

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT-3	Sheet No. 1/5
Branch	Electrical and Electronics Engineering		Semester	V	
Course Code	501	Course Name	Power System Operation and Protection		
Course Outcome - 1	Express restructuring and representation of power system.		Teach Hrs	Marks	
Learning Outcome E0150111	Describe various elements, interconnection and restructuring of power system. [Cognitive Domain]		07	10	
Contents	<ul style="list-style-type: none"> • Various elements of power system: electrical equivalent circuit diagram, phasor diagram of alternator, transformer and transmission lines. • Interconnection of power system: necessity, advantages and types. • Restructuring of power system: concept, necessity, advantages and disadvantages. 				
Method of Assessment	Internal: Mid semester-I theory examination (Pen paper test)				
Learning Outcome E0150112	Identify different methods of representing a power system. [Cognitive Domain]		07	10	
Contents	<ul style="list-style-type: none"> • Single line diagram: construction and advantages. • Per unit system: definition and advantages. • Per unit impedances (Z_{pu}): computation in 1ϕ and 3ϕ system, computation for changed base value. • Per unit impedance diagram: construction for a given power system. • Representation of a power system as two-port power network: generalized ABCD parameters, proof of AD-BC=1 • Numerical Problems 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150113	Evaluate parameters of a two port power network. [Psychomotor Domain]		07	10	
Contents	<ul style="list-style-type: none"> • Determine ABCD parameters of given 'π' and 'T' network. • Verify reciprocity of a power network by proving AD-BC=1 				
Method of Assessment	External: End semester practical exam (performance of task & viva voce)				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT-3	Sheet No. 2/5
Branch	Electrical and Electronics Engineering		Semester	V	
Course Code	501	Course Name	Power System Operation and Protection		
Course Outcome - 2	Expound power system operation and fault analysis.			Teach Hrs	Marks
Learning Outcome E0150121	Explain in brief the concept of PLCC, load flow study and symmetrical fault analysis. [Cognitive Domain]			07	10
Contents	<ul style="list-style-type: none"> • PLCC: functioning with the help of block diagram • Load flow study: types of buses in a power system, formation of admittance matrix (Y-bus matrix) for a given 3-bus test system. • Fault study: definition of fault, types of fault: series and shunt faults, abnormalities in power system, causes and effects of fault. • Symmetrical fault analysis: transients in transmission lines, 3ϕ short circuit on an unloaded synchronous generator. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150122	Illustrate symmetrical components to identify sequence networks and unsymmetrical faults. [Cognitive Domain]			9	12
Contents	<ul style="list-style-type: none"> • Fortescue's theorem, 'a' operator, symmetrical components. Numerical problems • Sequence networks: sequence impedances, sequence networks for alternator, transformer, and transmission line. Construction of sequence networks for a given PS (i.e. single line diagram). • Analysis of L-G, L-L and L-L-G unsymmetrical faults by using symmetrical components. Numerical problems. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150123	Model unsymmetrical faults for transmission lines. [Psychomotor Domain]			07	10
Contents	<ul style="list-style-type: none"> • To determine fault current and draw sequence networks for L-G fault. • To determine fault current and draw sequence networks for L-L fault. • To determine fault current and draw sequence networks for L-L-G fault. 				
Method of Assessment	External: End semester practical exam (performance of task & viva voce)				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT- 3	Sheet No. 3/5
Branch	Electrical and Electronics Engineering		Semester	V	
Course Code	501	Course Name	Power System Operation and Protection		
Course Outcome - 3	Discuss protection system and protective relays.			Teach Hrs	Marks
Learning Outcome E0150131	Explain necessity, types and various components of protection system [Cognitive Domain]			07	10
Contents	<ul style="list-style-type: none"> • Circuit diagram and components of a basic protection system. • Need of a protection system. • Role of CTs and PTs in protection. • Primary and Back-up protection. • Desirable qualities of protective relaying. 				
Method of Assessment	Internal: Mid semester-II theory examination (Pen paper test)				
Learning Outcome E0150132	Classify and describe protective relays [Cognitive Domain]			07	10
Contents	<ul style="list-style-type: none"> • Technical terms regarding relays: pick-up value, re-set value, operating time. • Classification of relays. • Principle and working of relays: Electromagnetic (induction and attracted armature type) relays, static (thermal) relays and Directional relay • Time-current characteristics of various relays: IDMT characteristic, plug setting multiplier (PSM), time multiplier setting (TMS). Numerical problems. • Distance relays: impedance relay, reactance relay and mho relay. • Differential relays: current differential relay, biased differential protection 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150133	Analyse time-current characteristic of IDMT relays. [Psychomotor and Affective Domain]			07	10
Contents	<ul style="list-style-type: none"> • To plot time-current characteristic of an IDMT relay. • To demonstrate the effect of PSM and TMS on current setting and operating time. 				
Method of Assessment	Internal: Performance of task, and viva voce				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT-3	Sheet No. 4/5
Branch	Electrical and Electronics Engineering		Semester	V	
Course Code	501	Course Name	Power System Operation and Protection		
Course Outcome 4	Comprehend circuit interrupting devices.			Teach Hrs	Marks
Learning Outcome E0150141	Explain fuses and their characteristics. [Cognitive Domain]			05	8
Contents	<ul style="list-style-type: none"> • Basic technical terms regarding fuses: fuse element, minimum fusing current, fuse rating, fusing factor, operating time (arcing and pre-arcing time), prospective current, cut off current. • Types of fuses: Kit-kat and high rupturing capacity (HRC) fuses. • Construction, working, cut-off characteristic and applications of HRC fuses. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150142	Elucidate circuit breakers. [Cognitive Domain]			07	10
Contents	<ul style="list-style-type: none"> • Arc formation and principle of arc extinction. • Arc extinction methods. • Technical terms regarding circuit breakers: arc voltage, re-striking voltage, recovery voltage, making and breaking current, RRRV and circuit breaker rating. • Types of circuit breakers: minimum oil CB (MOCB), bulk oil CB (BOCB), air blast CB (ABCB), SF₆ CB and vacuum CB. • Construction, working principle, merits, demerits and applications of above said circuit breakers. • Isolators: working and application. • Comparison among fuse, circuit breaker and isolator. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150143	Evaluate performance of fuse and MCB. [Psychomotor Domain]			07	10
Contents	<ul style="list-style-type: none"> • To determine fusing factor of a given fuse. • To plot time-current characteristic of a given fuse wire. • To plot time-current characteristic of a given MCB. 				
Method of Assessment	External: End semester practical exam (performance of task & viva voce)				

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Branch	Electrical and Electronics Engineering		Semester	V	
Course Code	501	Course Name	Power System Operation and Protection		
Course Outcome - 5	Discuss over voltage protection and select suitable protective schemes.			Teach Hrs	Marks
Learning Outcome E0150151	Explain over voltage protection. [Cognitive Domain]			7	10
Contents	<ul style="list-style-type: none"> • Causes and effects of over voltage. • Travelling wave phenomenon. • Necessity of insulation co-ordination. • Lightning and switching surges: impulse wave shape. • Lightning arresters (LA): operating principle and location. • Surge absorbers • Ground wire: constructional diagram, advantages and disadvantages. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0150152	Identify various protection schemes for protecting different components of a power system. [Cognitive Domain]			07	10
Contents	<ul style="list-style-type: none"> • Abnormalities in alternator, transformer and transmission lines. • Protection schemes: <ul style="list-style-type: none"> (i) Alternators: merz price protection, overcurrent and earth fault protection. (ii) Transformers: buchholz relay and differential protection. 				
Method of Assessment	Internal: Quiz and Assignment				
Learning Outcome E0150153	Identify various protective devices. [Psychomotor and Affective Domain]			07	10
Contents	<ul style="list-style-type: none"> • To visit a power sub-station for identification of protective devices, over-voltage protection and earthing system. • To demonstrate the working of Bucholz relay. 				
Method of Assessment	Internal: Report submission and viva voce				

REFERENCE BOOKS:

S.N.	Book Title& Publication	Author	ISBN number
1	Electrical Power System, New Age International Publishers,	C. L. Wadhwa	978-81-224-2468-3
2	Power System Engineering, Mc Graw Hill publication	D. P. Kothari and I. J. Nagrath	978-93-531-6512-3
3	Power System Analysis, Mc Graw Hill publication, Indian Edition	J. John Grainger and Willium D. Stevenson	978-00-705-8515-7
4	Electrical Power Systems. CBS Publishers & Distributors	Ashfaq Hussain	9788123914480
5	Power System Analysis, CBS Publishers and Distributers	Nagoor Kani	978-9389261714
6	Principles of Power System, S. Chand and Company Ltd.	V. K. Mehta and Rohit Mehta	9788121924962
7	Power system Analysis, McGraw-Hill Inc.,US; Subsequent edition.	Hadi saadat	978-0075616344
8	Power System Analysis. Chand and Company Ltd.	Dr. B.R. Gupta	978-81-219-22388
9	Restructured Electrical Power Systems Operation, Trading and Volatility. New York : Marcel Dekker, c2001	Mohammad Shahidehpour Muwaffaq Alomoush	9780824706203