VEER MADHO SINGH BHANDARI
UTTARAKHAND TECHNICAL UNIVERSITY DEHRADUN

Specialization/Minor in Energy Engineering

EFFECTIVE FOR 2021-22 BATCH

2ND YEAR TO 4TH YEAR

Eligible Branches to adopt as Specialization

1. B.Tech.- Mechanical Engineering

2. B.Tech.- Civil Engineering

Evaluation Schemes for Specializations/Minor in B.Tech

Specialization in Energy Engineering										
S.No.	**Code**	**Sem**	**Subject**	**Periods**			**Evaluation Scheme**		**Total Marks**	**Credits**
				L	T	P	**Internal**	**External**		
1.	SEE301	3rd	Renewable energy source	3	0	0	50	100	150	3
2.	SEE401	4th	Energy Audit	3	0	0	50	100	150	3
3.	SEE501	5th	Energy conservation and management	3	0	0	50	100	150	3
4.	SEE601	6th	Waste to Energy	3	0	0	50	100	150	3
5.	SEE701	7th	Electrical Systems	3	0	0	50	100	150	3
6.	SEE801	8th	Energy Storage Systems	3	0	0	50	100	150	3
			Total	**18**	**0**	**0**	**300**	**600**	**900**	**18**

SEE301	RENEWABLE ENERGY SOURCE	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	World Energy Use, Reserves of Energy Resources, Environmental Aspects of Energy Utilisation, Renewable Energy Scenario in Tamil nadu, India and around the World, Potentials, Achievements / Applications, Economics of renewable energy systems	8
Unit 2	**Solar Energy:** Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Solar direct Thermal Applications, Solar thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.	12
Unit 3	**Wind Energy:-** Wind Data and Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator, Safety and Environmental Aspects.	8
Unit 4	Hydropower: Basic properties of water energy. Available energy of water flow. Transformation of water energy. Hydropower plants. Small hydropower plants. Special hydropower plants. Utilisation of hydropower, examples. Economics of hydropower. Trends in hydropower utilisation. Hydrogen Energy: Basic properties of hydrogen. Technologies of hydrogen production. Transformation of hydrogen energy, hydrogen economy. Fuel cells, operating principle, main parts, properties. Applications of hydrogen and fuel cells, examples. Economics of hydrogen. Trends in hydrogen utilisation.	8
Unit 5	Biomass Energy: Types of biomass and their basic properties. Transformation of biomass energy. Applications of biomass. Technologies for utilisation of biomass, examples. Economics of biomass. Trends in biomass energy utilisation. Geothermal Energy, Heat Pumps, Financial Models, Legislative Framework, Administrative Procedures	9

Text Books:

1. Boyle, Godfrey. *Renewable Energy: Power for a Sustainable Future*, Third Edition. Oxford University Press, 2012.
2. Tester, et al. *Sustainable Energy, Choosing Among Options*, 2nd Edition. MIT Press, 2012.

SEE401	ENERGY AUDIT	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Basic Principles of Energy Audit:Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.	8
Unit 2	Energy Management:Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.	12
Unit 3	Energy Efficient Motors:Energy efficient motors, factors affecting efficiency, loss distribution , constructional details , characteristics – variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit	8
Unit 4	Power Factor Improvement, Lighting and Energy Instruments: Power factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.	8
Unit 5	Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors-calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .	9

Text Books:

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
2. Energy management hand book by W.C.Turner, John wiley and sons
3. Energy management and good lighting practice : fuel efficiency- booklet 12-EEO

SEE501	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Classification of Energy Sources, Principle fuels for energy conversion: Fossil fuels, Nuclear fuels. Conventional & Renewable Energy Energy Sources: prospecting, extraction and resource assessment and their peculiar characteristics. Direct use of primary energy sources, Conversion of primary into secondary energy sources such as Electricity, Hydrogen, Nuclear energy etc. Energy Conversion through fission and fusion, Nuclear power generation etc.	8
Unit 2	Thermal energy using fossil fuels. Conversion of Thermal Energy to Mechanical energy & Power. Turbines: Steam turbines, Hydraulic turbines.	12
Unit 3	Boilers -Types, combustion in boilers, performance evaluation, analysis of losses, feed water treatment, blow down. FBC Boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, retrofitting FBC system to conventional boilers. HVAC, Refrigeration and Air Conditioning: Vapor compressor refrigeration cycle, refrigerants, coefficient of performance, capacity, factors affecting refrigeration and air conditioning system performance, Vapor absorption refrigeration systems: Working principle, type and comparison with vapor compressor system.	8
Unit 4	Sterling Engines, Steam Engine, Internal Combustion systems and external combustion system, Overview of different types of turbines. 7 Mechanical Engineering and Overview: Basic Engineering concepts and design considerations, Governing regulations and codes and standards, Strength of Materials, mechanical properties of materials, mechanics of materials Torque and Power: Basic theory, Shafts, Flywheels etc. Power Transmission: Concepts of Belts Drives, Gearing, Coupling etc. Bearing and Lubricants as Energy Saving Measures Electromechanical energy: Electric to mechanical energy conversion, Electric Motors.	8
Unit 5	Co-generation & Tri-generation: Definition, need, application, advantages, classification, saving Potential. Waste Heat Recovery: Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices.	9

Text Books:

1. Direct Energy Conversion : W.R.Corliss
2. Aspects of Energy Conversion: I.M.Blair and B.O.Jones
3. Principles of Energy Conversion: A.W.Culp (McGrawHill International
4. Energy conversion principles: Begamudre , Rakoshdas
5. Fuel Economy Handbook, NIFES,
6. Industrial Furnaces (Vol I & II) and M.H. Mawhinney, (John Wiley Publications)
7. Refractories – F.H. Nortan,(John Wiley Publication.)

SEE601	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	Introduction to energy from waste: characterisation and classification of waste as fuel – agrobased, forest residues, industrial waste, Municipal solid waste.	8
Unit 2	Waste to energy options: combustion (unprocessed and processed fuel), gasification, anaerobic digestion, fermentation, pyrolysis.	8
Unit 3	Conversion devices: combustors (Spreader Stokes, Moving grate type, fluidized bed), gasifier, digesters. Briqueting technology: Production of RDF and briquetted fuel. Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes	8
Unit 4	Comparison of properties with conventional fuels. Power generation using waste to energy technologies: Cl and Sl engines.	8
Unit 5	IGCC and IPCC concepts. Landfills: Gas generation and collection in land fills, Introduction to transfer stations. Comparison with non-energy options like Vermiculture, Composting.	8

Text Books:

1. M.M. EL-Halwagi, Biogas Technology- Transfer and diffusion, Elsevier Applied science Publisher, New York, 1984.
2. D.O Hall and R.P. Overeed, Biomass – regenerable energy, John Willy and Sons Ltd. New York. 1987

SEE701	ELECTRICAL SYSTEMS	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	**System planning** Basic design considerations, Planning guide for the supply and distribution system, Power system modernization and evaluation studies/programs, Voltage considerations, Voltage control in electric power systems, Voltage selection, Voltage ratings for low-voltage utilization equipment, Voltage drop considerations in locating the low-voltage/ high-voltage, Calculation of voltage drops,	8
Unit 2	**Cost estimating of industrial power systems** Preparing the cost estimate, Classes of estimates, Equipment and material costs, installation costs, Other costs	8
Unit 3	LIGHTING DESIGN Different entities of illuminating systems, Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamp and Lasers, Luminaries, wiring, switching & control circuits, Laws of illumination; illumination from point, line and surface sources Photometry and spectrophotometry, Interior lighting – industrial, residential, office departmental stores, indoor stadium, theater and hospitals. Exterior lighting- flood, street, aviation and transport lighting, lighting for displays and signaling- neon signs, LED-LCD displays beacons and lighting for surveillance, Utility services for large building/office complex & layout of different meters and protection units, Different type of loads and their individual protections, Selection of cable/wire sizes; potential sources of fire hazards and precautions, Prepare layout of Different type lights	8
Unit 4	Cable Sizing and Selection of single Phase and Three Phase Load Details Calculation, Cable type and Construction features, Site Installation Conditions, Cable Selection Based on Current Rating of feeder, Base Current Ratings of feeder, Installed Current Ratings of Cable, Cable Selection and Coordination with Protective Devices, Feeders load detail, Motors load detail, Voltage Drop of cable, Cable Impedances, Maximum Permissible Voltage Drop by ANSI and IEC std., Calculating Maximum Cable Length due to Voltage Drop, Short Circuit Temperature Rise calculation of cable, selection Minimum Cable Size Due to Short Circuit Temperature Rise, Initial and Final Conductor Temperatures withstand capability of cable,	8
Unit 5	Internal Electrification design, Electrical Layout in residential building using Auto CAD, Selection of house wiring, Sizing and Selection of Conduit, Sizing and selection of Switch Socket, Calculation of load on circuit, Design of sub circuit (Lighting Circuit and Power Circuit), Distribution of Power Circuit, Calculation of fan, Calculation of Earthing for residential buildings, Sizing and selection of low voltage switchgears (MCB,MCCB, RCB, RCBO MPCB), Refer Std. IS 4648,CPWD	8

SEE801	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Contents		Hours
Unit 1	**ENERGY STORAGE MODES:** Potential energy, Pumped hydro storage; KE and Compressed gas system: Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, Superconducting Magnet Energy Storage (SMES) systems	8
Unit 2	**ELECTROCHEMICAL ENERGY STORAGE SYSTEMS:** Batteries-primary, secondary, Lithium;Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium batteries; Advanced batteries, Role of carbon nano-tubes in electrodes.	12
Unit 3	**ELECTRIC ENERGY STORAGE SYSTEMS:** Capacitor and Batteries: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube.	8
Unit 4	**SENSIBLE AND LATENT HEAT STORAGE:** SHS mediums; Stratified storage systems; Rock-bed storage systems; Thermal storage in buildings; Earth storage; Energy storage in aquifers, Phase Change Materials (PCMs); Selection criteria of PCMs; solar thermal LHTE systems.	8

Text Books:

1. Ibrahim Dincer and Mark A Rosen, “Thermal Energy Storage Systems and Applications”, John Wiley and Sons 2011.
2. James Larminie and Andrew Dicks, “Fuel cell systems Explained”, Wiley Publications, 2003.
3. Ru-shiliu, Leizhang, Xueliang sun, “Electrochemical technologies for energy storage and conversion”, Wiley Publications, 2012.
4. Yves Brunet., “Energy storage”, Wiley publications,2013.
5. Luisa F.Cabeza.,Advances in thermal energy storage systems, Woodhead publications 2014.