SYLLABUS

SEVENTH SEMESTER B.E. (E&P/ELECTRICAL/EEE)

GONDWANA UNIVERSITY, GADCHIROLI

(With effect from 2015-16)

COURSE : **SEVENTH SEMESTER B.E. (Electrical/ Electronics & Power/ EEE)**
SIXTH SEMESTER B.E. (Electronics / Electronics & (Tele) Communication)

SUBJECT: **POWER ELECTRONICS**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
04	01	02	07	06

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	25	25	50

UNIT	CONTENTS	HOURS
I	**Basics in Power Electronics Engineering** Development of Power Controllers, Working Principle & Characteristics of different Power Controllers, Thyristor Family, Two Transistor model of SCR, Gate Characteristic, Turn On , Turn Off Mechanisms & other ratings of SCRs , Relaxation Oscillators using UJT, Basic Firing Circuits for SCR, Application of SCR in obtaining Logic Gates, Flip Flop and Circuit Breaker, AC Power control using TRIAC- DIAC, Basic Firing Circuits for SCR. Power Transistor, Power MOSFET & IGBT (Basic properties, characteristics, comparison & applications).	12
II	**Phase Controlled Rectification** Principle of Phase Control, Line Commutation, Single phase half wave, Full wave mid –point, Fully controlled with & without freewheeling diode with different types of Loads, Effect of Source inductance, Half Controlled Bridge configurations, Development of expressions for mean current & voltage for different loads, Dual Converter. Three Phase fully controlled & half controlled bridge circuits , Development of expressions for mean voltage .	10
III	**Inverters** Principle of Inversion, Various Techniques of Forced Commutation & their designs, Single phase & Three phase series Inverter, Single Phase Parallel Inverter, Single phase bridge Inverter (All with commutation Circuits), Design of Filter. Three phase fully controlled bridge inverters in different modes (without commutation Circuit), Design of complete firing circuit for Three phase Power Control Circuits.	12
IV	**Choppers & Cycloconverter** Principle of Working ,Types of Choppers, Oscillating Chopper, Jones & Morgan's Chopper, Multi Phase Chopper, Step Up Chopper, AC Chopper, Need & Principle of Working of Cycloconverter using single	08

	phase bridge circuits.	
V	**Multiple Connection & Protection** Need & methods of multiple connections of SCRs, Design of Equalizing Circuits, Firing Circuits during multiple connection, Gate protection, Over current & over voltage protections of SCR, Design of Snubber Circuit, Converter Faults.	08
		50

(*Minimum 8 practical should be performed based on above syllabus)

Text Books

(1) M.H. Rashid, "Power Electronics Circuits, Devives & Applications", Pearson Education

(2) C.W. Lander, "Power Electronics", McGraw Hill

(3) M. Ramamoorthy, " Thyristors & their Applications"

(4) GK Dubey, Doradla, Singh, Joshi " Thyristorstorized Power Controllers", New Age International

(5) Singh, Khanchandani, " Power Electronics", Tata McGraw Hill

(6) SCR Manaual by General Electric

Reference Books

(1) Philip T. Krein, "Elements of Power Electronics", Oxford University Press

(2) Vedam Subrahmanyam, "Power Electronics", New Age International

(3) MS Jamil Asghar, "Power Electronics", Prentice Hall of India

(4) PC Sen, 'Modern Power Electronics", S. Chand Publishers

(5) PS Bhimra, "Power Electronics", Khanna Publishers

GONDWANA UNIVERSITY, GADCHIROLI

COURSE : **SEVENTH SEMESTER B.E. (Electrical/ Electronics & Power/ EEE)**

SUBJECT: **POWER SYSTEM PROTECTION & SWITCHGEAR**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
04	00	02	06	04+01=05

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	25	25	50

UNIT	CONTENTS	HOURS
I	**Fundamentals of Arc Interruption & Circuit Breaker** Fundamentals of Arc Interruption: Current interruption in AC circuit breaker, high & low resistance principles, arc interruption theories, arc voltage, recovery voltage, restriking voltage and RRRV, current chopping, interruption of capacitive and inductive current, Circuit breakers: C.B. ratings, Different media of arc interruption, Overview of circuit breakers, construction and operation of air blast, SF6 and vacuum breakers.	12
II	**Fundamentals of Protective Relaying and Over current Protection** Fundamentals of Protective Relaying: Need for protective system, nature & causes of fault, types of faults, effects of faults, evolution of protective relaying, zones of protection, primary & backup protection, essential qualities of protective relaying. Trip circuit of circuit breaker, zones of protection. Attracted armature and Induction disc type electromagnetic relays. Operating principles of over current and directional over current relays, Various types of over current relays as per their time-current characteristics, Current and time settings, Over current protective schemes for transmission line and feeder protection..	10
III	**High voltage line protection** Introduction to distance protection, impedance relay, reactance relay and mho relay, Methods of relay settings Connections of impedance, reactance and mho relays, Effect of arc resistance, Line length and source impedance and power swing on performance of distance relays. Realization of distance relays using static relays. Carrier current protection.	08

IV	**Equipment protection** Transformer Protection: Types of faults in transformer. Percentage differential protection in transformers, Inrush phenomenon, percentage differential relay with harmonic restraint. Restricted E/F protection. Incipient faults, buchholz relay. Phenomenon of over fluxing in transformer, protection against over fluxing. Generator Protection: Various faults, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover. Digital protection scheme based on injection of sub-synchronous component in rotor circuit. C) Bus bar Protection: Differential protection of bus bars.. High impedance differential relay. Protection of induction motor: Abnormal operating conditions and causes of failures in induction motor, Protection against overloads, unbalance and single phasing, stator fault protection .	12
V	**Introduction to static and Microprocessor based Digital relay** Introduction to static relay: Comparison of static and electromechanical relays, two input amplitude and phase comparator and their duality. Generation of various distance and over current relay characteristics using comparators. Microprocessor based Digital Relaying: Introduction, Digital logic communication, Direct relay to relay digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.	08
		50

(*Minimum 8 practical should be performed based on above syllabus)

Text Books

1. S. Rao, “Switchgear Protection and Power Systems”, Khanna Publications

2. Y. G. Paithankar, S. R. Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India

3. Badri Ram, D. N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill

4. Ravindra P.Singh, “Switchgear and Power System Protection” Prentice Hall of India

Reference Books

1.C.R.Mason, “Art and science of protective relaying”WileyEastern Ltd.

2. C.L.Wadhwa, Electrical Power Systems, New Age international (P) Limited, Publishers

3. B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, A Text book on Power System Engineering, Dhanpat Rai & Co

GONDWANA UNIVERSITY, GADCHIROLI

COURSE : **SEVENTH SEMESTER B.E. (Electrical/ Electronics & Power/ EEE)**

SUBJECT: **ELECTRICAL ENERGY UTILIZATION**

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
04	00	00	04	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

UNIT	CONTENTS	HOURS
I	**ELECTRIC DRIVES** Advantages of electric drives. Characteristics of different mechanical loads. Types of motors used in electric drive. Electric braking, Plugging, Rheostatic & Regenerative braking. Methods of power transfer by direct coupling using devices like belt drive, gears, pulley drives etc. Selection of motors for different types of loads: domestic, general workshop, textile mill, paper mill, steel mill, printing press, crane, lift etc. Specifications of commonly used different motors e.g. squirrel cage, slip ring induction motors, AC series motors.	10
II	**ELECTRIC HEATING** Need of electrical heating. Heating methods: Resistance heating – direct and indirect resistance heating, electric ovens and their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit. Induction heating; principle of core type and coreless induction furnace. Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace. Other heating methods: Dielectric heating, Infra-red heating, Microwave heating and their applications.	10
III	**ELECTRIC WELDING** Need of electric welding. Welding method. Principles of resistance welding, types: spot, projection, seam and butt welding and welding equipment use. Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, Welding control circuits, Welding of aluminum and copper. Introduction of TIG, MIG Welding.	10

IV	**ILLUMINATION FUNDAMENTALS & METHODS** Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light. Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous Efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Laws of illumination –simple numerical. Different type of lamps, construction and working of incandescent and discharge. lamps – their characteristics, fittings required for filament lamp, mercury vapour. Lamp, fluorescent lamp, metal halide lamp, neon lamp. Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor. Illumination levels. Main requirements of proper lighting; absence of glare, contrast and shadow. General ideas about street lighting, flood lighting, monument lighting and decorative lighting, light characteristics.	10
V	**ELECTRIC TRACTION** Advantages of electric traction. Different electric traction systems: DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves. Accessories for track electrification; overhead capacitor wire, conductor rail system, current collector-pantograph. Special features of traction motor. Train movement mechanics. Crest, average and schedule speed, Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run. Effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion. Introduction to EMU and metro railways. Train movement mechanism. Digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.	**10**
	TOTAL	**50**

TEXT BOOKS:

1. A First Course in Electrical Drives by S.K.Pillai, New Age International.
2. Art & Science of Utilization of electrical Energy – by H. Partab, Dhanpat Rai & Sons.
3. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana.
4. A.Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi

REFERENCE BOOKS:

1. Utilization of Electric Energy in SI Units by E.O.Taylor , Orient Longman Ltd.
2. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

GONDWANA UNIVERSITY, GADCHIROLI

COURSE : SEVENTH SEMESTER B.E. (Electrical/ Electronics & Power/ EEE)

SUBJECT : CONTROL SYSTEM-II

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	01	--	04	04

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

UNIT	CONTENTS	HOURS
I	**Compensation Technique** Approaches and Preliminary consideration. Need for compensation. Common compensating network. Transfer function of Lag, Lead and Simple Lag-Lead network. Analysis of compensator in time and frequency domain Bode Plot. Physical realization of compensators using Active and Passive elements.	08
II	**State Space Analysis** Review of state space analysis. Concept of diagonalization. Eigen values, Eigen vector, Diagonalization of system matrix with distinct and repeated Eigen values. Vander Monde matrix. Solution of homogenous and non-homogenous state equation. State transition matrix, Its properties, Various method to determine State transition matrix.	08
III	**Design of Control System Using State Space Technique** Definition of controllability & observability, controllability & observability matrices, condition for controllability & observability from the system matrices in canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability & observability of the system, duality property. Pole placement design by state feedback. State observer, design of full order observer	09
IV	**Non linear System Analysis** Introduction , Types of non-linearities, Characteristics of non linear control systems, Inherent & intentional non linearities, Introduction to describing function, Describing function of some common non-linearities. Stability anlaysis, Limit cycle & stability of limit cycles. **Stability of Non Linear System** Introduction to phase plane method, Singular point. Stability from nature of singular point, Construction of trajectory by Isoline & Delta method. Computation of time.	16
V	**Sampled Data Control Systems** Representation of SDCS. Sample & Hold circuit, Z-Transform. Inverse Z-Transform & solution of difference equation. 'Z' &'S' domain relationship. Stability by Bi-linear transformation & Jury's test. Discrimination of continuous time state equation. Solution of Discrete time equation ,Controllability & Observability of Discrete time system.	09
	TOTAL	**50**

Text Books -

1. I.J. Nagrath ,M.Gopal “Contorl System Engineering”, 5th Edition, New Age International Publishers.

Reference Books -

1. Benjamin C. Kuo, “Automatic Control Engineering”, Prentice Hall of India Pvt. Ltd.
2. K. Ogata’ “ Modern Control Engineering”, Prentice Hall of India Pvt. Ltd.
3. M. Gopal’ “Digital Control Engineering”, Wiley Eastern, 1988
4. M. N. Bandyopadhyan, “ Control Engineering – Theory and Practice”, Prentice Hall of India Ltd. Delhi

GONDWANA UNIVERSITY, GADCHIROLI

ELECTIVE-I

COURSE : SEVENTH SEMESTER B.E. (ELECTRICAL/ E&P/EEE)

SUBJECT : EHV AC-DC TRANSMISSION

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	--	00	03	03

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

UNIT	CONTENTS	HOURS
I	Need of EHV transmission lines, Power handling capacities. Voltages gradients: Electric field of point charge, sphere gap line-charge. Single and three phase lines, and bundled conductors. Maxwell's potential coefficients, Mangoldt Formula.	10
II	Electrostatic and electromagnetic fields of EHV lines, electric shock and Threshold current Effect of high electrostatic field, measurement of electrostatic field, Induced voltages in insulated ground wires, electromagnetic interference. Corona: Types, critical disruptive voltages: Factors affecting corona, Methods for reducing corona power loss, corona current wave form, charge voltage diagram, audible noise and radio interference.	10
III	Comparison for EHVAC and HVDC systems. Conversion from AC to DC, Rectifiers, conversion from DC to AC, Inverters. Kind of DC link. Earth electrode and earth returns:- Introduction, objectives, location and configuration, Resistance of electrodes means of reducing earth electrode resistance, troubles caused by earth current and remedies. Multi-terminal HVDC system: Introduction, 2 pole transmission, MTDC system with series and parallels connected converters, advantages and parallel connected converters, advantages and applications, configurations and types.	10
IV	Power flow control in HVDC system:- Constant current. Constant voltage, constant ignition and excitation angle control, control characteristics. Parallel operation of AC and DC links (Synchronous and Asynchronous links.) Reactive power requirement of HVDC Converter	10

V	HVDC circuit breakers: Introduction, construction, principle, switching energy, interruption of DC current, application of MRTB, Type of HVDC C.B, capability and characteristics of HVDC circuit breakers. HVDC Substation protection against short-circuits: Introduction, fault clearing, protective zones, protection symbol, HVDC line pole protections (fault clearing and re- energizing). HVDC Sub-station Protection against over-voltages. Difference between insulation co- ordination of AC and DC systems.	10
	TOTAL	**50**

Books Recommended:

1. Rakesh Das Begmudre, Extra High Voltage AC Transmission Engineering, Wiley Eastern Limited.
2. S. Rao , EHVAC and DC transmission , Khanna Publications
3. K.R. Padiyar , HVDC Transmission System Wiley eastern Limited.
4. P. Kundur, HVDC Transmission , Mcgraw-hill publications
5. 5 C.L. Wadhwa , Electrical Power Systems New age International Pvt Limited.

GONDWANA UNIVERSITY, GADCHIROLI

ELECTIVE-I

COURSE : SEVENTH SEMESTER B.E. (ELECTRICAL/ E&P/EEE)

SUBJECT: ARTIFICIAL INTELLIGENCE

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	--	00	03	03

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

Unit	Contents	Hours
I	**Introduction to AI** Definition of AI, importance of AI, AI and related fields, task domains of AI, physical symbol system and it's hypothesis, AI technique, Turing test, Knowledge and knowledge based systems.	10
II	**Problems, problem spaces and search** Defining a problem on a state space search, production systems and control strategies, deapth-first and breadth-first search, backtracking, problem characteristics, issues in the design of search problems, Heuristic search techniques: generate and test, hill climbing, best-first search, problem reduction, constraint satisfaction, means-ends analysis.	10
III	**Knowledge Representation** **I**ssues, representation and mapping approaches, introduction to proposition logic, knowledge representation using predicate logic, unification and resolution, Representing knowledge using rules, procedural Vs declarative knowledge, logic programming, forward Vs backward reasoning, matching control knowledge.	10
IV	Knowledge representation using semantic nets, frames, conceptual dependency and scripts, statistical reasoning,: Probability and Bayes' theorem, certainty factors and rule-based systems.	10
V	**Learning** General Learning Model, types of learning, rote learning, learning by taking advice, learning by analogy, induction learning, learning by observation and discovery. Introduction to Expert Systems.	10
	TOTAL	50

Text Books:

1. Artificial Intelligence by E. Rich & K. Knight (Tata McGraw Hill)
2. Introduction to Artificial Intelligence & Expert Systems by D.W.Patterson (PHP)
3. Principles of Artificial Intelligence by N.J. Nilsson (Narosa)

GONDWANA UNIVERSITY, GADCHIROLI

ELECTIVE-I

COURSE : SEVENTH SEMESTER B.E. (Electrical/E&P/EEE)

SUBJECT : MODELING OF ELECTRICAL SYSTEMS

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	--	00	03	03

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

UNIT	CONTENTS	HOURS
I	**Modeling of synchronous machines I** Basic models, electrical equations, mechanical equations, per unit system and normalization, parks transformation, flux linkages equations voltage and current equations.	10
II	**Modeling of synchronous machines II** Formulation of state-space equations, equivalent circuit sub transient and transient inductances and time constants, simplified model of synchronous machines, steady state equations and phasor diagram, determination of machines parameters from manufactures data.	10
III	**Excitation system modeling** Modeling of excitation system components, modeling of complete excitation system.	10
IV	**Modeling of induction motors I** Circuit model of a three phase induction motor, linear transformation, phase transformation, transformation to a reference frame, and two axis models for induction motor. **Modeling of induction motors II** Voltage and current Equations in stator reference frame, equation in rotor reference frame, equations in a synchronously rotating frame, torque equation.	10

V	**Line and load modeling** Transformer model, transformer with nominal turns ratio, three winding transformers model, phase shifting transformers, load modeling, constant current model, constant impedance model, constant power model, composite load, dynamic characteristics, static load modeling for load flow studies, voltage dependence of equivalent loads, derivation for equivalent load powers.	10
	TOTAL	**50**

Text Books -

1) P. S. Bimbhra, “Generalized theory of electrical machines”, Khanna Publishers

2) PSR Murty, “Modeling of power system components”, BS Publications

Reference Books -

1) P. M. Anderson and A. A. Fouad, “Power System control and stability”, Wiley-India Edition

2) Paul C. Krause, Oleg Wasynezuk, Scott D. Sudhoff, “Analysis of Electric Machinery”, IEEE Press, 1995

3) Prabha Kundur, Neal J. Balu, Mark G. Lauby, “Power System Stability and Control”, Tata McGraw Hill Publishing Co. Ltd.

4) Vedam Subramanyam, “Thyristor control of Electric Drives”

GONDWANA UNIVERSITY, GADCHIROLI

ELECTIVE-I

COURSE : SEVENTH SEMESTER B.E. (Electrical/E&P/EEE)

SUBJECT: PROGRAMMABLE LOGIC AND SEQUENTIAL SYSTEMS

Lectures	Tutorial(s)	Practical	Total periods/week (each of 60 minutes duration)	Credits
03	--	00	03	03

Evaluation System						
Theory				Practical		
MSE	IE	ESE	TOTAL	TW	POE	TOTAL
10	10	80	100	--	--	--

UNIT	CONTENTS	HOURS
I	**Programmable logic** Read only memories, Programmable logic arrays, programmable array logic, Complex programmable logic devices and Field programmable gate arrays.	10
II	**Programmable Controllers** Register transfers, other operations, Register responsive to multiple commands, A simple controller, Implementation of controller, Shift register controller, conditional response of controller, Sequence for subtraction.	10
III	**Synchronous Sequential logic I** Sequential circuits, storage elements, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure, Registers and Counters.	10
IV	**Synchronous Sequential Logic** II Finite State Machines, Basic Design steps, State diagram, State assignment, Choice of flip-flops, Design and Implementation of Moore circuits ,Design and implementation of Mealy circuits.	10
V	**Asynchronous sequential Logic** Asynchronous behavior, Analysis of Asynchronous circuits, Races, Critical races, State reduction, state assignment, design procedure, , Flow table, Reduction of state and flow table, Implication table ,race free assignment, implementation of circuits, types of hazards, Static Hazards, dynamic hazards.	10
	TOTAL	**50**

Text Books -

1) Digital Design M.Morris Mano PHI

2) Digital Circuits and Microprocessors Herbert Taub TMC

Reference Books -

Fundamentals of digital circuits A . Anand Kumar PHI

Introduction to Digital Design Swati Saxena Amit Saxena Dhanpatrai & company