Baba Ghulam Shah Badshah University
Rajouri (J&K)-185131

Syllabus Sixth Semester
B. Tech. Degree Course

Department of Electrical Engineering
College of Engineering and Technology
School of Mathematical Sciences & Engineering
Baba Ghulam Shah Badshah University
Rajouri (J&K)-185131

Curriculum Structure

Semester-VI

Theory Courses

Course Code	Title	Scheme of Exam				Hrs./Week		
		Duration (Hrs.)	IA	UE	Total Marks	L	T	P
ERE-621	Power Electronics	3	40	60	100	4	0	0
ERE-622	Electrical Measurement-II	3	40	60	100	3	1	0
ERE-623	Power System Protection	3	40	60	100	3	1	0
ERE-624	Energy Audit & Management	3	40	60	100	3	1	0
ERE-625	Renewable Energy Sources	3	40	60	100	3	1	0
ERE-626	Control System-II	3	40	60	100	3	1	0
Total			**240**	**360**	**600**			

Laboratory Courses

ERE-631	Power Electronics	2	25	25	50	0	0	2
ERE-632	Power System Protection	2	25	25	50	0	0	2
ERE-633	Renewable Energy Sources	2	25	25	50	0	0	2
Total			**75**	**75**	**150**			
Total (Theory + Lab)			**315**	**435**	**750**			

At the end of semester VI students are required to attend an Industrial Training for 6 weeks duration, during summer vacations. After the completion of training every student is required to prepare a detailed report of the training work which he/she has attended in an Organization/Industry/Company. Industrial Training shall be an essential component of curriculum to fulfill the eligibility criteria for appearing in semester VII University Exam. Evaluation of Industrial Training shall be conducted during semester VII.

Semester VI

Course Title:Power Electronics **Max Marks: 100**
Course Code: ERE-621 **University Exam:60**
Duration of Exam: 3 hours **Internal Assessment: 40**

Objective: The objective of this course is familiarizing students with working of power electronic converters under various loads.

Unit-I

Characteristics of Various Solid State Devices: Power diode: structure, I-V characteristics, turn On and turn Off characteristics. SCR: structure, I-V characteristics, turn On and turn Off characteristics, Two transistor model, triggering circuits. Power transistor, MOSFET, GTO, IGBT: I-V characteristics, rating, comparison, parallel operation.
Triac: I-V characteristics, application. Snubber circuits for Power Diodes, SCR's and BJT's. Applications of power electronics.

Unit-II

AC TO DC Converters: Natural commutation- performance analysis under passive loads of Single phase/three phase bridge, Semi controlled and fully controlled rectifiers- Dual converters- Effect of load and source inductances, Inverter operation.

Unit-III

DC TO DC Converters: Switch mode DC-DC Converters: Introduction, Control. Operation of Buck, Boost and Buck-Boost , Cuk converters. Basic principles of switch mode power supplies.

Unit-IV

DC TO AC Converters: Basic concept of switch mode Inverters, square Wave and Sinusoidal PWM switching scheme. Single- phase inverters: Half bridge and full bridge, Bipolar and Unipolar PWM.
3-Pase Inverters: Square wave with 120 and 180 degree conduction mode, 3-phase PWM. Basic Principle of Switch mode power supplies.

Unit-V

AC TO AC Converters: Single phase and three phase AC voltage controllers using thyristors and Triac integral cycle control –AC choppers-single phase Cyclo converters application –effect of harmonics and Electromagnetic interference.

Text Books:

1. **Ned Mohan T. M Undeland & W.P. Robbin,** Power Electronics.
2. **M.H Rashid,** Power Electronics.

Reference Books:

1. **B.K BOSE**, Recent Advances in semiconductor Devices.
2. **M.Ramamurthy**, An introduction to thyristor and their application.
3. **Dubey Doradla, joshi** and **Sinha,** Thyristorised power controllers.

Note for Paper Setter: The question paper shall comprise of 10 questions. Two questions will be set from each unit. The student has to attempt five questions selecting one from each unit.

Semester VI

Course Title: Electrical Measurement-II **Max Marks: 100**
Course Code: ERE-622 **University Exam:60**
Duration of Exam: 3 hours **Internal Assessment: 40**

Objective: The objective of this course is to expose the students to a broad knowledge of experimental methods and measurement techniques.

Unit-I
Potentiometers:
Introduction, DC potentiometer- principle of operation, standardization of potentiometer, Crompton's & Duo range potentiometer, Applications of DC Potentiometer.
AC Potentiometer: Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement

Unit-II
Transducers:
Principe of operation, classification of transducers, Summary of factors influencing the choice of transducer. Qualitative treatment of Strain Gauge, Linear Variable Differential Transformer (LVDT), Thermocouple, Piezoelectric crystal & photoelectric transducers.

Unit-III
Phase & Frequency Measurement:
Frequency meters – vibrating reed type, electrical resonance type & Weston type frequency meters, Digital frequency meter, Analog & digital phase meters & their comparison.

Unit-IV
Digital Instruments:
Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses.

Unit-V
Data Display & Recording Systems:
Introduction to cathode ray tube, block Diagram of CRO. Measurement of voltage, current, phase & frequency using CRO, Dual Beam Oscilloscope, Dual Trace Oscilloscope. Analog and Digital Recorders, Measurement systems applied to Micro and Nanotechnology.

TEXT BOOKS

1. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
2. Ernest o Doebelin and dhanesh N manik, "Measurement systems" ,5th edition ,McGraw-Hill, 2007.

REFERENCES

1. John P. Bentley, "Principles of Measurement Systems", Fourth edition, pearson Education Limited, 2005.
2. A. K. Sawhney, "Course In Electrical And Electronic Measurement And Instrumentation", Dhanpat Rai Publisher, 2000.
3. Bouwens,A.J, "Digital Instrumentation", Tata Mc-Graw Hill, 1986.
4. David A.Bell, "Electronic Instrumentation and Measurements", Second edition, Prentice Hall of India, 2007.

Note for Paper Setter: The question paper shall comprise of 10 questions. Two questions will be set from each unit. The student has to attempt five questions selecting one from each unit.

Semester VI

Course Title: Power System Stability **Max Marks: 100**
Course Code: ERE-623 **University Exam: 60**
Duration of Exam: 3 hours **Internal Assessment: 40**

Objective: This course gives an overview of different aspects of load flow in power systems, power system stability and reactive power generation & control.

Unit-I

Load Flows: Nature and importance of the problem, Network model formulation, algorithm for the formulation of Y-bus matrix, formulation of Y-bus by singular transformation, primitive network, Bus incidence matrix, load flow problem, load flow equations, bus classification – List of variables in load flow equations, Gauss - Seidel & Newton-Raphson method for solving load flow problem.

Unit-II

Power System Stability: The stability problem, steady state, dynamic and transient stability, rotor dynamics and swing equation, power- angle curve, equal-area criterion of stability, Numerical solution of swing equation, Factors affecting transient stability.

Unit-III

Automatic Generation Control: Real power balance and its effect on system frequency, load frequency control of single area system – Models of speed governing system, turbine and generator load, steady state analysis and dynamic response, proportional plus integral control, two area load frequency control, economic dispatch control.

Unit-IV

Control of voltage and Reactive Power: Generation and absorption of reactive power, Relation between voltage and reactive power, Need for voltage control at various system buses, Methods of voltage control – injection of reactive power, tap changing transformers, booster transformers, phase – shift transformers.

Unit-V

Economic Operation of Power System: Introduction, system constraints, economic dispatch neglecting losses, penalty factor, economic dispatch with losses, transmission loss equation, automatic load dispatching.

Text Books:

1. **C.L. Wadlhwa**, Electric Power Systems.
2. **B.M. Weedy** and **Cory** Electrical Power Systems.
3. **Nagrath** and **Kothari,** Power Systems Engineering.

Reference Books:

1. **J.J. Grainger** and **W.D Stevenson** Power System Analysis
2. **O. I Elgard**, Electric Energy System Theory.

Note for Paper Setter: The question paper shall comprise of 10 questions. Two questions will be set from each unit. The student has to attempt five questions at least one from each unit

Semester VI

Course Title: Energy Audit and Management **Max Marks: 100**
Course Code: ERE-624 **University Exam: 60**
Duration of Exam: 3 Hours **Internal Assessment: 40**

Objective: This course gives an overview of various aspects of conservation, management & audit of electrical energy.

Unit-I

Energy management: Concept of energy management ,energy demad and supply, economic analysis; duties and responsibilities of energy managers

Unit-II

Energy conservation: Basic concepts, energy conservation in household, transportation, agricultural, service and industrial sectors, lighting, HVAC systems

Unit-III

Energy audit: Definition, need, and types of energy audit: energy management(audit) approach, understanding energy costs, bench marking, energy performance, matching energy requirement, maximizing system efficiencies , optimizing the input energy requirements: fuel and energy substitution: energy audit instruments; energy conservation act; duties and responsibilities of auditors

Unit-IV

Electrical energy management: Supply side: method to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, power factor improvement, importance and methods

Unit-V

Electrical system: Energy efficient lighting system, energy efficient motors, soft starters for enrgy savers, energy efficient transformers

Text Books:

1. Amit Kumar Tyagi," Handbook on energy Audits and Management".

Reference Books:

1. Wayne C Turner,Energy Management Handbook, The Fairmount Press

Note for Paper Setter: -The Question paper shall comprise of 10 questions. Two questions will be set from each unit. The student has to attempt five questions at least one from each unit.

Semester VI

Course Title: Renewable Energy Sources **Max Marks: 100**
Course Code: ERE-625 **University Exam:60**
Duration of Exam: 3 hours **Internal Assessment: 40**

Objective: The objective of this course is to train and aware the new and advanced technologies in renewable energy technologies.

Unit-I

Energy scenario in India, Renewable and Non-renewable Energy sources, Energy for sustainable development, Direct Energy conversion systems.

Unit-II

Solar energy – solar photovoltaic, types of solar modules, solar array, solar thermal – types of collectors, applications of solar energy systems, solar water heater, solar cooker.

Unit-III

Wind energy–potential, site selection, types of wind turbines, wind generation and control.

Unit-IV

Bio energy, wave & tidal energy, ocean thermal energy systems, introduction to MHD & fuel cells.

Unit-V

Energy storages: Introduction, characteristics of energy storage system, storage capacity, charging and discharging rate, storage efficiency, storage of mechanical energy, fly wall energy storage, compressed air storage, electro chemical energy storage system (Battery).

Text books:

1. **B.R. Gupta**, Generation of Electrical Energy.
2. **G.D. Rai**, Non-conventional Energy Sources.

Reference Books:

1. **Padmashree S.P.Sukhatme**, Solar Energy.
2. **O.I.Elgerd**, Electrical Energy System Theory.

Note for Paper Setter: The Question paper shall comprise of 10 questions. Two questions will be set from each unit .The student has to attempt five questions at least one from each unit

Semester VI

Course Title: Control System-II **Max Marks: 100**
Course Code: ERE-626 **University Exam: 60**
Duration of Exam: 3 hours **Internal Assessment: 40**

Objective: This subject familiarizes a student with state variables and various advanced control techniques.

Unit-I

State Variable Techniques of Continuous Systems: Introduction, concept of sate, finding state model of continuous systems from block diagrams/signal flow graphs, finding transfer function of continuous system from state variable models, Solution of state equations, properties of state transition matrix, computation of state transition matrix by Laplace transformation and Cayley Hamilton theorem, Controllability and Observability.

Unit-II

State Variable Techniques of Discrete systems: Introduction, concept of sate, finding state model of Discrete systems from block diagrams/signal flow graphs, finding transfer function of Discrete system from state variable models, Solution of state equations, properties of state transition matrix, computation of state transition matrix by Z transformation and Cayley Hamilton theorem

Unit-III

Digital control system: Hardware elements of a digital control system, Z- transform, inverse Z-transform, difference equations, pulse transfer function. Discrete time system analysis.

Unit-IV

Introduction to Optimal Control: Optimal control problems, regulator problem, output regulator, Tracking problem, Principle of Optimality

Unit-V

Introduction to control Problems: Industrial Control Problems, Control Hardware and their models-potentiometers, synchros, LVDT, dc and ac servomotors, Tachogenerators, Electro-pneumatic valves, pneumatic actuators.

Text Books:

1. **Ogatta**, Modern Control Systems.
2. **Norman S. Nise**, Control system engineering.

Reference Books:

1. **Stefani**, Design of Feedback control systems.
2. **Palm**, Modeling, analysis and control of dynamic systems.
3. **Franklin** and **Powel,** Feedback control of dynamic systems.

Note for Paper Setter: The Question Paper shall comprise of 10 questions. Two questions will be set from each unit. The student has to attempt 5 questions at least one from each unit.

Semester VI

Course Title: Power Electronics Lab **Max Marks: 50**
Course Code: ERE-631 **University Exam: 25**
Duration of Exam: 2 hours **Internal Assessment: 25**

List of Experiments:

1. SCR Characteristics.
2. TRIAC Characteristics..
3. MOSFET Characteristics.
4. IGBT Characteristics. Fully
5. RC Triggering Circuit.
6. Voltage Commutated DC Chopper.
7. UJT Triggering of SCR.
8. Series Inverter.

Note: These are only the suggested list of practicals. Instructor may add or change some practical relevant to the course contents.

Semester VI

Course Title: MATLAB **Max Marks: 50**
Course Code: ERE-632 **University Exam: 25**
Duration of Exam: 2 hours **Internal Assessment: 25**

List of Experiments

1. Introduction to MATLAB, MATLAB-windows and various toolboxes
2. Arithmetic calculations in MATLAB
3. Matrix and Array Operations
4. Logical Operations
5. Programming in MATLAB, Script files, Function files
6. Graphics: 2D and 3D plots. Style Options, titles, axe control , zoom.
7. Introduction to simpower systems, toolbox and its use.
8. Simulation ac-dc Converters
9. Simulation of dc-ac Converters
10. Simulation of dc-dc Converters

Note: These are only the suggested list of practicals. Instructor may add or change some practical relevant to the course contents.

Semester VI

Course Title: Renewable Energy lab **Max Marks: 50**
Course Code: ERE-633 **University Exam: 25**
Duration of Exam: 2 hours **Internal Assessment: 25**

List of Experiments:

1. Study of the voltage and current of solar cells.
2. Study of voltage and current of the solar cells in series and parallel calculation.
3. Study of both I-V characteristics and the power curve to find the MMP and efficiency.
4. To calculate the efficiency of solar cell.
5. Study of the application of solar cells of charging Ni-Cd battery so that the loads can be used while the module is unexposed to light.
6. Study of the application of solar cells of providing electrical energy to the domestic appliances such as lamp, fan and radio.
7. Installation of wind turbine set up and measurement5 of wind energy based DC voltage and current.
8. Measurement of voltage and current of wind energy based DC supply with the change in angle of blades.
9. Measurement of V-I (voltage and current) of wind energy based DC supply with change in direction of wind.
10. Measurement of V-I (voltage and current) of wind energy based DC supply with change in speed of wind imposed on the blade.
11. Study of the application of wind energy based DC supply of changing the Ni-Cd battery so that the load can be used even while the module is unexposed to wind.
12. Study of the application of wind energy based DC supply of providing electrical energy to the domestic application such as lamp, fan FM receiver etc.