducting survey, validation of models.	**15**
Unit- 4	**Preparation of Publications-** Elements of research publications, types of publications, writing for journal publications, basic requirements for publication, selection of journals, journal quality indicators, peer review, reply to comments and responses, publication ethics, references, citations, authorship, plagiarism, academic integrity	**15**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Herman Tang, 'Engineering Research-Design, Methods and Publications', John Wiley and Sons, 2021, ISBN:9781119624486. 2. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for Science and Engineering', Taylor & Francis Publications, 2022,	

	ISBN:9781003139058 3. Michael Jay Katz, 'From Research to Manuscript', Springer Publication, 2009, ISBN:9781402094668. 4. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work', Springer Publications, 2022, ISBN:9783030900243
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the importance of literature review, defining the research objectives. CO 2. Explain qualitative and quantitative methods of data analyses and its importance. CO 3. Classify research publications, select appropriate journals based on research areas. CO 4. Practice ethics in publication and academic integrity

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Name of the Programme : Master of Engineering (Power and Energy Engineering)
Course Code : REC-562
Title of the Course : Literature Review & Technical Writing for Engineers
Number of Credits : 04 (3L+1T)
Effective from AY : 2024-25

Pre-requisites for the Course:	Nil	
Course Objectives:	The course will enable the students to 1. Understand the importance of literature review and writing a review paper. 2. Explain the method to be followed to write a review paper. 3. Classify data for qualitative and quantitative analysis 4. Demonstrate technical writing for conference.	
Content:		**No. of Hours**
Unit -1	**Overview on Literature Review**, difference between objectives of literature review and research objectives; types of literature review, qualitative and quantitative reviews, search strategies, primary and secondary sources, database search strategies, field search, root search, complimentary search, meta-analysis	**15**
Unit -2	**Database management of literature reviews**, bibliometric analysis, importance of writing a review paper, reply to comments and responses, publication ethics, references, citations, authorship, plagiarism, academic integrity; public domain, open access, current literature.	**15**
Unit -3	**Technical writing on a specific research topic**, structure of the paper, abstract, introduction, experimental, simulation, analysis, discussion, inferences, title, acknowledgment, referencing, presentation of tables, figures, graphs, equations; comparison between technical writing for conference papers and journal paper	**15**
Unit- 4	**Importance of data in research**, types of data, data collection techniques, Quantitative methods for analysis of data – statistical tools, mathematical modeling, simulation, experimental data, optimization methods; Qualitative data collection, preparing questioners, rating scale, conducting survey, validation of models.	**15**
Pedagogy:	Inquiry based learning, Integrative, Reflective Learning, Constructive learning and Collaborative learning	
References/ Readings:	1. Herman Tang, 'Engineering Research-Design, Methods and Publications', John Wiley and Sons, 2021, ISBN:9781119624486. 2. Meikang Qiu, Han Qiu, Yi Zeng, 'Research & Technical Writing for Science and Engineering', Taylor & Francis Publications, 2022, ISBN:9781003139058. 3. Michael Jay Katz, 'From Research to Manuscript', Springer Publication, 2009, ISBN:9781402094668	

	4. Rob Dekkers, Lindsey Casey, Peter Langhorne, 'Making Literature Review Work – Multidisciplinary Guide to Systematic Approaches', Springer Publications, 2022, ISBN:9783030900243.
Course Outcomes:	After taking this course, student will be able to: CO 1. Understand the importance of literature review and writing a review paper. CO 2. Explain the method to be followed to write a review paper. CO 3. Classify data for qualitative and quantitative analysis CO 4. Demonstrate technical writing for conference.

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