

B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE)			
CHOICE BASED CREDIT SYSTEM (CBCS)			
SEMESTER - III			
TRANSFORMERS AND GENERATORS (Core Course)			
Subject Code	15EE33	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
Credits - 04			
Course objectives:			
<ul style="list-style-type: none"> • To understand the concepts of transformers and their analysis. • To suggest a suitable three phase transformer connection for a particular operation. • To understand the concepts of generator and to evaluate their performance. • To explain the requirement for the parallel operation of transformers and synchronous generators. ■ 			
Module-1			Teaching Hours
<p>Single phase Transformers: Review of Principle of operation, constructional details of shell type and core type single-phase transformers, EMF equation, losses and commercial efficiency, conditions for maximum efficiency (No question shall be set from the review portion). Salient features of ideal transformer, operation of practical transformer under no - load and on - load with phasor diagrams. Equivalent circuit, Open circuit and Short circuit tests, calculation of equivalent circuit parameters and predetermination of efficiency- commercial and all-day. Voltage regulation and its significance.</p> <p>Three-phase Transformers: Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers. Transformer connection for three phase operation – star/star, delta/delta, star/delta, zigzag/star and V/V, choice of connection. Phase conversion - Scott connection for three-phase to two-phase conversion. Labelling of three-phase transformer terminals, vector groups. Equivalent circuit of three phase transformers. ■</p>			10
Revised Bloom's Taxonomy Level	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.		
Module-2			
<p>Parallel Operation of Transformers: Necessity of Parallel operation, conditions for parallel operation – Single phase and three phase. Load sharing in case of similar and dissimilar transformers.</p> <p>Autotransformers and Tap changing transformers: Introduction to auto transformer - copper economy, equivalent circuit, three phase auto connection and voltage regulation. Voltage regulation by tap changing – off circuit and on load.</p> <p>Tertiary winding Transformers: Necessity of tertiary winding, equivalent circuit and voltage regulation, tertiary winding in star/star transformers, rating of tertiary winding. ■</p>			10
Revised Bloom's Taxonomy Level	L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.		
Module-3			
<p>Transformers (continuation): Cause and effects of harmonics, Current inrush in transformers, noise in transformers. Objects of testing transformers, polarity test, Sumpner's test.</p> <p>Direct current Generator – Review of construction, types, armature windings, relation between no load and terminal voltage (No question shall be set from the review portion). Armature reaction, Commutation and associated problems, no load and full load characteristics. Reasons for reduced dependency on dc generators.</p> <p>Synchronous generators- Review of construction and operation of salient & non-salient pole synchronous generators (No question shall be set from the review portion). Armature windings, winding factors, emf equation. Harmonics – causes, reduction and elimination. Armature reaction, Synchronous reactance, Equivalent circuit. ■</p>			10
Revised Bloom's Taxonomy Level	L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing, L ₅ – Evaluating.		
Module-4			
<p>Synchronous generators (continuation): Generator load characteristic. Voltage regulation, excitation control for constant terminal voltage. Generator input and output. Parallel operation of</p>			10

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15EE33 TRANSFORMERS AND GENERATORS (Core Course) (continued)				
Module-4(continued)				Teaching Hours
<p>Synchronous generators(continuation): generators and load sharing. Synchronous generator on infinite bus-bars – General load diagram, Electrical load diagram, mechanical load diagram, O – curves and V – curves. Power angle characteristic and synchronizing power.</p> <p>Synchronous generators(continuation): Effects of saliency, two-reaction theory, Direct and Quadrature reactance, power angle diagram, reluctance power, slip test. ■</p>				10
Revised Bloom's Taxonomy Level	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.			
Module-5				
<p>Synchronous generators(continuation): Open circuit and short circuit characteristics, Assessment of reactance- short circuit ratio, synchronous reactance, adjusted synchronous reactance and Potier reactance. Voltage regulation by EMF, MMF, ZPF and ASA methods.</p> <p>Performance of synchronous generators: Capability curve for large turbo generators and salient pole generators. Starting, synchronizing and control. Hunting and dampers. ■</p>				10
Revised Bloom's Taxonomy Level	L ₁ – Remembering, L ₂ – Understanding, L ₃ – Applying, L ₄ – Analysing.			
Course outcomes:				
<p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> • Explain the construction and operation and performance of transformers. • Explain different connections for the three phase operations, their advantages and applications. • Explain the construction and operation of Synchronous machines and evaluate the regulation of synchronous machines by different methods. • Analyze the operation of the synchronous machine connected to infinite machine. 				
Graduate Attributes (As per NBA)				
Engineering Knowledge, Problem analysis.				
Question paper pattern:				
<ul style="list-style-type: none"> • The question paper will have ten questions. • Each full question is for 16 marks. • There will be 2full questions (with a maximum of four sub questions in one full question) from each module. • Each full question with sub questions will cover the contents under a module. • Students will have to answer 5 full questions, selecting one full question from each module. ■ 				
Text/Reference Books				
1	Electric Machines	D. P. Kothari, et al	McGraw Hill	4 th Edition, 2011
2	Performance and Design of A.C. Machines	M. G. Say	CBS Publishers	3 rd Edition, 2002
3	Principles of Electric Machines and power Electronics	P.C.Sen	Wiley	2 nd Edition, 2013
4	Electric Machines	MulukuntlaS.Sarma,at el	Cengage	1 st Edition, 2009
5	Electrical Machines, Drives and Power systems	Theodore Wildi	Pearson	6 th Edition, 2014
6	Electrical Machines	M.V. Deshpande	PHI Learning	1 st Edition, 2013
7	Electrical Machines	AbhijitChakrabarti et al	McGraw Hill	1 st Edition, 2015
8	A Textbook of Electrical Machines	K.R.SiddapuraD.B.Raval	Vikas	1 st Edition, 2014