SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B.Tech. Semester VI

Subject Name: INTERCONNECTED POWER SYSTEM **Subject Code: BTEL13602**

Type of course: Professional Core Course

Prerequisite: Power System - 1 & Power System - 2

Rationale: This subject is offered to study of behavior of power systems during normal operating conditions and/or when subjected to disturbances by mathematical modeling of components of power systems. It also briefs the students about the modeling of power systems networks for steady state analysis. They will also learn the economic operation and planning of power system network and also use the knowledge for the selection of components like Circuit Breaker for Power system protection.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	5	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Cascade Tripping, Islanding, Load dispatch centre, Generation Scenario in Gujarat and India	03	05
2.	**Power system matrices:** Brief explanation of Graph theory, Primitive Network, Ybus formation methods, Singular transformation method, Direct inspection method, Algorithm for formation of Zbus, Addition branch and link, Removal of elements, Numerical [6,7,8]	08	15
3.	**Load flow studies:** Introduction, Static Load Flow Equations, Bus Classifications, Approximate method, Gauss-Seidel Method, Newton Raphson Method, Fast Decoupled Load Flow Method, Comparison of different methods, Numerical [1,3]	10	25

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4.	**Economic operation of power systems:** Generator operating cost, Economic operation of generators within thermal plant, Optimal operation by co-ordination equation, Penalty factor, Derivation of transmission loss formula (Kron's method), Unit commitment problem solution by dynamic programming, Numerical [1,2]	**06**	**15**
5.	**Frequency and voltage control methods:** Speed governing mechanism, Mathematical modeling, Adjustment of Governor characteristics, Single area control, Flat frequency control, Selective frequency control, Tie line load bias control, Methods of voltage control, Numerical.[1,3]	**06**	**10**
6.	**Power system stability** Introduction, Classification of stability studies, concept of load angle and infinite bus, Dynamics of a Synchronous Machine, Swing equation, Power angle curve, Node Elimination Technique, Steady state stability analysis, Methods of improving Steady state stability , Transient stability analysis, Equal area criteria, Single Machine infinite bus stability studies, Numerical Solution of Swing Equation, Methods of improving Transient stability, Numerical [1,2]	**12**	**30**

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**30**	**15**	**20**	**15**	**5**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students andteachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
1	Modern Power System Analysis	D. P. Kothari, I. J. Nagrath	TMH Publication ISBN (13): 978-0-07-107775-0	2011	Fourth
2	Power Systems Analysis	John J. Grainger W. D. Stevenson	Jr., Tata McGrawHill International ISBN (13): 978-0-07-058515-7	2011	First
3	Power System Analysis	Hadi Saadat	McGraw Hill Education India Pvt Ltd. ISBN: 0-07-116758-7	1999	First
4	Power System Analysis and Stability	S.S. Vadhera	Khanna Publication ISBN: 81-7409-059-2	2000	Fourth
5	Electrical Power systems	D.Das	New Age International ISBN: 81-224-1885-6	2008	First
6	Advanced Power System Analysis and Dynamics	L. P. Singh	New Age International ISBN: 81-224-2049-4	2007	Fifth
7	Computer Methods in Power System Analysis	Glenn Stagg El-abiad	McGraw-Hill ISBN: 0070606587	1968	First
8	Computer Aided Power System Analysis	G.L. Kusic	CRC Press ISBN: 978-1-4200-6106-2	2005	Second
9	Power System Analysis and Design	B.R. Gupta	S.Chand ISBN: 81-219-2238-0	2007 Reprint	First
10	Electric Power System	C.L.Wadhwa	New Age International Ltd. ISBN: 978-1-906574-39-0	2012	First

LIST OF PRACTICALS:

1. Formation of Primitive & incidence matrix for given power system network
2. Formation of Ybus matrix for given power system network using singular transformation method
3. Formation of Ybus matrix for given power system network using direct inspection method
4. Formation of Zbus matrix for given power system network using step by step bus algorithm method
5. To write a programme for solution of a single nonlinear equation and a set of non linear algebraic equation using Gauss-Seidel method
6. To write a programme for solution of a single nonlinear equation and a set of non linear algebraic equation using Newton Raphson method

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7. Solution of static load flow equation using approximate method of Load Flow
8. Solution of static load flow equation using Gauss-Seidel Method of Load Flow
9. Solution of static load flow equation using Newton Raphson Method of Load Flow
10. Solution of static load flow equation using Fast Decoupled Load Flow Method of Load Flow
11. Find most economical generation on generator of a given power system
12. Find (Beta) coefficient for the given power system
13. Simulation of Transient Stability for Sudden Three-Phase fault occurs at Generator terminal in a SMIB System
14. To write a computer program for Transient Stability for sudden short circuit at middle of one of parallel transmission lines in a SMIB system using step by step method.
15. Simulation of Load – Frequency Dynamics of Single Area Power Systems
16. Simulation of Load – Frequency Dynamics of Two Area Power Systems

Major Equipment:

1. Computer LAB equipped with MATLAB/ PSCAD /MiPower / PowerWorld Simulator software

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Describe the complete overview of interconnected power system operation.	05
CO-2	Develop appropriate mathematical models for an interconnected power system.	15
CO-3	Evaluate power flow analysis using numerical techniques.	25
CO-4	Analyze the power system economics and factors affecting the economic load dispatch with and without considering network loss.	15
CO-5	Demonstrate the methods used for voltage and frequency regulation in electrical power network by mathematical analysis.	10
CO-6	Demonstrate the factors which determine power system stability. Analyze the same for a single machine infinite bus system using both analytical and graphical (Equal area) methods.	30

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Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	-	-	-	-	1	3	2	3	1	3	-	3	1	1	3
CO-2	3	2	1	3	2	-	-	-	3	-	1	3	3	2	1
CO-3	3	3	3	3	3	2	1	2	3	2	2	3	3	3	3
CO-4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO-5	3	3	2	3	3	2	3	2	2	1	2	3	3	3	2
CO-6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Rationale*	15	14	12	15	15	13	12	13	15	12	10	18	16	15	15

List of Open Source/learning website:

1. https://onlinecourses.nptel.ac.in/noc19_ee62/preview
2. https://nptel.ac.in/courses/108/104/108104051/
3. https://nptel.ac.in/courses/108/105/108105067/

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