



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE0300041

Subject Name : Network Analysis

WEF Academic Year:	2024 - 2025
Semester:	3
Category of the Course:	Professional Core Course

Prerequisite :	Fundamental knowledge of electric circuit sources and elements, basic mathematics (integration, differentiation, etc.)
Rationale :	Students of IC Engineering need to possess good understanding of concepts and principles of passive circuit analysis and synthesis by applying various circuit laws and theorems. This is one of the foundation courses which are required to understand the concepts of advanced courses and develop skills that are needed in Electronics field.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Apply dot convention & node convention analysis to various circuits.	RM/UN
02	To apply node and mesh circuit analysis techniques and various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, Millman's Theorem, etc.	UN
03	Calculate Laplace Transform on one port and two port network.	AP
04	To apply graph theorem to solving networks.	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme :

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
60	0	30	30	120	04	70	30	20	30	50	200

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.



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Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Coupled Circuit and Dot Conventions: Magnetically Coupled Circuit, Faraday's law of Electromagnetic induction, Self-induced emf and self-inductance, Mutually induced emf and Mutual induction, Coefficient of coupling, Dot Convention, inductive coupling of series-parallel, Conductively coupled equivalent circuit.	4	7
2	Nodal Analysis and Mesh Analysis of resistive Circuits: Nodal Analysis of Circuits Containing Resistors and Independent and Dependent Sources – Source Transformation Theorem for circuits with independent sources – Source Transformation Theorem for circuits with Dependent sources –Nodal Analysis of Circuits Containing Dependent Sources - Mesh Analysis of Circuits with Resistors and Independent Voltage Sources- Mesh Analysis of Circuits with Independent Sources - Mesh Analysis of Circuits Containing Dependent Sources.	7	11
3	Circuit Theorems and Their Application in Electric Networks: Linearity of a Circuit and Superposition Theorem-Substitution Theorem-Compensation Theorem - Thevenin's Theorem and Norton's Theorem -Determination of Equivalents for Circuits with Dependent Sources -Reciprocity Theorem - Maximum Power Transfer Theorem - Millman's Theorem-Duality Theorem - Duality between Electricity and Magnetism.	9	18
4	Time domain response of First order RL and RC circuits: Mathematical preliminaries – Source free response –DC response of first order circuits – Superposition and linearity – Response Classifications	4	7
5	Time domain response of Second order linear circuits: Discharging of a Capacitor through an inductor – Source free second order linear networks – second order linear networks with constant inputs.	5	7
6	Initial Conditions: Initial conditions in elements, procedure for evaluating initial conditions, Solution of circuit equations by using Initial Conditions.	4	7



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7	Laplace Transform Analysis and its Applications: Notions of Impedance and Admittance – Manipulation of Impedance and Admittance- Notions of Transfer Function- Equivalent circuits for inductors and capacitors – Nodal and Loop analysis in the s-domain – Switching in RLC circuits- Switched capacitor circuits and conservation of charge	8	10
8	Two –Port Networks : One port networks –Driving Port and Transfer function for one port and two port network, Poles and zeroes of network functions, Two port admittance Parameters (y parameters)– Admittance parameters analysis of terminated two- Port networks - Two port impedance Parameters (z-parameters) –Impedance and Gain calculations of terminated two- Port networks modeled by z-parameters – Hybrid parameters (h para)– Inverse Hybrid Parameters (g-para)- Transmission parameters (ABCD parameters)-Scattering parameters(S parameters)-Scattering Transfer parameters(T parameters) –reciprocity-Variou s Combinations of Two-Port network-Variou s Combinations of Two port n/w.	9	15
9	Introduction to Network Topology: Linear Oriented Graphs (Connected Graph, Sub graphs and Some Special Sub graphs) - The Incidence Matrix of a Linear Oriented Graph -Kirchhoff's Laws in Incidence Matrix Formulation - Nodal Analysis of Networks – The Circuit Matrix of a Linear Oriented Graph- Kirchhoff's Laws in Fundamental Circuit Matrix Formulation - Loop Analysis of Electrical Networks – (Loop Analysis of Networks Containing Ideal Dependent Sources- Planar Graphs and Mesh Analysis –Duality)- The Cut-set Matrix of a Linear Oriented Graph (Cut-sets - The All cut-set matrix Q_a - Orthogonality relation between Cut-set matrix and Circuit matrix - The Fundamental Cut-set Matrix Q_f - Relation between Q_f , A and Bf) - Kirchhoff's Laws in Fundamental Cut-set formulation - Tie set -Tie set Matrix (F-loop matrix)- Tie set schedule.	10	18
Total		60	100

Reference Book:

1. Network Analysis & Synthesis By Franklin S. KUO, Wiley Publication
2. Network Analysis :- By M.E Van Valkenburg PHI Publication
3. Electric Circuits and Networks :- By K. S. Suresh Kumar – Pearson Education
4. Linear Circuits Analysis 2nd edition :-By DeCarlo/ Lin – Oxford University Press(Indian edition)



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5. Engineering Circuit Analysis : - By W H Hayt, J E Kemmerly, S M Durbin 6th Edition TMH Publication
6. Graphs: Theory and Algorithms By K. Thulasiraman, M.N.S Swamy, Wiley Publication.
7. Electric Circuit Analysis By S N Sivanandam, Vikas Publishing House
8. Introductory Circuit Analysis by Robert Boylestad, Pearson.

A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpatrai Publication.

1. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
2. Raj Kamal, "Internet of Things: Architecture and Design Principles, Mc Graw Hill Education Hanes et al "IoT Fundamentals", Cisco Press
3. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.
4. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
5. YashwantKanetkar, "21 Internet of Things Experiments", Kindle edition
6. AdeelJaved, "Building Arduino projects for Internet of Things", Apress publication
7. Donald Noris, "The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black" Mc Graw Hill Publication
8. Adrian McEwen & Hakim Cassimally, "Designing the Internet of things", Willey publication
9. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
10. Raj Kamal, "Internet of Things: Architecture and Design Principles, Mc Graw Hill Education Hanes et al "IoT Fundamentals", Cisco Press
11. Vijay Madiseti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.
12. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
13. YashwantKanetkar, "21 Internet of Things Experiments", Kindle edition
14. AdeelJaved, "Building Arduino projects for Internet of Things", Apress publication
15. Donald Noris, "The Internet of Things: Do it yourself Projects with Arduino, Raspberry PI and BeagleBone Black" Mc Graw Hill Publication
16. BeagleBone Black" Mc Graw Hill Publication
17. Adrian McEwen & Hakim Cassimally, "Designing the Internet of things", Willey publication
18. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication

- **Suggested Course Practical List:**

1. To measure and calculate currents and voltages for a given resistive circuit and verify KCL and KVL.
2. To verify superposition theorem experimentally for a given resistive circuit consisting two independent sources.



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- To verify Thevenin's theorem experimentally for a given circuit.
- To verify maximum power transfer theorem experimentally for a given circuit.
- To verify reciprocity theorem experimentally for a given circuit.
- To measure and calculate RC time constant for a given RC circuit.
- To measure and calculate RC time constant for a given RL circuit.
- To measure and analyze (settling time, overshoot, undershoot, etc.) step response of for a given series RLC circuit for following cases: (1) $\zeta = 1$ (critically damped system), (2) $\zeta > 1$ (over damped system), (3) $\zeta < 1$ (under damped system). Choose appropriate values of R, L, and C to obtain each of above cases one at a time.
- To measure and calculate Z-parameters for a given two-port system.
- To measure and calculate Y-parameters for a given two-port system.
- To measure and calculate h-parameters for a given two-port system.
- To measure and calculate ABCD-parameters for a given two-port system.

List of Laboratory/Learning Resources Required:

- Common Lab Manual (DTE)
- Virtual Laboratory (vLab.co.in)
- NPTEL Website

List of suggested activities for Problem Based Learning:

Sr. No.	Name of the activity	No. of hours per activity	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and	Based on the depth of the solution submitted.



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		solution finding, Total = 10h	
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software
15	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	Based on quiz scores and reflection report after each quiz.
16	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

- All the suggested activity should be related to the subject.
- Subject coordinator shall identify activities from above list as per the subject needs, they also declare list of activities wise hours, evaluation scheme and rubrics to students at the start of semester.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.



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- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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