KALINGA UNIVERSITY
RAIPUR | INDIA

SCHEME & SYLLABUS FOR

Bachelor of Vocational Studies (B. Voc.) Renewable Energy

NAAC GRADE B+ Accredited University | nirf RANKING 2024 Ranked in Top 151-200 Universities

Kalinga University, Naya Raipur, Chhattisgarh

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BACHELOR OF VOCATIONAL STUDIES (B. VOC.)

RENEWABLE ENERGY

Semester-I							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE101	Communication Skills	3	0	3	30	70	100
BVRE102	Fundamentals of Information Technology	3	0	3	30	70	100
BVRE103	Fundamentals of Electronics	3	0	3	30	70	100
BVRE104	A Energy Sources and Energy Scenario	3	0	3	30	70	100
BVRE105P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

Semester-II							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE201	Wind Energy	3	0	3	30	70	100
BVRE202	Environmental Studies	3	0	3	30	70	100
BVRE203	Biomass Mass Power Generation Systems	3	0	3	30	70	100
BVRE204	Solar PV Power Plant and Components	3	0	3	30	70	100
BVRE205P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

Semester-III							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE301	Mechanics & Thermodynamics for Energy Application	3	0	3	30	70	100
BVRE302	Electrical Systems	3	0	3	30	70	100
BVRE303	Waste to Energy Conservation Systems	3	0	3	30	70	100
BVRE304	Installation and Commissioning of Solar PV Power Plant	3	0	3	30	70	100
BVRE305P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

Semester-IV							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE401	Energy Management, Auditing and Utilization	3	0	3	30	70	100
BVRE402	Material Science for Energy Applications	3	0	3	30	70	100
BVRE403	Hydrogen Energy and Fuel Cells	3	0	3	30	70	100
BVRE404	Energy Efficiency in Thermal Utilities	3	0	3	30	70	100
BVRE405P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

Semester-V							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE501	Solar Business Solutions	3	0	3	30	70	100
BVRE502	Energy in Buildings	3	0	3	30	70	100
BVRE503	Energy Modeling & Project Management	3	0	3	30	70	100
BVRE504	Solar Thermal Technologies	3	0	3	30	70	100
BVRE505P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

Semester-VI							
Subject Code	**Subject**	**L**	**T/P**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BVRE601	Health and Safety Practices at Project Site	3	0	3	30	70	100
BVRE602	Energy Efficiency in Electrical Utilities	3	0	3	30	70	100
BVRE603	Smart and Micro-Grid	3	0	3	30	70	100
BVRE604	Evaluation and Monitoring for Wind Power Plant	3	0	3	30	70	100
BVRE605P	**Industrial Training/ On Job Training/ Workshop**	0	36	18	50	150	200
Total		**12**	**36**	**30**	**170**	**430**	**600**

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SEMESTER-I

COMMUNICATION SKILLS

BVRE101

Course Objective

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

Course outcome:

1. The purpose of this course is to introduce students to the theory, fundamentals and tools of communication
2. To develop vital communication skills which should be integral to personal, social and professional interactions.
3. One of the critical links between human beings.
4. An important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal.
5. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

CONTENTS

Unit I: Introduction: **06**

Theory of Communication, Types and modes of Communication, Mediums and channels of communication, barriers to communication, English as a Global language, the Lingua Franca, Social influences on English

Unit II: Language of Communication: **06**

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication, Varieties of English, Language, Accent, Dialect, Colloquialism, Historical influences on English

Unit III: Speaking Skills: **06**

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech, Regional influences on English, Convergence and divergence, Linguistic Imperialism,

Unit IV: Reading and Understanding- **06**

Close Reading, Reading analysis of a text - Audience and purpose, Content and theme, Tone and Mood, stylistic devices, structure Comprehension- Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills **06**

Documenting Report Writing Making notes Letter writing, Writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters

It will enhance Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, notetaking etc. While, to an extent, the art of communication is natural to all living beings, intoday's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

REFERENCE BOOKS:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr. RanjanaKaul, Dr. Brati Biswas

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FUNDAMENTALS OF INFORMATION TECHNOLOGY

BVRE102

Unit I:

Computer characteristics: Speed, storage, accuracy, diligence; Digital signals, Binary System, ASCII; Historic Evolution of Computers; Classification of computers: Microcomputer, Minicomputer, mainframes, Supercomputers; Personal computers: Desktop, Laptops, Palmtop, Tablet; Hardware & Software; Von Neumann model.

Unit II:

Hardware: CPU, Memory, Input devices, output devices. Memory units: RAM (SDRAM, DDR RAM, RDRAM etc. feature wise comparison only); ROM-different types: Flash memory; Auxiliary storage: Magnetic devices, Optical Devices; Floppy, Hard disk, Memory stick, CD, DVD, CD/DVD-Writer; Input devices - keyboard, mouse, scanner, speech input devices, digital camera, Touch screen Voice Input, Joystick, Optical readers, bar code reader; Output devices: Display device, size and resolution; CRT, LCD, LED; Printers: Dot-matrix, Inkjet, Laser; Plotters, Sound cards & speaker.

Unit III:

Software: System software, Application software; concepts of files and folders, Introduction to Operating systems, Different types of operating systems: single user, multitasking, time-sharing multi-user; Booting, POST; Basic features of two GUI operating systems: Windows & Linux (Basic desk top management); Programming Languages, Compiler, Interpreter, Databases; Application software: Generic Features of Word processors, Spread sheets and Presentation software; Generic Introduction to Latex for scientific typesetting; Utilities and their use; Computer Viruses & Protection, Free software, open source.

Unit IV:

Computer Networks and Internet: Connecting computers, Requirements for a network: Server, Workstation, switch, router, network operating systems; Internet: brief history, World Wide Web, Websites, URL, browsers, search engines, search tips; Internet connections: ISP, Dial-up, cable modem, WLL, DSL, leased line Wireless and Wi-Fi connectivity ; email, email software features (send receive, filter, attach, forward, copy, blind copy); characteristics of web-based systems, Web pages, Web Programming Languages.

Unit V:

Information Technology And Society: Indian IT Act, Intellectual Property Rights, issues. Application of information Technology in Railways, Airlines, Banking, Insurance, Inventory Control, Financial systems, Hotel management, Education, Video games, Telephone exchanges, Mobile phones, Information kiosks, special effects in Movies.

Programming Concepts & Techniques: Program Concept, Characteristics of Programme, Stages in Program Development, Tips for Program Designing, Programming Aids, Algorithms, Pseudo code, Notations, Design, Flowcharts, Symbols, Rules, compiler & Interpreter. Introduction to programming techniques, Top-down & Bottom-up approach, Unstructured, & Modular programming, Cohesion, Coupling, Debugging, Syntax & Logical Errors, Linking and Loading, Testing and Debugging, Documentation.

Reference Books:

1. Programming in C, R.S. Salaria, Khanna Publishing House
2. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
3. Handbook of Computer Fundamentals, N.S. Gill, Khanna Publishing House

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FUNDAMENTALSOFELECTRONICS

BVRE103

LEARNING OBJECTIVES

1. To familiar students to the basic electronics devices and their fundamentals.
2. To enable students to use different electronics devices for different applications.
3. To encourage students to get their hands in the field of semiconductor, as this technology will play a vital role in understanding the concept for generation of various types of energy.

Unit I:

Electronics: Introduction, Applications-Current and Voltage Source, Physics of Semiconductor Materials –Structure of Atom-Energy band gap diagram of Conductors, Semiconductors and Insulators.

Unit II:

Semiconductor Diode: Types of semiconductors – P & N Types – charge carriers –P &N junction theory-VI characteristics –ideal diode-Rectifiers-types of rectifiers- Filters-C, LC and π –

Regulators – Zener diode -voltage Regulator, Series voltage Regulator Different types of filters- clipping and clamping circuits –LED-7-segment –Photo diode-LDR.

Unit III:

Transistor: Amplifying action-transistor configuration:-CB, CE, CC Configurations-comparison- thermal runway-heat sink- Transistor ratings -Transistor biasing and stabilization –selection of operating point-different biasing circuits.

FET: Introduction, Types, construction, operation, characteristics – FET Parameters–Comparison between FET and BJT– JFET, MOSFET – UJT Characteristics, features and Applications.

Unit IV:

Storage Batteries: Introduction, Types of Batteriesprimary and Secondary Batteries- Classification of Secondary Batteries base on their Use-Classification of Lead Storage BatteriesBattery lifeand DOD,Battery Charging, State of Charge, Effect of temperature,Battery for Photovoltaic applications, Battery aging, important guidelines.

REFERENCES BOOKS:

1. Basic Electronics and Linear Circuits, Bhargava, Kulshreshtra& Gupta Tata McGraw-Hill Publishing Ltd. 2007
2. Applied Electronics, R S Sedha, S. Chand and Company Ltd. 2008
3. Principles of Electronics, V.K. Mehta, S.Chand and Company Ltd.2005
4. Electronics Service Technology Vol-1. SajiA.G, Shyam Mohan , Ayodhya publications, 2007
5. Integrated Electronics, Jacob Millman and C. Halkias Mill, Tata McGraw-Hill Publishing Ltd.008
6. Science & Technology of Photovoltaics P Jayrama Reddy, BS Publications ,CRC Press 2010
7. Solar Electricity Handbook - 2012 Edition: A Simple Practical Guide to Solar Energy - Designing and Installing Photovoltaic Solar Electric Systems, Michael Boxwell, Greenstream Publishers, 2012
8. Photovoltaics: Design and Installation Manual, Solar Energy International, 2012
9. Solar Electric Handbook: Photovoltaic Fundamentals and Applications, Solar Energy International, 2012

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ENERGY SOURCES AND ENERGY SCENARIO

BVRE104

LEARNING OBJECTIVES

1. To understand the social, economic impacts of various energy sources.
2. To discuss the financial aspects like pricing and reforms of energy sources.
3. To make the students aware about conservation act, security of energy and environment.
4. To understand the vision and policies of government.

UNIT – I

Introduction to Energy: Definition and units of energy and power,Conversion, Energy terms, calorific value, Forms of energy, Classification of energy sources Quality and concentration of energy sources, Energy and Thermodynamics, Energy parameters, Conservation ofenergy, Energy flow diagram to the earth, Origin of fossil fuels, Time scale of fossil fuels, Roleof energy in economic development and social transformation, Energy security.

UNIT – II

Energy and Growing Economy: Commercial energy production, Final energy consumption, Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy conservation and its importance, Energy strategy for the future, Energy Conservation Act-2001 and its features.

UNIT – III

Global Energy Scene: Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear power and hydroelectricity, impact of exponential rise in energy consumption on global economy, future energy options.

UNIT – IV

Indian Energy Scene: Commercial and non-commercial forms of energy, energy consumption pattern and its variationas a function of time, India's Power Scene, Gas-Based Generating Plants, Nuclear Power Programme, urban and rural energy consumption,energy as a factor limiting growth, need for use of new andrenewable energy sources, Socio-economic impacts, Rural development, Poverty alleviation,Employment; Security of supply and use, Environmental and ethical concerns, Economicalaspects of renewable energy systems vs large hydro and thermal power projects.

RECOMMENDED REFERENCES:

1. Bani P. Banerjee, Energy and the Environment in India, Oxford University Press, New Delhi.
2. G. D. Rai, Non- conventional Sources of Energy, Khanna Publishers, Delhi.
3. Gopalkumar, Energy Independence Vision of a Hybrid, Unbound Future, Deep and Deep Publications Pvt. Ltd., New Delhi.
4. D. K. Asthana, MeeraAsthana, Environment Problems and Solutions, S.Chand and Company Ltd., New Delhi.
5. Abdul Mubeen, M. Emran Khan, M. Muzaffar-ul-Hasan, Energy and Environment, Anamaya Publishers, New Delhi.
6. UpenderPandel, M.P.Poonia, Energy Technologies for Sustainable Development, Prime Publishing, Ghaziabad (UP).
7. Renewable Energy Sources and Emerging Technologies,Kothari D.P. andSingal K. C, New Arrivals - PHI; 2 edition (2011)

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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE105P

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SEMESTER-II

WIND ENERGY

BVRE201

LEARNING OBJECTIVES

1. Awareness about Wind Energy.
2. Understanding the design considerations of Wind projects.
3. Awareness about global scenario & current status.
4. Get acquainted to various types of Wind power stations.

UNIT – I

Perform the following activities to do the wind resource analysis: analyse detailed site information, analyse the daily, monthly and annual wind resource data of site to evaluate the potential for wind energy generation , ensure the collection of data on local weather conditions such as temperature range, flooding (in case of onshore), wind speed, humidity, rainfall and assess its impact on wind energy generation , assess the ground water availability and quality, load bearing capacities.

UNIT – II

Wind Energy- pH levels and seismic risk , analyse the pre-site selection baseline data for project execution suitability identify location for Power Curve test , ensure installation of meteorological mast (met mast) at site , analyse wind data collected from met mast for wind potential.

UNIT – III

Perform the contour mapping - prepare a detailed survey plan of the land proposed for installation of wind power plant with elevations and topography , calculate the exact land area of the proposed site where installation is to be commenced, prepare contour map of proposed wind plant site , conduct field surveys and give site ranking.

UNIT – IV

Wind energy systems: Environment and Economics Environmental benefits and problems of wind energy, Economics of wind energy Factors influence the cost of energy generation: Site specific

parameters, machine parameters, Life cycle cost analysis, Wind electric generators, Tower, rotor, gearbox, power regulation, safety mechanisms, Generator: Induction and synchronous generator, Grid integration, Wind pumps ,Wind driven piston pumps, limitations and performance analysis.

RECOMMENDED REFERENCES:

1. Freris L.L: Wind Energy Conversion Systems, Prentice Hall
2. Brendan Fox: Wind power integration : connection and system operational aspect
3. Frede Blaabjerg, Zhe Chen: Power electronics for modern wind turbines
4. Olimpo Anaya-Lara: Wind energy generation : modelling and control

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ENVIRONMENTAL STUDIES

BVRE202

Unit 1 : Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 2 : Natural Resources : Renewable and Non--renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 3 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega--biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity : In--situ and Ex--situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 4 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested Readings:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.

2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.

3. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.

4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36--37.

7. McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19. Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.
20. World Commission on Environment and Development. 1987.Our Common Future. Oxford University Press.

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BIOMASS MASS POWER GENERATION SYSTEMS

BVRE203

LEARNING OBJECTIVE

The course develops necessary understanding on the biomass of energy materials. It is specifically designed to empower non-biology background students with necessary knowledge and very important concepts of biomass. Student will acquire understanding at the molecule level as well as at the bulk material level.

UNIT –I

Biomass- Generation and Utilization, Properties of biomass, Agriculture crop and forestry residues and as fuels, Biochemical and Thermo chemical conversion, combustion, Gasification, Biomass gasifiers and types etc, Biomass as a decentralized power generation source for villages.

UNIT – II

Biomass resource analysis - analyse detailed site information including source of biomass and storage space requirements, if any , Identify the type and quantity of biomass available. , Conduct the tests to identify the moisture content, carbon content and calorific value of the biomass available.

UNIT – III

Identify pre-production process requirements for each type of biomass, Study present market linkages and data on current practices of use or disposal of biomass , Collect information about the local weather conditions such as temperature range, wind speed, humidity, rainfall and seasonal availability of the resource, assess the ground water availability and, load bearing capacities, pH levels, seismic risk and do a detailed risk analysis for fire accidents.

UNIT – IV

Analyse the pre-site selection baseline data for project execution suitability , identify location for Power Curve test , collect and analyse the biomass availability data – check at least 10 years data to establish trends, Identify limitations and incentives according to relevant applicable policies, regulations and procedures.

RECOMMENDED REFERENCES:

1. Non-Conventional Energy Resources, B.H. Khan, Tata McGraw-Hill Education (2006).
2. Renewable Energy Technologies: A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008).
3. Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
4. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K.C., New Arrivals - PHI; 2 edition (2011)
5. G. D. Rai, Non- conventional Sources of Energy, Khanna Publishers, Delhi.

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SOLAR PV POWER PLANT AND COMPONENTS

BVRE204

LEARNING OBJECTIVES

This subject will enable students to understand the Designing, Installation and Operation & Maintenance of Solar Based Power Plants

UNIT – I

calibration of SCADA/any monitoring system, prepare inspection report and forward to site-in charge for further, on getting the clearance from electricity inspector, initiate start-up procedures as per manufacturer's instructions , monitor the energy readings and voltages at regular intervals on start up, record and report any anomalous condition to the site in-charge for further action.

UNIT – II

prepare as-built drawings and document design changes including signages and warnings at appropriate places, if any , operation and maintenance of solar power plant o ensure periodical cleaning of solar module array , periodically ensure tightness of cable connections o ensure periodic maintenance of the solar plant.

UNIT – III

Check modules earmarked for powerplant using a random selection as per relevant IS/IEC standards, visit manufacturing facility of inverter supplier and witness testing of a few inverters, collect documentation related to each and every equipment and submit to site in-charge, on receipt of material at site, ensure proper delivery/off-load of solar equipment, check all the material and equipment received at site for any physical damage, ensure specifications of the equipment and components match with what has been ordered, ensure all warrantees by manufacturers are properly signed and are in order.

UNIT – IV

Installation, inspect the foundations of structures, inspect the inter-row spacing and alignment, inspect and verify cable routes and specifications as per design documents, inspect module installation, inspect the cable terminations and ensure tightness, inspect the installation of inverters, protection devices and systems, after installation carry out visual inspection of the plant to find out defects and deficiencies, measure and record the circuit voltage and short circuit current of all the module strings and compare that with design values, carry out thermography of doubtful strings and modules to know the defects carry out performance ratio test by continuous operation of the plant as per the industry norms and compare with designed values, preparing handing over documents, collect and compile conformity, warranty documentation, performance guarantees, calibration certificates and any other relevant documentation and handover to site in-charge, certificates ,Prepare final as-is drawings, Prepare O&M schedule to be handed over to the agency and ensuring asset and personal security systems are in place for their effectiveness.

RECOMMENDED REFERENCES:

1. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K. C, New Arrivals - PHI; 2 edition (2011)
2. Solar Energy, Fundamentals, Design, Modelling & Applications, G.N.Tiwari, Narosa Publishing House.
3. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley & sons.
4. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Chetan Singh Solanki, PHI (1 January 2013)
5. Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
6. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki

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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE205P

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SEMESTER-III

MECHANICS & THERMODYNAMICS FOR ENERGY APPLICATION

BVRE301

LEARNING OBJECTIVES

1. To familiar students to the basics of mechanics & thermodynamics and their fundamentals.
2. To enable & encourage students to apply the subject skill in different applications, as this portion will play a vital role in understanding the concept for structural based analysis & technological information of various system used in energy.

UNIT – I

Forces in Structures: Forces, Moments of forces, Types of forces and moments, Stress-Strain Diagrams, Fracture at Low Stresses, Tensile stress, Compressive stress, Fatigue, Creep, Hardness of materials, bending of beams, basic of civil work & foundation.

UNIT – II

Fluid Mechanics: Types of Fluid ,fluid statics , Bernoulli's equation ,Conservation of mass, Definition of viscosity, Reynolds number, Navier-Stokes equations, Laminar and turbulent flow.

UNIT – III

Thermodynamic System: Introduction, Properties, process, cycle, thermodynamic equilibrium, Quasi-static Process, Zeroth Law of thermodynamics, Work and Heat transfer, flow work.

First Law of Thermodynamics: Internal energy, proof of internal energy as a point function.

UNIT – IV

Second Law of Thermodynamics: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence.

Thermodynamic Relationships: T-dS equations, difference in heat capacities, coefficient of Volume expansion and isothermal compressibility, adiabatic compressibility, ratio of specific heat.

RECOMMENDED REFERENCES:

1. N.D. Bhatt, Elementary Engineering Drawing, Chartor Publishing house, Anand, India.
2. D. N. Johle, Engineering Drawing, Tata Mcgraw-hill Publishing Co. Ltd.
3. P. K Nag “Thermodynamics”, Tata McGraw-Hill Publishing Co. Ltd
4. Building Construction --- Bindra Arora; Dhanpat Rai publication.
5. Dr. R.K. Bansal, Fluid Mechanics, Laxmi Publication (P) Ltd. New Delhi
6. Engineering Mechanics (Statics and Dynamics); A. K. Tayal ,Umesh Pub., Delhi
7. Engineering Thermodynamics: C.P.Arora, TMH

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ELECTRICAL SYSTEMS

BVRE302

LEARNING OBJECTIVES

1. To familiar students to the basic concepts of electrical & its laws.
2. To get student squinted with principles of electrical devices.
3. Concepts of electrical system will play major role in designing the power plants & their operation.

UNIT – I

Single Phase A.C. Circuits: Production of ac voltage, waveforms and basic definitions, root mean square and average values of alternating currents and voltage, form factor and peak factor, phasor representation of alternating quantities, the j operator and phasor algebra, analysis of ac circuits.

UNIT – II

Three Phase AC circuits: Introduction, Generation of Three-phase EMF, Phase sequence, Connection of Three-phase Windings - Delta and Star connection: Line and Phase quantities, phasor diagrams, Power equations in balanced conditions.

UNIT – III

Magnetic Circuits: Introduction, Magnetomotive force (MMF), Magnetic field strength, Reluctance, B-H curve, Comparison of the Electric and Magnetic Circuits, Series-Parallel Magnetic Circuit, Leakage flux and fringing, Magnetic Hysteresis, Eddy currents.

UNIT – IV

Single Phase Transformers: Introduction, Principles of operation, Constructional details, Ideal Transformer and Practical Transformer, EMF equation, Rating, Phasor diagram on no load, Losses, Efficiency calculations.

Direct Current Machines: Constructional details, Principle of operation of DC machines, e.m.f. equation, Torque production, classification of DC machines, Starting of DC motors.

RECOMMENDED REFERENCES:

1. V.N. Mittle and Arvind Mittal, “Basic Electrical Engineering”, Second Edition, Tata McGraw Hill.
2. Del Torro, Vincent “Electrical Engineering Fundamentals”, Second Edition Prentice Hall of India Pvt. Ltd.
3. Fitzrald and Higgonbothom, “Basic Electrical Engineering”, Fifth Edition, McGraw Hill.
4. D.P. Kothari and I.J. Nagrath, “Theory and Problems of Basic Electrical Engineering”, PHI.
5. I.J. Nagrath and D.P. Kothari, ”Electrical Machines”, Tata McGraw Hill.
6. Ashfaq Hussain, “Fundamentals of Electrical Engineering”, Third Edition, Dhanpat Rai and Co.
7. H. Cotton, “Advance Electrical Technology,” ISSAC Pitman, London.
8. Parker Smith S. (Ed. Parker Smith N.N.), “Problems in Electrical Engineering”, Tenth edition, Asia publication.

KALINGA UNIVERSITY
RAIPUR INDIA

WASTE TO ENERGY CONSERVATION SYSTEMS

BVRE303

LEARNING OBJECTIVES

1. To understand the various waste generation sources and their management.
2. To know the various waste to energy conversion technologies.
3. To understand various impacts like health and environment issues and significance of different technologies.
4. To get acquainted with commercial aspects of waste to energy.

UNIT – I

Waste resource analysis- analyse detailed site information, Identify the type and quantity of waste available for incineration , Conduct the tests to identify the moisture content, chemical composition, presence of hazardous material, non-degradable content in waste, carbon content and calorific value of the waste available.

UNIT - II

Collect information about the local weather conditions such as temperature range, wind speed, humidity, rainfall and seasonal availability of the resource, assess the ground water availability and its quality, load bearing capacities, pH levels and seismic risk and fire risk analaysis.

UNIT – III

Analyse and present comparison of different types of technologies for waste to-energy conversion , analyse the pre-site selection baseline data for project execution suitability , identify the load , collect and analyse the waste availability data .

UNIT – IV

Identify bi-products and waste from the plant and their disposal arrangements , Environment impact for storage and disposal of waste.

RECOMMENDED REFERENCES:

1. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, ISBN: 9780470539675, John Wiley and Sons.
2. Velma I. Grover and Vaneeta Grover, Recovering Energy from Waste Various Aspects, ISBN 978-1- 57808-200-1.
3. Shah, Kanti L., Basics of Solid and Hazardous Waste Management Technology, Prentice Hall.
4. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers.
5. Marc J. Rogoff, Waste-to-Energy, Elsevier.
6. Parker, Colin and Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London.
7. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House.
8. Bhide A. D., Sundaresan B. B., Solid Waste Management in Developing Countries, INSDOC, New Delhi.

KALINGA UNIVERSITY
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INSTALLATION AND COMMISSIONING OF SOLAR PV POWER PLANT BVRE304

LEARNING OBJECTIVES

1. To understand the various solar cell parameters
2. The principle of photovoltaic technologies and there characteristics.
3. Estimation of cost, installation and commissioning of PV Systems.

UNIT – I

Preparation before initiating construction at site, read and interpret the design and detailed drawings of the civil, mechanical and electrical works to be carried out at site, ensure the marking of the complete layout of the plant as per design, arrange for tools and consumable required for installation.

UNIT – II

Identify and allocate work items for labour teams and coordinate among the teams for parallel and timely execution of the project, manage the installation schedule, follow the schedule for each of the civil and mechanical construction activity, manage the schedule for installation of modules, inverters, transformers, power protection devices, lightning arresters, earthing systems, etc. ensure installation as per the design documents, ensure the installation of cables between different components including modules, inverter and other components as per design documents, check cables for continuity.

UNIT – III

Manage the installation of communication and storage system with SCADA facility/ any monitoring system, Complete all ground / roof related activities like drainage systems, cable trenches identification marking, signages at different locations in the plant, ensure installation of battery banks if required, prepare, review and report progress on daily basis to the site in- charge for further action – through use of project management techniques such as MS Project, etc.,

UNIT – IV

Test and commission the solar PV power plant , visually inspect the plant after installation , get pre-connection connectivity and conductivity test done, verify system grounding and get the insulation resistance measured , confirm that electrical protections, disconnection and other provisions are fulfilled as per design documents, get the DC voltage and current test done for each of the module strings, measure and record all relevant parameters of energy storage system if present ,confirm smooth functioning of trackers, if any .

RECOMMENDED REFERENCES:

1. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K. C, New Arrivals - PHI; 2 edition (2011)
2. Solar Energy, Fundamentals, Design, Modelling & Applications, G.N.Tiwari, Narosa Publishing House.
3. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley & sons.
4. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Chetan Singh Solanki, PHI (1 January 2013)
5. Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
6. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki PHI; 3 edition 2015.

KALINGA UNIVERSITY
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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE305P

KALINGA UNIVERSITY
RAIPUR INDIA

SEMESTER-IV
ENERGY MANAGEMENT, AUDITING AND UTILIZATION
BVRE401

LEARNING OBJECTIVES

1. Better energy conservation
2. Cost reduction & efficiency
3. Energy auditing & plugging of losses
4. Awareness about Energy Management Principles & energy audit procedure as adopted by the Bureau of Energy Efficiency, Ministry of Power, GoI.

UNIT – I

ENERGY CONSERVATION: Energy Conservation and its Importance; Energy Strategy for the Future; the Energy Conservation Act, 2001 and its Features

ENERGY MANAGEMENT: Definition & Objectives of Energy Management; Importance; Indian need of Energy Management; Duties and responsibilities of energy managers.

UNIT – II

ENERGY AUDIT: Energy Audit: Types and Methodology; Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximizing System Efficiency; Energy Audit Instruments; Duties and responsibilities of energy auditors.

UNIT – III

MATERIAL AND ENERGY BALANCE: Basic Principles; The Sankey Diagram and its Use; Material Balances; Energy Balances; Method for Preparing Process Flow Chart; Facility as an Energy System; How to Carryout Material and Energy (M & E) Balance.

UNIT – IV

ENERGY POLICY PLANNING AND IMPLEMENTATION KEY ELEMENTS: Force Field Analysis, Energy Policy-Purpose, Perspective, Contents and Formulation. Format and Ratification, Organizing: Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability, Motivation of employees.

RECOMMENDED REFERENCES:

1. LC Witte, PS Schmidt, DR Brown, Industrial Energy Management and Utilization, Hemisphere Publication, Washington, 1988.
2. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982.
3. IGC Dryden, Butterworths (Ed), The Efficient Use of Energy, London, 1982.
4. WC Turner (Ed), Energy Management Handbook, Wiley, New York, 1982.
5. Technology Menu for Efficient energy use- Motor drive systems, Prepared by National Productivity Council and Center for Environmental Studies- Princeton University, 1993.
6. Frank, Kreith, Ronald E West Hand Book of Energy Efficiency, CRC Press.
7. Bureau of Energy Efficiency Study Material for Energy Managers and Auditors Examination Paper I to IV.
8. BG Desai, BS Vaidya DP Patel and R Parman, Savings Electricity in Utility Systems of Industrial Plants Efficient use of electricity in industries.
9. Instructions to Energy Auditors, Vol - I and Vol - II National Technical Information Services US Deptt of Commerce Springfield, VA 22161.
10. Energy Auditing, The Fairmont Press Inc Published by Atlanta, Georgia.

KALINGA UNIVERSITY
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MATERIAL SCIENCE FOR ENERGY APPLICATIONS

BVRE402

LEARNING OBJECTIVES

1. Basics of materials science and engineering.
2. Properties of various materials and special coatings and applications.
3. Testing of materials behavior suitable for application in solar energy systems.
4. Environmental impact on solar system materials and corrosion protection.

UNIT – I

FUNDAMENTAL PRINCIPLES OF MATERIALS SCIENCE: Electronic and atomic structures, atomic bonding in solids, crystal structure, microstructure, solidification, alloys, semiconductors, ceramics, polymers.

UNIT – II

PROPERTIES OF MATERIALS: Super conductivity and applications. Mechanical, optical , thermal electrical and magnetic properties of metals, alloys, semiconductors, polymers, glass, nanomaterials and magnetic materials.

UNIT – III

TESTING OF MATERIALS: Concepts of stress and strain, Hooke's law, tension, compression and shear. Stress-strain diagram and thermal stresses. Elasticity in metals and polymers, plastic deformation, yield stress, shear strength, strengthening mechanisms.

UNIT – IV

EFFECTS ON MATERIALS: Environmental effects - corrosion, erosion, thermal stress and weathering properties of solar materials, Effect of temperature, fracture behavior of various materials, failure analysis of solar materials.

RECOMMENDED REFERENCES:

1. Ramamrutam S., “Strength of Materials” , 16th edition, Danpat Rai Publications, 2010
2. Callister W.D.., Materials Science and Engineering 6th edition, Wiley India, 2009
3. Sheckel ford J., F. Muralidham M.K., “Introduction to Materials Science for Engineers” , 6th edition, Pearson, 2007.
4. RaghavanV., “ Materials Science and Engineering”, Prentice-Hall India, 2007.
5. Askeland D.R., “ Science and Engineering of Materials” , 4th edition, Thomson, 2003.
6. Bala subramaniam R., “ Callister’s Materials Science and Engineering”, Wiley India, 2007.
7. Ben G. Streetman, Solid State electronic devices, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.

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HYDROGEN ENERGY AND FUEL CELLS

BVRE403

LEARNING OBJECTIVES

1. Methods of hydrogen production, storage and utilization.
2. Basics of fuel cell technology.
3. Major types of fuel cells and their modes of operation.
4. Application of fuel cells in power cogeneration and heat and power cogeneration.

UNIT –I

Fuel Cell Basics Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells Fuel cell thermodynamics - second law analysis of fuel cells, efficiency of fuel cells fuel cell electrochemistry - Nernst equation.

UNIT - II

Butler-Volmer equation , Fuel cell types Classification by operating temperature/electrolyte type, Fuel Cell Performance, Activation, Ohmic and Concentration over potential.

UNIT-III

Fuel cell design and components Cell components, stack components, system components Overview of intermediate/high temperature fuel cells - Solid oxide fuel cells (SOFC), Molten carbonate fuel cells (MCFC), Phosphoric acid fuel cells (PAFC) Polymer Electrolyte fuel cells ,Heat and mass transfer in polymer electrolyte fuel cells, water management in PEFCs, Current issues in PEFCs, Direct methanol fuel cells (DMFC) - Electrochemical kinetics methanol oxidation, Current issues in MFCs, Fuel crossover in DMFCs, Water management in DMFCs, high methanol concentration operation, limiting current density.

UNIT –IV

Hydrogen Energy: Its merit as a fuel, Applications Hydrogen production methods Production of hydrogen from fossil fuels, electrolysis, thermal decomposition, photochemical and photo- catalytic methods Hydrogen storage methods Metal hydrides, metallic alloy hydrides.

RECOMMENDED REFERENCES:

1. Kettani, M.A., Direct energy conversion, Addison-Wesley, Reading, Mass, 1970
2. Angrist S.W. ,Direct Energy Conversion. 4th Ed. Allyn And Bacon, Boston, 1982

3. Green M.A. ,Solar Cells, Prentice-Hall, Englewood Cliffs, 1982
4. Hand book Batteries and Fuel Cells. Linden, McGraw Hill, 1984.
5. J Larminie and A Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley,2003
6. Xianguo Li, Principles of Fuel Cells, Taylor and Francis, 2006
7. S Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer
8. O'Hayre, SW Cha, W Colella and FB Prinz, Fuel Cell Fundamentals, Wiley, 2005
9. A Faghri and Y Zhang, Transport Phenomena in Multiphase Systems, Elsevier 2006
10. Hand Book of Batteries and Fuel cells, 3rd Edition, Edited by David Linden and Thomas. B. Reddy, McGraw Hill Book Company, N.Y. 2002
11. Principles of Fuel Cells, by Xianguo Li, Taylor & Francis, 2006
12. Fuel Cells, Principles and Applications, Viswanathan, B. and Scibioh, Aulice M, Universities Press, 2006.

KALINGA UNIVERSITY
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ENERGY EFFICIENCY IN THERMAL UTILITIES

BVRE404

LEARNING OBJECTIVES

1. To understand the main constituents of boiler feed water, classification of boiler in to various types.
2. To study different water treatment methods, to examine types of refractories.
3. To understand the mechanism of heat transfer, determination of economic thickness of insulation.
4. To understand the need for cogeneration & examining functioning of various types of cogeneration systems.

UNIT - I

Boilers: Types, combustion in boilers, performance evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings.

UNIT –II

Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

Insulation and Refractories: Insulation types and application, economic thickness of insulation, heat saving and application criteria, refractory types, selection and application of refractories, heat loss.

UNIT – III

FBC Boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, retro-fitting of FBC system to conventional boilers, saving potential.

UNIT –IV

Cogeneration: Definition, need, application, advantages, classification, saving potential. Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.

RECOMMENDED REFERENCES:

1. George Polimeros, Energy Cogeneration Hand Book for Central Plant Design, Industrial Press inc, Newyork, 1981
2. M.M.EI- Wakil, Power Plant Technology, McGraw Hill, 1984
3. Chapters in a number of books on Power Plant Engineering and Thermodynamics
4. Eastop, T.D. & Croft D.R, "Energy efficiency for engineers and Technologists", 2nd Edition, Longman Harlow, 1990.
5. O'Callaghan, Paul W, "Design and Management for energy conservation", Pergamon,1993.
6. Osborn, peter D, "Handbook of energy data and calculations including directory of products and services", Butterworths, 1980.
7. Charles H.Butler, Cogeneration, McGraw Hill Book Co., 1984.
8. Horlock JH, Cogeneration - Heat and Power, Thermodynamics and Economics, Oxford, 1987
9. IEEE Bronze Book: IEEE Standard 739-1984 – Recommended Practice for Energy Conservation and Cost Effective Planning in Industrial Facilities, IEEE Publications, 1996.
10. A.P.W. Thumann: Plant Engineers and Managers Guide to Energy conservation, 7e, UNR, 1977.

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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE405P

KALINGA UNIVERSITY
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SEMESTER-V

SOLAR BUSINESS SOLUTIONS

BVRE501

LEARNING OBJECTIVES

1. Understand the research preparation and planning.
2. Understand various data collection methods.
3. Study various sampling methods.

UNIT- I

For smart grids and micro grids ,biomass power generation systems business, small scale wind power plant business, solar water pumping systems business, rooftop solar pv business- Assess the market and evaluate the market trends to decide the strategy for sale of solar lighting solutions , identify market opportunities and potential customers , Devise strategy to reach potential customer through business promotion techniques, media outreach plan.

UNIT- II

Content for brochures and product catalogues, etc. , identify the customer requirements , clarify the customer queries with respect to solar lighting solutions , assess the area of installation, power output expectation, budget, etc. during discussion with the customer ,

UNIT – III

Create relevant solutions to meet customer requirements , develop the working calculation sheet outlining the broad estimate for the solar lighting solutions.

UNIT- IV

Prepare the cost benefit analysis for solar lighting solutions , prepare a proposal for solar lighting solutions , prepare a pitch for the customer and close the sale , create and manage a pipeline of potential customers.

RECOMMENDED REFERENCES:

1. Development of Solar and Wind Power in Karnataka and Tamil Nadu, Edition by Asian Development Bank
2. The Solar Economy: Renewable Energy for a Sustainable Global Future, Hermann Scheer,
3. Solar Revolution – The Economic Transformation of the Global Energy Industry Travis Bradford, The MIT Press.
4. The Solar Electricity Handbook: A Simple, Practical Guide to Solar Energy: How to Design and Install Photovoltaic Solar Electric Systems 2017, Michael Boxwell.

KALINGA UNIVERSITY
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ENERGY IN BUILDINGS

BVRE502

LEARNING OBJECTIVES

1. Concepts and techniques of energy efficient buildings design features.
2. Concepts and techniques of solar passive heating and cooling systems.
3. Concepts and techniques of day lighting and electrical lighting, heat control of buildings.

UNIT- I

Climate and shelter, Historic buildings, Modern architecture, Examples from different climate zones, Thermal comfort, Solar geometry and shading, Heating and cooling loads, Energy estimates and site planning.

UNIT- II

Passive solar heating, Direct gain, Thermal storage wall, Sunspace, Convective air loop, Passive cooling, Ventilation, Radiation, Evaporation and Dehumidification, Mass effect, Design guidelines.

UNIT – III

Energy conservation in building: Day lighting, Water heating and photovoltaic systems Air conditioning, HVAC equipments, Computer packages for thermal design of buildings and performance prediction, Monitoring and instrumentation of passive buildings

UNIT- IV

Control systems for energy efficient buildings, Illustrative passive buildings, Integration of emerging technologies, Intelligent building design principles. Various Energy Efficiency Rating Systems for Buildings, LEEDS, BEE & GRIHA Rating Systems Energy Conservation Building Code.

RECOMMENDED REFERENCES:

1. Sodha M., Bansal, N.K., Bansal, P.K., Kumar, A. and Malik, M.A.S.,"Solar Passive Buildings", Pergamon Press, 1986.
2. Koenigsberger, O.H., Ingersoll, T.G., Mayhew Alan and Szokolay, S. V., "Manual of Tropical Housing and Building part 1: Climatic Design", OLBN 0 00212 0011, Orient Longman Limited, 1973.
3. Bureau of Indian Standards, I.S. 11907 –1986 Recommendations for calculation of Solar Radiation Buildings, 1986.
4. Givoni,B., "Man, Climate and Architecture", Elsevier, Amsterdam, 1986. 3. Smith, R. J., Phillips,
5. G.M. and Sweeney, M. "Environmental Science", Longman Scientific and Technical, Essex, 1982.
6. J.A. Clarke, Energy Simulation in Building Design (2e) Butterworth 2001.
7. J.K. Nayak and J.A. Prajapati Handbook on Energy Conscious Buildings, Solar Energy Control MNES, 2006.
8. Energy Conservation Building Codes 2006; Bureau of Energy Efficiency.
9. J.R. Williams, Passive Solar Heating, Ann Arbar Science, 1983.
10. R.W. Jones, J.D. Balcomb, C.E. Kosiewiez, G.S. Lazarus, R.D. McFarland and W.O. Wray, Passive Solar Design Handbook, Vol.3, Report of U.S. Department of Energy (DOE/CS-0127/3), 1982.
11. M.S. Sodha, N.K., Bansal, P.K. Bansal, A.Kumar and M.A.S. Malik. Solar Passive Building, Science and Design, Pergamon Press, 1986.
12. J.L. Threlkeld, Thermal Environmental Engineering, Prentice Hall, 1970.

KALINGA UNIVERSITY
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ENERGY MODELING & PROJECT MANAGEMENT

BVRE503

LEARNING OBJECTIVES

1. To familiarize the students with the methods of modeling and analysis of solar thermal and PV systems.
2. To understand the Mathematical modeling development methods, Quantitative techniques, various numerical methods to solve equations, Software tools to solve problems.

UNIT –I

Modeling: Testing for proportionality, Modeling change with difference equations, examples- A saving certificate, mortgaging a home, Approximating change with difference equations, examples growth of yeast culture, growth of yeast culture revisited, Solutions to Dynamical systems, examples- A saving certificate revisited, sewage treatment.

UNIT-II

Systems of difference equations , examples- A car rental company, discrete epidemic models, Modeling process- mathematical models, example- vehicular stopping distance, modeling using proportionality, example- kepler's third law.

UNIT-III

Modeling process- modeling using geometric similarity, example- rain drops from a motionless cloud, automobile gasoline mileage, body weight and height, strength and agility, Model fitting- Fitting models to data graphically, Analytic methods of model fitting, Applying the Least- Squares Criterion, choosing a best model.

UNIT – IV

Experimental Modeling- Introduction, harvesting in the Chesapeake Bay and other one term models, example harvesting Blue fish and harvesting Blue crabs, Higher order Polynomial models, example- Elapsed time of a tape recorder, Smoothing- Low Polynomial models, example- Elapsed time of a tape recorder revisited, HOMER software, Power system modeling.

RECOMMENDED REFERENCES:

1. Bender E.A., "Introduction to Mathematical Modeling" , Dover Publ., 2000.
2. Meyer W.J., "Concepts of Mathematical Modeling", Dover Publ., 2004.
3. Dym C.L., "Principles of Mathematical Modeling", Elsevier, 2004.

KALINGA UNIVERSITY
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SOLAR THERMAL TECHNOLOGIES

BVRE504

LEARNING OBJECTIVES

1. The fundamentals of design calculations and analysis of solar thermal systems.
2. The functioning and design of solar thermal cooling systems.
3. The basics of solar thermal technology for process heating applications.
4. The fundamentals of design calculations and economics of solar power generation.

UNIT – I

Analyze the client requirements , visit the client site to understand the details of their manufacturing process, identify the heat requirement for various process, temperature and quantity ,collect data on the present source of heat and its utilization,

UNIT – II

compute the shadow free open area available on the ground or rooftop for installation of solar thermal system, analyze solar radiation data for the project site, describe the benefits of using solar thermal technologies to the client .

UNIT – III

solar thermal technology (ies) for supply of process heat, analyze and recommend the relevant solar thermal technologies (i.e. air collectors, FPC/ETC water heater, scheffler disc, , parabolic trough collector and linear fresnel reflector collector) as per client requirements and suitability, suggest capacity of solar thermal system with estimated heat output at designed temperature and solar radiation levels.

UNIT – IV

design relevant solar thermal technology solution catering to the client's requirementIdentify necessary changes to existing process for integration of solar thermal system , integrate the solar thermal system with the existing process heat supply system, Quality of water and need for treatment plant and thermal storage, if required

RECOMMENDED REFERENCES:

1. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Singal K. C, New Arrivals
a. PHI; 2 edition (2011)
2. Solar Energy, Fundamentals, Design, Modelling & Applications, G.N.Tiwari, Narosa Publishing House.
3. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley & sons.
4. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Chetan Singh Solanki, PHI (1 January 2013)
5. Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
6. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki PHI; 3 edition 2015.

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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE505P

KALINGA UNIVERSITY
RAIPUR | INDIA

SEMESTER-VI

HEALTH AND SAFETY PRACTICES AT PROJECT SITE

BVRE601

LEARNING OBJECTIVES

UNIT – I

adherence to safe working practices at wind project site, select the relevant protective clothing/ equipment for specific tasks and work , state the name and location of relevant documents and people responsible for health and safety in the workplace , identify possible causes of risk at workplace and their mitigation measures ,identify and follow warning signs on site.

UNIT – II

establish safe working procedures at the workplace ensure safe working practices when working at heights, confined areas and trenches, identify methods of accident prevention in the work environment ,follow safe operating procedures for lifting, carrying and transporting heavy objects& tools , inspect the work place on a regular basis for any signs of spillage , ensure safe storage of flammable materials and machine lubricating oil, apply good housekeeping practices at all times by removal/disposal of waste products, inform relevant authorities about any abnormal situation/behavior of any equipment/ system promptly,

UNIT – III

fire safety and tackling emergency situations - exhibit the use of various appropriate fire extinguishers on different types of fires correctly , demonstrate rescue techniques applied during fire hazard, administer appropriate first aid to victims were required e.g. in case of bleeding, burns, choking, electric shock, poisoning etc., respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments

UNIT – IV

participate in emergency procedures: raising alarm, safe/efficient, evacuation, correct means of escape, correct assembly point, roll call, correct return to work f. report the accident to the relevant authority in the prescribed format.

RECOMMENDED REFERENCES:

1. The Solar Electricity Handbook: A Simple, Practical Guide to Solar Energy: How to Design and Install Photovoltaic Solar Electric Systems 2017, Michael Boxwell
2. Industrial Safety Management 1st Edition (English, Hardcover, L M Deshmukh)
3. Gap Analysis of Env., Health & Safety Mgt. Systems - Highway Project (English, Paperback, Ziauddin Akbar).
4. The Grid: A Journey Through the Heart of Our Electrified World, Phillip F. Schewe.

KALINGA UNIVERSITY
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ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

BVRE602

LEARNING OBJECTIVES

1. To enable the students to understand the concept of generation, transmission and distribution of energy & to enlighten them on the power factor improvement and transformer distribution.
2. To get acquainted about factors affecting motor performance, rewinding and motor replacement issues & energy saving opportunities with energy efficient motors.
3. To enrich students to identify compressed air systems, types of air compressor, fans & blowers & its types, lighting systems & types of lamp and light source, compressor efficiency and its components, factors affecting performance and efficiency.
4. To enrich students with the knowledge regarding energy efficient technologies in electrical systems.

UNIT-I

Electrical System: Introduction, Generation, Transmission and Distribution of Electricity, IE (Indian Electricity) Rules, Important Equipments, Electricity Billing, Electrical Load Management and Maximum Demand Control, Maximum Demand, Contracted Maximum Demand, Connected Load.

UNIT-II

Electric Motors: Introduction, Types of Motors, Direct Current Motors (DC Motors), Synchronous Motors, Induction Motors, Power Factor, Motor Efficiency and its Losses, Factors Affecting Motor Performance, Rewinding and Motor Replacement Issues, Energy Saving Opportunities with Energy Efficient Motors.

UNIT –III

Lighting System: Introduction, Basic Terms in Lighting Systems and Features, Lamp Types and their Features, Recommended Illuminance Levels for Various Tasks / Activities / Locations, Methodology of Lighting System Energy Efficiency Study, Energy Efficient Replacement Options, Good Practices in Lighting, Installation of Compact Fluorescent Lamps (CFL's) in Place of Incandescent Lamps, Installation of LED Panel Indicator Lamps in Place of Filament Lamps.

UNIT-IV

Energy Efficient Technologies in Electrical Systems: Maximum Demand Controllers, Automatic Power Factor Controllers, Voltage Control, Kilovar Control, Automatic Power Factor Control Relay, Intelligent Power Factor Controller (IPFC), Energy Efficient Transformers, Electronic Ballast, Role of Ballast, Conventional vs. Electronic Ballasts.

RECOMMENDED REFERENCES:

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.
2. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
3. Larry C Whitetal, Industrial Energy Management & Utilization.

Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2008

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RAIPUR INDIA

SMART AND MICRO-GRID

BVRE603

LEARNING OBJECTIVES

1. To know, list and classify the basic terms of a Power System Grid; explain the importance and objectives of the various dispersed generation units.
2. To describe by drawing a block diagram and explain the operation of the basic part of a smart grid (namely the Microgrid) & to quantify its operation.
3. To know, understand and explain the concept of a smart grid.

UNIT - I

Introduction to Smart Grid: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grids, Introduction to EMS, HVDC, FACTS.

UNIT - II

Smart Grids and Smart cities: Overview of Smart Grid, Smart City program design, Application and technology demonstration module, Deliverables of Smart Grid- Smart City modules, Governance structure, funding arrangements and process, SMART GRID BUSINESS.

UNIT – III

Basics of Microgrid: Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

UNIT - IV

Modes of operation and control of Microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids.

RECOMMENDED REFERENCES:

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011. 34
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids,
3. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions",CRC Press 2012.
4. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
5. "Voltage Source Converters in Power Systems: Modeling, Control and Applications", Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications.
6. "Power Switching Converters: Medium and High Power", DorinNeacsu, CRC Press, Taylor & Francis, 2006.
7. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi, 2009

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EVALUATION AND MONITORING FOR WIND POWER PLANT

BVRE604

LEARNING OBJECTIVES

1. Awareness about various wind Energy.
2. Understanding the design considerations of Wind projects.
3. Awareness about global scenario & current status.
4. Get acquainted to various types of Wind power stations.

UNIT – I

conduct preliminary analysis for the project, identify project objectives and constraints, study the prefeasibility and feasibility study and identify physical viability of project execution , analyse the project DPR in detail and assist in preparing a work plan, analyse the wind farm layout and identify necessary permits and clearances to be taken ,identify the possible risks associated with the project and assist in preparing risk mitigation procedures ,analyse the environmental impact studies and plan for necessary clearances , prepare a report of preliminary analysis of the project and submit to the planning engineer, assist in preparing the project plan for wind power plant.

UNIT – II

identify and prepare a plan for taking necessary clearances as per general local framework like municipal permits, grid permit, etc. carry out route survey for material delivery at site , assist in planning for procurement and manufacturing of wind power plant components , assist in material planning and handling assist in manpower and resource planning for project execution, prepare a time schedule for each of the activities , identify the location for project site office and ensure its construction as per specification, plan for construction power supply at project site, plan for safety and security of man and material at project site.

UNIT – III

Establish suitable Project Management technics and prepare all necessary formats, organize tasks concurrently to make optimal use of workforce during project execution, assist in undertaking personnel selection and evaluation for project execution, monitor and report the progress of the construction of access roads for material delivery at site, monitor and report the progress of equipment and material delivery at wind project site.

UNIT – IV

Prepare consolidated relevant report and presentations for project monitoring, ensure following of industry standards within the wind site, ensure following contingency plan in case of unforeseen delay. carry out regular site visits to ensure protocols are followed, ensure restoration of site post commissioning, prepare handover documentation as per prescribed format .

RECOMMENDED REFERENCES:

1. Freris L.L: Wind Energy Conversion Systems, Prentice Hall
2. Brendan Fox: Wind power integration : connection and system operational aspect
3. Frede Blaabjerg, Zhe Chen: Power electronics for modern wind turbines
4. Olimpo Anaya-Lara: Wind energy generation : modelling and control

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INDUSTRIAL TRAINING/

ON JOB TRAINING/ WORKSHOP

BVRE605P

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