Course Code: 16EMEC707	**Course Title: Research Methodology**	
L-T-P: 2-1-0	Credits: 3	Contact Hrs: 4hr/week
ISA Marks: 100	ESA Marks: --	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

Research: Definition, Characteristics and Objectives; Types of Research, Research Methodology, Research Process, Literature Review, Review concepts and theories, Formulation of Hypothesis, Research design, Data collection, Processing and analysis of data collected, Interpretation of data, Computer and internet: Its role in research, Threats and Challenges to research, Writing a research paper, research project, Thesis, Research ethics, Citation methods and rules. Case studies	5hrs

Reference Books

1. Kothari C. R. "Research Methodology – Methods & Techniques", Vishwa Prakashan, A Division of New Age International Pvt. Ltd., 2008.
2. Ranjit Kumar, "Research Methodology – A step by step guide for Beginners", 3rd Edition, Pearson Edition, Singapore, 2011.
3. Dawson Catherine, "Practical Research Methods", UBS Publishers, New Delhi, 2002

Course Code: **15EESE802**		Course Title: **Sustainable Building Design**
L-T-P-S: **4-0-0-0**	Credits: **4**	Contact Hrs: **4 hrs/week**
CIE Marks: **50**	SEE Marks: **50**	Total Marks: **100**
Teaching Hrs: **40**		Exam Duration: **3 hrs**

1.	**Introduction: Sustainability and Building Design**.
	Site planning: Site assessment, Site selection, Site analysis**,** site development and layout, sustainable urban drainage systems, flow attenuation
2.	**Efficient water management and waste water treatment techniques** Climate change and water conservation, the need for conservation, basic steps for reducing water consumption, Water conservation in landscape irrigation, Measures for reuse and conservation.
3.	**Solid waste management:** Introduction, guidelines for waste minimisation, Segregation of wastes, Resources recovery or recycling, Processing of waste.
4.	**Passive solar design:** Introduction, Thermal comfort, building physics, building design, building form, orientation, building components, Advanced soalr passive techniques, passive solar heating, passive cooling strategies, Day lighting, Factors for the design of day lighting, factors affecting daylight factor distribution. Innovative day lighting systems, Hybrid day lighting system.
5.	**Building technologies:** Traditional efficient building techniques, walling systems. Traditional stone masonry, Roofing systems, Doors and windows, High-rise masonry, curtain walls, pre-fabrication,
6.	**Energy systems:** units of lighting, lighting equipment, system design approach for energy-efficient lighting, Additional parameters for design approach for lighting, Approach for an energy efficient lighting system by sector, Energy conservation opportunities in existing lighting systems,
7.	**Building Envelop**: Domestic appliances, Non-domestic appliances, Heating ventilation and air conditioning systems, Use of renewable energy.

Text Books

1. Sustainable building Design manual volume-2, sustainable building design practices, TERI, New Delhi, 2004.

References:

1. S.P. Sukhatme, Nayak J.K.,Solar Energy:Principles of Thermal Collection and Storage, Tata-Mc-Graw Hill Education, 2008
2. Garg & Prakash, H. P. Garg,Solar Energy:Fundamentals and Applications, Tata-Mc-Graw Hill Education, 2000
3. G.N. Tiwari, Solar Energy:Fundamentals, Design, Modelling and Applications, Alpha Science International Limited, 2002

Course Code:18EESP701	Course Title: **Energy System Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

Studies on : a. Operational experience on i) Pyranometer, ii) Sunshine recorder b. Measurement of temperature using Infrared Thermometers d. Measurement of illumination using Lux meter e. Exhaust gas analysis using gas analyzer **List of experiments** 1. Performance evaluation of a solar flat plate thermo-syphon water heating 2. Conversion efficiency of a solar flat plate forced solar water heating system 3. Conversion efficiency of a solar Concentrating water heating system 4. Determination of conversion efficiency of a solar air heating system 5. Study and analysis of a solar still / distillation plant 6. Performance estimation of photovoltaic water pumping system 7. Investigation on a solar dryer 8. Operational characteristics of P.V. Indoor lighting system 9. Determination of characteristics of a wind generator 10. Performance evaluation of solar cooker 11. P.V. System sizing exercise 12. Data acquisition system for monitoring of P.V system using LABVIEW s/w 13. Performance estimation of Solar fuel cell 14. Performance evaluation of vertical and horizontal axis wind turbine rotors.	24 hrs

Course Code:18EESP702	Course Title: **Industrial Instrumentation and Control Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

1. **Control technologies** Local manual, remote electrical, Local pneumatic, Remote analog/digital 2. **Basic electrical and math concepts**: Applications to instruments, Electrical principles and symbols, Series/parallel circuits 3. **Pressure instrumentation & measurements**: Pressure measurement devices, U-tube manometer, bourdon gauge, bellows gauge, piezoelectric 4. **Temperature instrumentation and measurements** • Measurement devices and techniques, Bimetallic temperature measurement, Filled capillary and bulb, thermocouple, resistance temperature detector (RTD), thermistors, thermowells, infrared 5. **Flow Instrumentation and Measurements:** Flow measurement methods, Factors influencing flow measurement, Flow measurement devices: orifice plates, venturi tube, flow nozzle, elbow taps, pitot tube, magnetic flow meter (Mag meter), vortex shedding meter, turbine meter, target flowmeter, ultrasonic, variable area rotameter, coriolis meter 6. **Level instrumentation and measurements:** Level measurement methods: sight glass, differential pressure level measurement, bubbler, displacer level sensor, float level sensors, capacitance, radiation-based, radar and ultrasonic level sensors 7. **Manipulating the process**: Final control element, Actuators, valve positioners, I/P, valves • Variable frequency drives 8. **Controllers:** Control modes: proportional, integral, derivative, Tuning feedback controllers ¼ decay, Zeigler-Nichols, damped oscillation, Ratio, cascade and feed-forward control 9. **Control systems**: Overview of PLCs, DCS and SCADA systems **Hands-on Exercises**: Sensor checkout, Hookup to calibration stands, Transmitter calibration check, Program/tune controller, Set up of differential pressure, temperature, and other process-simulation devices, Checking current output with Volt-Ohm Mille-ammeter (VOM) & tracing around loop, Simulate and source 4-20mA-DC signals	24 hrs

Course Code:18EESP703	Course Title: **Process Modeling and Simulation Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

MATLAB Analysis 1. Declination of earth, hour angle, day length, local apparent time. 2. Monthly average, hourly global and diffuse radiation on a horizontal surface and tilted Surfaces. 3. Power generation from a wind turbine, Variation of wind velocity and power with altitude. 4. Solution of ordinary differential eqations-4th order R K Method. 5. Solution of one-dimensional steady state heat conduction equation. 6. Solution of two-dimensional steady state PDE. 7. Solution of one-dimensional transient PDE. **Finite Element Analysis** 8. Two dimensional heat conduction. 9. One dimensional transient heat conduction. 10. Transient analysis of a casting process. **CFD Analysis** 11. Flow through a pipe bend. 12. Flow through a nozzle.	24 hrs

Course Code:18EESP704	Course Title: **IoT based Living Space Lab**	
L-T-P: 0-0-2	Credits: 2	Contact Hrs: 4 hr/week
ISA Marks: 80	ESA Marks: 20	Total Marks: 100
Teaching hrs: 24		Exam Duration: 02 hrs

1. Introduction to IoT, Automation, Arduino, Raspberry Pi and IoT.	24 hrs
2. Introduction to Arduino programming and interfacing with peripherals and sensors Motor, Servo motor, LDR, PIR sensor, ultrasonic sensor, DHT 11, MQ2 smoke sensor, LCD and RC522 RFID	
3. Wireless communication with Arduino: GSM Module, Ethernet Shield. Raspberry Pi and Raspbian operating system: Installing operating system ,Starting Raspberry Pi desktop and using Linux commands	
4. Connecting to the network: Wired networking and Wireless networking, Setting up static IP for raspberry pi, Remote accessing of Raspberry Pi	
5. Python programming with Raspberry Pi: Introduction to Python, Python commands and Python scripting for programming GPIO	
6. Interfacing of Arduino with Raspberry Pi: Programming Arduino from Raspberry Pi using IDE Programming Arduino from Raspberry Pi using Python	
7. Raspberry Pi as web server: Installing Apache Server	
8. Connecting Arduino and Raspberry Pi to cloud service: Uploading Arduino sensor data to cloud. Connecting Raspberry Pi to cloud and interfacing sensors	
9. Conduction Of Living Space Lab Experiments Design of IoT based weather DAQ system IoT based temperature data monitoring and DAQ IoT based humidity data monitoring and DAQ IoT based solar insolation data monitoring and DAQ IoT based wind speed data monitoring and DAQ	
10. Design of Energy management system IoT based SPV - Solar generation data monitoring IoT based Wind generation data monitoring IoT based SPV – Wind hybrid generation data monitoring	

Course Code:**19EESC703**	Course Title: **Computational Methods in Engineering Analysis**	
L-T-P: 3-1-0	Credits: 4	Contact Hrs: 5
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hrs: 40		Exam Duration: 3 hrs

1.Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modelling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering.	06 hrs
2.Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton-Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.	06hrs
3.Roots of polynomial- Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method.	06 hrs
4.Numerical Differentiation and Numerical Integration: Newton –Cotes and Guass Quadrature Integration formulae, integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae.	06 hrs
5.System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, iteration Methods.	06 hrs
6.Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method.	05 hrs
7.Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engg.	05 hrs

Reference Books

1. Erwin Kreyszig , Advanced Engineering Mathematics, 10th Edition , Willely India, 2016.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
3. Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, TMGH, 4th Ed, 2002.
4. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.
5. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
6. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002.