## Department of Electrical & Electronics Engineering

**Course Title:** **Electric Circuit Analysis (GR20A2023)**
**Following documents are available in Course File.**

| S.No. | Points | Yes | No |
|---|---|---|---|
| 1 | Institute and Department Vision and Mission Statements | √ | |
| 2 | Academic Calendar | √ | |
| 3 | Subject Allocation Sheet | √ | |
| 4 | Class Time Table, Individual Timetable (Single Sheet) | √ | |
| 5 | Syllabus Copy | √ | |
| 6 | Course Handout | | √ |
| 7 | CO-PO Mapping | √ | |
| 8 | Assignment Questions with CO's | | √ |
| 9 | Tutorial Sheets With Solution | | √ |
| 10 | Sessional Question Papers, External Question Paper and Scheme of Evaluation | | √ |
| 11 | Previous University Question Papers | | √ |
| 12 | Best, Average and Weak Answer Scripts for Each Sessional Exam. (Photocopies) | | √ |
| 13 | CO-PO Attainments for All Mids. | √ | |
| 14 | Soft Copy of Notes/Ppt/Slides | | √ |
| 15 | Feedback From Students | √ | |
| 16 | Result Analysis | √ | |
| 17 | Remedial Action. | | √ |
| 18 | Course Exit Survey | | √ |

**Course Instructor / Course Coordinator**

**Course Instructor / Course Coordinator**

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

# COURSE OBJECTIVES

**A**cademic **Y**ear : 2022-23

Semester : I

Name of the Program: B.Tech Year: II

Course/Subject: **Electric Circuit Analysis** Course Code: GR20A2023

Name of the Faculty: G Sandhya Rani Dept.:EEE

On completion of this Subject/Course the student shall be able to:

| S.No | Objectives |
|---|---|
| 1 | Explain the various properties of Fourier series and Fourier transforms. |
| 2 | Simplify the transient state analysis of a circuit. |
| 3 | Evaluate the steady state analysis(three phase) and dot convention of given circuit. |
| 4 | Apply the Laplace transforms to electric circuit. |
| 5 | Develop the network parameters of the circuits. |

Signature of HOD Signature of faculty

Date: Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

# COURSE OUTCOMES

**A**cademic **Y**ear : 2022-23

Semester : I

Name of the Program: B.Tech Year: II

Course/Subject: **Electric Circuit Analysis** Course Code: GR20A2023

Name of the Faculty: G Sandhya Rani Dept.:EEE

The expected outcomes of the Course/Subject are:

| S.No | Outcomes |
|---|---|
| 1 | Apply Fourier series, network theorems for the analysis of electric circuits. |
| 2 | Develop the transient response of electric circuits. |
| 3 | Analyze three phase and mutually coupled circuits. |
| 4 | Solve electrical circuits using Laplace transform and mark poles and zeros. |
| 5 | Simplify network by two port parameters. |

Signature of HOD Signature of faculty

Date: Date:

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

# GUIDELINES TO STUDY THE COURSE /SUBJECT

**A**cademic **Y**ear : 2022-23

Semester : I

Name of the Program: B.Tech Year: II

Course/Subject: **Electric Circuit Analysis** Course Code: GR20A2023

Name of the Faculty: G Sandhya Rani Dept.:EEE

Guidelines to study the Course/ Subject: ……………………………………………..

**Course Design and Delivery System (CDD):**

The Course syllabus is written into number of learning objectives and outcomes.

These learning objectives and outcomes will be achieved through lectures, assessments, assignments, experiments in the laboratory, projects, seminars, presentations, etc.

Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.

The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

Understand the principles of Learning

Understand the psychology of students

Develop instructional objectives for a given topic

Prepare course, unit and lesson plans

Understand different methods of teaching and learning

Use appropriate teaching and learning aids

Plan and deliver lectures effectively

Provide feedback to students using various methods of Assessments and tools of Evaluation

Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD Signature of facul

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## Department of Electrical & Electronics Engineering

# SCHEDULE OF INSRTUCTIONS COURSE PLAN

**A**cademic **Y**ear : 2022-23

Semester : I

Name of the Program: B.Tech Year: II

Course/Subject: **Electric Circuit Analysis** Course Code: GR20A2023

Name of the Faculty: G Sandhya Rani Dept.:EEE

| Exp.No. | No. of Periods | Topics / Sub-Topics | Objectives & Outcomes Nos. |
|---|---|---|---|
| 1 | 2 | Representation of continuous-time periodic signals by Fourier series | 1&1 |
| 2 | 2 | Dirichlet's conditions; Properties of Fourier series | 1&1 |
| 3 | 2 | Parseval's theorem; Trigonometric and Exponential Fourier series; | 1&1 |
| 4 | 2 | Complex Fourier spectrum; Fourier transform via Fourier series; | 1&1 |
| 5 | 2 | Fourier transform of periodic and aperiodic signals, Convergence of FT | 1&1 |
| 6 | 2 | Properties of Fourier transforms Parseval's theorem; | 1&1 |
| 8 | 2 | Fourier transforms involving impulse & Signum function & Hilbert Transform | 1&1 |
| 9 | 2 | Maximum Power Transfer theorem, Reciprocity theorem | 2&2 |
| 10 | 2 | Millman theorem, Compensation theorem | 2&2 |
| 11 | 2 | Telligence Theorem, Concept of duality and dual network | 2&2 |
| 12 | 2 | Solution of first and second order differential equations for Series RL, RC, RLC circuits | 2&2 |
| 13 | 2 | Solution of first and second order differential equations for parallel RL, RC, RLC circuits | 2&2 |
| 14 | 2 | Initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. | 2&2 |

## Department of Electrical & Electronics Engineering

| | | | |
|---|---|---|---|
| 15 | 2 | Introduction to Three-phase circuits | 3&3 |
| 16 | 2 | Star-star, delta-delta analysis of balanced circuits of three phase 3 wire, 4 wire, delta circuits, | 3&3 |
| 17 | 2 | Star-star, delta-delta analysis of unbalanced analysis of three phase 3 wire, 4 wire, delta circuits | 3&3 |
| 18 | 2 | Measurement of power by three and two watt meters, | 3&3 |
| 19 | 2 | Measurement of reactive power by single wattmeter, | 3&3 |
| 20 | 2 | Mutual coupled circuits, Dot Convention in coupled circuits. | 3&3 |
| 21 | 2 | Review of Laplace Transform | 4&4 |
| 22 | 2 | Analysis of electrical circuits using Laplace Transform for standard inputs | 4&4 |
| 23 | 2 | Convolution integral | 4&4 |
| 24 | 2 | Inverse Laplace Transform | 4&4 |
| 25 | 2 | Transformed network with initial conditions, | 4&4 |
| 26 | 2 | Transfer function representation & Poles and Zeros. | 4&4 |
| 27 | 2 | Two Port Networks | 5&5 |
| 28 | 2 | Terminal pairs, relationship of two port variables, | 5&5 |
| 29 | 2 | Impedance & admittance parameters, | 5&5 |
| 30 | 2 | Hybrid and transmission parameters, condition for symmetry and reciprocity | 5&5 |
| 32 | 2 | Interrelationship between various parameters | 5&5 |
| 33 | 2 | Interconnections of two port networks (series, parallel and cascade) | 5&5 |

Signature of HOD Signature of faculty

Date: Date:

Note: 1. ENSURE THAT ALL TOPICS SPECIFIED IN THE COURSE ARE MENTIONED.
2. ADDITIONAL TOPICS COVERED, IF ANY, MAY ALSO BE SPECIFIED IN BOLD
3. MENTION THE CORRESPONDING COURSE OBJECTIVE AND OUT COME NUMBERS AGAINST EACH T

# EVALUATION STRATEGY

**A**cademic **Y**ear : 2022-23

Semester : I

Name of the Program: B.Tech Year: II

Course/Subject: **Electric Circuit Analysis** Course Code: GR20A2023

Name of the Faculty: G Sandhya Rani Dept.:EEE

Designation: Assistant Professor

1. TARGET:

A) Percentage for pass:

b) Percentage of class:

2. COURSE PLAN & CONTENT DELIVERY:

- OHP presentation of the Lectures
- Solving exercise problems
- Model questions

3. METHOD OF EVALUATION

3.1 Continuous Assessment Examinations (CAE-I, CAE-II)

3.2 Assignments

3.3 Seminars

3.4 Quiz

3.5 Semester/End Examination

## Vision of the Institute

To be among the best of the institutions for engineers and technologists with attitudes, skills and knowledge and to become an epicentre of creative solutions.

## Mission of the Institute

To achieve and impart quality education with an emphasis on practical skills and social relevance

## Vision of the Department

To impart technical knowledge and skills required to succeed in life, career and help society to achieve self sufficiency.

## Mission of the Department

1. To become an internationally leading department for higher learning.
2. To build upon the culture and values of universal science and contemporary education.
3. To be a center of research and education generating knowledge and technologies which lay groundwork in shaping the future in the fields of electrical and electronics engineering.
4. To develop partnership with industrial, R&D and government agencies and actively participate in conferences, technical and community activities.

Department of Electrical and Electronics Engineering

This Programme is meant to prepare our students to professionally thrive and to lead.During their progression:

**Graduates will be able to**

**PEO 1**: Graduates will have a successful technical or professional careers, including supportive and leadership roles on multidisciplinary teams.

**PEO 2**: Graduates will be able to acquire, use and develop skills as required for effective professional practices.

**PEO 3**: Graduates will be able to attain holistic education that is an essential prerequisite for being a responsible member of society.

**PEO 4**: Graduates will be engaged in life-long learning, to remain abreast in their profession and be leaders in our technologically vibrant society.

**Programme Outcomes (B.Tech. – EEE)**

**At the end of the Programme, a graduate will have the ability to**

**PO-1:** Ability to apply knowledge of mathematics, science, and engineering.

**PO-2:** Ability to identify, formulate, analyze engineering problems using engineering sciences.

**PO-3:** Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety..

**PO-4:** Ability to design and conduct experiments, as well as to analyze and interpret data with valid conclusions.

**PO-5:** Ability to utilize experimental, statistical and computational methods and tools necessary for modelling engineering activities.

**PO-6:** Ability to apply reasoning informed by the relative knowledge to evaluate societal, health, safety, legal and cultural issues and tasks applicable to the professional engineering practice.

**PO-7:** Ability to adapt broad education necessary to understand the impact of engineering solutions and obtain sustainability in a global, economic, environmental, and societal context.

**PO-8:** Ability to discover ethical principles and bind to professional and ethical responsibility.

**PO-9:** Ability to function as an individual and in multi-disciplinary teams.

**PO-10:** Ability to communicate effectively on complex activities in engineering community and society.

**PO-11:** Ability to develop Project management principles and apply in various disciplinary environments.

**PO-12:** Recognition of the need for, and an ability to engage in life-long learning

**Program Specific Outcomes(PSOs):**

**PSO-1**: Graduates will interpret data and able to analyze digital and analog systems related to electrical and programming them.

**PSO-2**: Graduates will able to demonstrate, design and model electrical, electronic circuits, power electronics, power systems and electrical machines.

**Gokaraju Rangaraju Institute of Engineering and Technology**
***(Autonomous)***
**Bachupally, Kukatpally, Hyderabad – 500 090, India**

GRIET/DAA/1H/G/22-23 09 May 2022

# Academic Year 2022-23

## II B.Tech. – First Semester

| S. No. | EVENT | PERIOD | DURATION |
|---|---|---|---|
| 1 | Commencement of First Semester class work | 10-10-2022 | |
| 2 | I Spell of Instructions | 10-10-2022 to 07-12-2022 | 9 Weeks |
| 3 | I Mid-term Examinations | 08-12-2022 to 12-12-2022 | 3 Days |
| 4 | II Spell of Instructions | 13-12-2022 to 07-02-2023 | 8 Weeks |
| 5 | II Mid-term Examinations | 08-02-2023 to 10-02-2023 | 3 Days |
| 6 | Preparation/Break | 11-02-2023 to 17-02-2023 | 1 Week |
| 7 | End Semester Examinations (Theory/ Practical) Regular/ Supplementary | 20-02-2023 to 11-03-2023 | 3 Weeks |
| 8 | Commencement of Second Semester, AY 2022-23 | 13-03-2023 | |

## II B.Tech. – Second Semester

| S. No. | EVENT | PERIOD | DURATION |
|---|---|---|---|
| 1 | Commencement of II Semester class work | 13-03-2023 | |
| 2 | I Spell of Instructions | 13-03-2023 to 29-04-2023 | 7 Weeks |
| 3 | Summer Vacation | 01-05-2023 to 13-05-2023 | 2 Weeks |
| 4 | I Spell of Instructions Contd | 15-05-2023 to 27-05-2023 | 2 Weeks |
| 5 | I Mid-term Examinations | 29-05-2023 to 31-05-2023 | 3 Days |
| 6 | II Spell of Instructions | 01-06-2023 to 31-07-2023 | 8 Weeks |
| 7 | II Mid-term Examinations | 01-08-2023 to 03-08-2023 | 3 Days |
| 8 | Preparation | 04-08-2023 to 10-08-2023 | 1 Week |
| 9 | End Semester Examinations (Theory/ Practical) Regular / Supplementary | 11-08-2023 to 31-08-2023 | 3 Weeks |
| 10 | Commencement of III B.Tech First Semester, AY 2023-24 | 01-09-2023 | |

J. Praveen

**Dean Academic Affairs**

Copy to Principal, All HoDs, CoE

**GOKARAJU RANGARAJU**
**INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**Department of Electrical and Electronics Engineering**

## Faculty Work load for the Academic Year 2022-23 / I SEM
## Subject Allocation Sheet

| S.No. | Faculty | Designation | Faculty ID | YEAR (UG/PG) | Subject Name | No.of Sections | No. of Hours | Total (in Hrs) |
|---|---|---|---|---|---|---|---|---|
| 2 | Dr B Phaneendra Babu | Prof. & HOD | 1563 | II B.Tech | DCM | 1 | 5 | 11 |
| | | | | II M.Tech | Dph 1 | 1 | 3 | |
| | | | | II M.Tech | DLED | 1 | 3 | |
| 3 | Dr.D G Padhan | Prof. | 1283 | III B.Tech | EHV | 1 | 5 | 11 |
| | | | | I M.Tech | EHV | 1 | 3 | |
| | | | | II M.Tech | IS | 1 | 3 | |
| 4 | Dr. J. Sridevi | Prof. | 516 | III B.Tech | PSA | 1 | 6 | 11 |
| | | | | III B.Tech | PS Lab | 1 | 5 | |
| 5 | Dr T Suresh Kumar | Prof. | 1494 | II B.Tech | EMF | 1 | 5 | 11 |
| | | | | I Mtech | PE Lab | 1 | 3 | |
| | | | | I Mtech | MSPEC | 1 | 3 | |
| 6 | V.Vijaya Rama Raju | Asso. Prof. | 361 | II B.Tech | PGT | 1 | 5 | 11 |
| | | | | II B.Tech | DCM Lab | 1 | 6 | |
| 7 | P Ravikanth | Asso. Prof. | 1178 | II B.Tech | PAE | 1 | 5 | 14 |
| | | | | III B.Tech | NPTEL | 1 | 3 | |
| | | | | IV B.Tech | ED Lab | 1 | 6 | |
| 8 | A Vinay Kumar | Asso. Prof. | 881 | IV B.Tech | HVE | 2 | 10 | 16 |
| | | | | IV B.Tech | PWK | 1 | 3 | |
| | | | | I M.Tech | PQ&FACTS | 1 | 3 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | Syed Sarfaraz Nawaz | Asso. Prof. | 695 | Electrical Maintenance Officer | | | | |
| 10 | Dr Pakkiraiah B | Asso. Prof. | 1593 | III B.Tech | PE Lab | 1 | 5 | 14 |
| | | | | I M.Tech | IPR | 1 | 3 | |
| | | | | III B.Tech | PE Lab | 1 | 6 | |
| 11 | Dr D Naga Mallesara Rao | Asso. Prof. | 1598 | IV B.Tech | ED | 2 | 10 | 16 |
| | | | | IV B.Tech | ED Lab | 1 | 6 | |
| 12 | Dr P Sri Vidya Devi | Asso. Prof. | 931 | III B.Tech | MC Lab | 1 | 6 | 11 |
| | | | | IV B.Tech | PS-III | 1 | 5 | |
| 13 | Dr D Raveendhra | Asso. Prof. | 1604 | I M.Tech | MAEM | 1 | 3 | 11 |
| | | | | I M.Tech | PQ Lab | 1 | 3 | |
| | | | | III B.Tech | MC | 1 | 5 | |
| 14 | P.Praveen Kumar | Asst. Prof | 609 | I B.Tech | 1 st Year BEE | | | |
| 15 | R. Anil Kumar | Asst. Prof | 657 | I B.Tech | I st Year BEE | | | |
| 16 | U Vijaya Lakshmi | Asst. Prof | 692 | II B.Tech | PAE Lab | 1 | 6 | 15 |
| | | | | III B.Tech | PS Lab | 1 | 6 | |
| | | | | I B.Tech | BEE Lab | 1 | 3 | |
| 17 | D Karuna Kumar | Asst. Prof | 760 | II B.Tech | CI | 1 | 2 | 14 |
| | | | | IV B.Tech | ED Lab | 1 | 6 | |
| | | | | I B.Tech | BEE Lab | 2 | 6 | |
| 19 | M Naga Sandhya Rani | Asst. Prof | 882 | III B.Tech | MC Lab | 1 | 6 | 14 |
| | | | | II B.Tech | BEEE | 1 | 5 | |
| | | | | IV B.Tech | PWK | 1 | 3 | |
| 20 | G Sandhya Rani | Asst. Prof | 888 | II B.Tech | ECA | 1 | 5 | 14 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | III B.Tech | PE Lab | 1 | 6 | |
| | | | | IV B.Tech | PWK | 1 | 3 | |
| 21 | M Rekha | Asst. Prof | 933 | II B.Tech | DCM Lab | 1 | 6 | 15 |
| | | | | III B.Tech | PE Lab | 1 | 6 | |
| | | | | I B.Tech | BEE Lab | 1 | 3 | |
| 22 | V Usha Rani | Asst. Prof | 1045 | IV B.Tech | ED Lab | 1 | 6 | 12 |
| | | | | III B.Tech | PS Lab | 1 | 6 | |
| 23 | P Prashanth Kumar | Asst. Prof | 1055 | I B.Tech | BEE | 1 | 6 | 20 |
| | | | | IV B.Tech | PS-III | 1 | 5 | |
| | | | | I B.Tech | BEE Lab | 3 | 9 | |
| 24 | K Sudha | Asst. Prof | 1211 | I B.Tech | 1 st Year BEE | | | |
| 25 | M Prashanth | Asst. Prof | 1279 | II B.Tech | PAE Lab | 1 | 6 | 14 |
| | | | | II B.Tech | VEGC | 1 | 2 | |
| | | | | I B.Tech | BEE Lab | 2 | 6 | |
| 26 | D Srinivasa Rao | Asst. Prof | 1540 | IV B.Tech | EHV | 2 | 10 | 13 |
| | | | | IV B.Tech | PWK | 1 | 3 | |

# GOKARAJU RANGARAJU
## INSTITUTE OF ENGINEERING AND TECHNOLOGY
### Department of Electrical and Electronics Engineering

# Class Time Table, Individual Timetable

**GRIET/PRIN/06/G/01/22-23** **Wef : 05th Oct 2022**

**BTech - EEE - A** **II Year - I Semester**

| DAY/ HOUR | 08:50 - 09:40 | 09:40 - 10:30 | 10:30 - 11:20 | 11:20 - 12:00 | 12:00 - 12:55 | 12:55 - 01:50 | 01:50 - 02:45 |
|---|---|---|---|---|---|---|---|
| MONDAY | EMF | | PAE | BREAK | PGT | VEGS | |
| TUESDAY | ECA | | PGT | | DCMT Lab/PAE Lab (A1/A2) | | |
| WEDNESDAY | ECA | DCMT | | | EMF | PAE | |
| THURSDAY | PAE | DCMT | | | DCMT Lab/PAE Lab (A2/A1) | | |
| FRIDAY | EMF | ECA | | | PAE | PGT | |
| SATURDAY | CI | | PGT | | EMF | JPE | |

| ROOM NO | |
|---|---|
| Theory/Tutorial | 4401 |
| Lab | PAE Lab-4505 DCMT Lab-2106/07 |
| Class Incharge: | U. Vijaya Lakshmi |

| Subject Code | Subject Name | Faculty Code | Faculty Name |
|---|---|---|---|
| GR20A2023 | Electrical Circuit Analysis | GSR | G. Sandhya Rani |
| GR20A2024 | Principles of Analog Electronics | PRK | P. Ravikanth |
| GR20A2025 | DC Machines and Transformers | Dr PBB | Dr B. Phaneendra Babu |
| GR20A2026 | Electromagnetic Fields | Dr TSK | Dr. T. Suresh Kumar |
| GR20A2033 | Power Generation and Transmission | VVRR | V. Vijayarama Raju |
| GR20A2028 | Java Programming for Engineers | | |
| GR20A2029 | Principles of Analog Electronics Lab | UVL/MP | U. Vijaya Lakshmi/ M. Prashanth |
| GR20A2030 | DC Machines and Transformers Lab | VVRR/MRE | V. Vijayarama Raju/ M. Rekha |
| GR20A2003 | Constitution of India (CI) | DKK | D. Karuna Kumar |
| GR20A2002 | Value Ethics and Gender Culture | MP | M. Prashanth |

| Almanac | |
|---|---|
| 1st Spell of Instructions | 06/10/2022 to 29/11/2022 |
| 1st Mid-term Examinations | 30/11/2022 to 02/12/2022 |
| 2nd Spell of Instructions | 03/12/2022 to 27/01/2023 |
| 2nd Mid-term Examinations | 28/01/2023 to 31/07/2023 |
| Preparation | 01/02/2023 to 07/02/2023 |
| End Semester Examinations (Theory/ Practicals) Regular / Supplementary | 08/02/2023 to 28/02/2023 |
| Commencement of Second Semester, A.Y 2021-22 | 01-03-2023 |

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
Department of Electrical and Electronics Engineering

| Faculty Name: G Sandhya Rani | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| DAY/ HOUR | 10.20-11.15 | 11.15-12.10 | 12.10-1.05 | 1.05-1.40 | 1.40-2.30 | 2.30 - 3.20 | 3:20 -4.10 |
| MONDAY | | | | LUNCH | | | |
| TUESDAY | ECA | | | | | | |
| WEDNESDAY | | | | | | | |
| THURSDAY | | | | | | | |
| FRIDAY | ECA | | | | | | |
| SATURDAY | | | | | | | |

| Branch: EEE | Subject Code: GR20A2023 | Academic Year: 2022-23 | Regulation: GR20 | Year: II Semester: I |
|---|---|---|---|---|

**Electric Circuit Analysis (GR20A2023)**

**L:2 T:1 P:0 C:3**

## Syllabus

**UNIT I**

**FOURIER SERIES AND FOURIER TRANSFORM:** Representation of continuous-time periodic signals by Fourier series; Dirichlet's conditions; Properties of Fourier series, Parseval's theorem; Trigonometric and Exponential Fourier series; Complex Fourier spectrum; Fourier transform via Fourier series; Fourier transform of periodic and aperiodic signals; Convergence of Fourier transform; Properties of Fourier transforms, Parseval's theorem; Fourier transforms involving impulse function and Signum function; Introduction to Hilbert Transform.

**UNIT II**

**NETWORK THEOREMS** Maximum Power Transfer theorem, Reciprocity theorem, Millman theorem, Compensation theorem, Telligence Theorem, Concept of duality and dual networks.
**Solution of First and Second order networks** Solution of first and second order differential equations for Series and parallel RL, RC, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

**UNIT III**

**THREE PHASE CIRCUITS AND COUPLED CIRCUITS** Three-phase circuits, star-star, delta-delta analysis of balanced circuits, unbalanced analysis of three phase 3 wire, 4 wire, delta circuits, measurement of power by three and two watt meters, measurement of reactive power by single wattmeter, Mutual coupled circuits, Dot Convention in coupled circuits.

**UNIT IV**

**ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS** Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, Inverse Laplace Transform, transformed network with initial conditions, Transfer function representation, Poles and Zeros.

**UNIT V**

**TWO PORT NETWORKS** Two Port Networks, terminal pairs, relationship of two port variables, impedance, admittance, hybrid and transmission parameters, condition for symmetry and reciprocity, interrelationship between various parameters, interconnections of two port networks (series, parallel and cascade)

# GOKARAJU RANGARAJU
## INSTITUTE OF ENGINEERING AND TECHNOLOGY
### Department of Electrical and Electronics Engineering

# Course Schedule

**A**cademic **Y**ear : **2022-23**

Semester : **I**

Name of the Program: **B.Tech** Year: **II-I** Section: **A**

Course/Subject: **Electric Circuit Analysis** Course Code: **GR20A2023**

Name of the Faculty: **G Sandhyarani**

Designation: **Assistant Professor**

Department: **Electrical and Electronics Engineering**

The Schedule for the whole Course / Subject is:

| Sl.No | Topics | No of periods |
|---|---|---|
| 1 | Representation of continuous-time periodic signals by Fourier series | 2 |
| 2 | Dirichlet's conditions; Properties of Fourier series | 2 |
| 3 | Parseval's theorem; Trigonometric and Exponential Fourier series; | 2 |
| 4 | Complex Fourier spectrum; Fourier transform via Fourier series; | 2 |
| 5 | Fourier transform of periodic and aperiodic signals, Convergence of FT | 2 |
| 6 | Properties of Fourier transforms Parseval's theorem; | 2 |
| 8 | Fourier transforms involving impulse & Signum function & Hilbert Transform | 2 |
| 9 | Maximum Power Transfer theorem, Reciprocity theorem | 2 |
| 10 | Millman theorem, Compensation theorem | 2 |
| 11 | Telligence Theorem, Concept of duality and dual network | 2 |
| 12 | Solution of first and second order differential equations for Series RL, RC, RLC circuits | 2 |
| 13 | Solution of first and second order differential equations for parallel RL, RC, RLC circuits | 2 |
| 14 | Initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. | 2 |
| 15 | Introduction to Three-phase circuits | 2 |
| 16 | Star-star, delta-delta analysis of balanced circuits of three phase 3 wire, 4 wire, delta circuits, | 2 |
| 17 | Star-star, delta-delta analysis of unbalanced analysis of three phase 3 wire, | 2 |

| | | |
|---|---|---|
| | 4 wire, delta circuits | |
| 18 | Measurement of power by three and two watt meters, | 2 |
| 19 | Measurement of reactive power by single wattmeter, | 2 |
| 20 | Mutual coupled circuits, Dot Convention in coupled circuits. | 2 |
| 21 | Review of Laplace Transform | 2 |
| 22 | Analysis of electrical circuits using Laplace Transform for standard inputs | 2 |
| 23 | Convolution integral | 2 |
| 24 | Inverse Laplace Transform | 2 |
| 25 | Transformed network with initial conditions, | 2 |
| 26 | Transfer function representation & Poles and Zeros. | 2 |
| 27 | Two Port Networks | 2 |
| 28 | Terminal pairs, relationship of two port variables, | 2 |
| 29 | Impedance & admittance parameters, | 2 |
| 30 | Hybrid and transmission parameters, condition for symmetry and reciprocity | 2 |
| 32 | Interrelationship between various parameters | 2 |
| 33 | Interconnections of two port networks (series, parallel and cascade) | 2 |

Total No. of Instructional periods available for the course: ……66……. Periods

-

**Course Outcomes-Program Outcomes (POs) Relationship Matrix** (Relationships are indicated by mark HIGH as “H” and MEDIUM as “M”)- COI

| | | **P-Outcomes** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **C-Outcomes** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| | **1** | H | H | | H | H | | H | H | | H | H | H |
| | **2** | | | M | | | M | | M | M | | M | |
| | **3** | M | H | H | H | H | H | H | | H | H | | H |
| | **4** | | H | | H | H | | H | M | | H | M | H |
| | **5** | H | | H | M | | H | M | M | H | M | M | |

| Branch: EEE | Subject Code: GR20A2023 | Academic Year: 2022-23 | Regulation: GR20 | Year: II Semester: I |
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## Electric Circuit Analysis (GR20A2023)

**L:2 T:1 P:0 C:3**

## Syllabus

**UNIT I**

**FOURIER SERIES AND FOURIER TRANSFORM:** Representation of continuous-time periodic signals by Fourier series; Dirichlet's conditions; Properties of Fourier series, Parseval's theorem; Trigonometric and Exponential Fourier series; Complex Fourier spectrum; Fourier transform via Fourier series; Fourier transform of periodic and aperiodic signals; Convergence of Fourier transform; Properties of Fourier transforms, Parseval's theorem; Fourier transforms involving impulse function and Signum function; Introduction to Hilbert Transform.

**UNIT II**

**NETWORK THEOREMS** Maximum Power Transfer theorem, Reciprocity theorem, Millman theorem, Compensation theorem, Telligence Theorem, Concept of duality and dual networks.
**Solution of First and Second order networks** Solution of first and second order differential equations for Series and parallel RL, RC, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

**UNIT III**

**THREE PHASE CIRCUITS AND COUPLED CIRCUITS** Three-phase circuits, star-star, delta-delta analysis of balanced circuits, unbalanced analysis of three phase 3 wire, 4 wire, delta circuits, measurement of power by three and two watt meters, measurement of reactive power by single wattmeter, Mutual coupled circuits, Dot Convention in coupled circuits.

**UNIT IV**

**ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS** Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, Inverse Laplace Transform, transformed network with initial conditions, Transfer function representation, Poles and Zeros.

**UNIT V**

**TWO PORT NETWORKS** Two Port Networks, terminal pairs, relationship of two port variables, impedance, admittance, hybrid and transmission parameters, condition for symmetry and reciprocity, interrelationship between various parameters, interconnections of two port networks (series, parallel and cascade)

# Unit-1

## Fourier Series and Fourier Transform

Step — 0

Ramp — t or K

Impulse — ∞

Parabola — $t^2$ or $K^2$

These are basic Signals

A Signal is said to be a Continous time Signal if it is available at all instants of time

- Fourier Series applicable to Periodic Signals only i.e., the Signals which repeat Periodically over $-\infty < t < \infty$

- The representation of Signals over a certain interval of time in terms of linear Combination of functions is called fourier Series.

Methods of Fourier Series

- Trignometric form
- Cosine form
- Exponential form.

Dirchlet's Condition:-

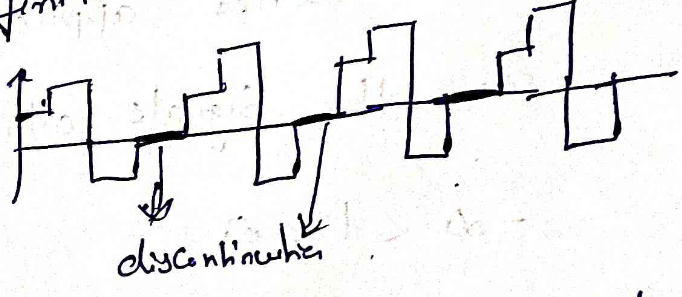
The Condition under which Periodic Signal Can be represented by fourier Series is known as Dirichlet's Condition.

- It Should Satisfy following Conditions

→a) The function $x(t)$ or $f(x)$ must be a Single Valued function

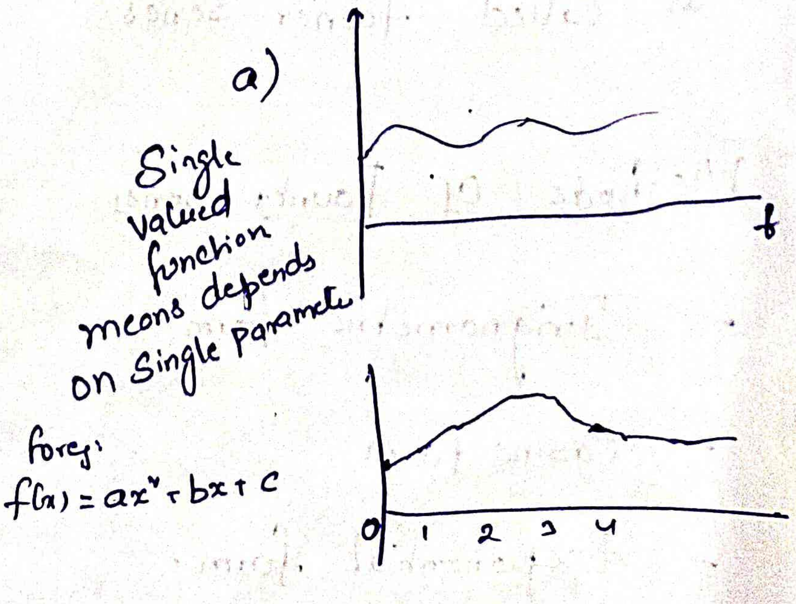
b) The function $x(t)$ has only finite number of maxima and minima.

c) The function $x(t)$ has finite number of discontinuities.




d) The function is absolutely integrable over one Period

i.e., $\int_0^T |x(t)|\, dt < \infty$



# Trignometric form of fourier Series

We can show the signal $x(t)$ a sum of sine and cosine functions, whose frequencies are integral multiples of $\omega_0$.

$$T = \frac{2\pi}{\omega_0}$$

$$x(t) = a_0 + a_1 \cos\omega_0 t + a_2 \cos 2\omega_0 t + \dots a_k \cos k\omega_0 t$$
$$+ b_1 \sin\omega_0 t + b_2 \sin 2\omega_0 t + \dots b_k \sin k\omega_0 t$$

$$= a_0 + \sum_{n=1}^{K} a_n \cos n\omega_0 t + b_n \sin n\omega_0 t$$

$\omega_0$ - fundamental freq. $a_0, a_1, a_2 \dots b_0, b_1, b_2 \dots$ are constants

For signal to be periodic, it should satisfy the condition

$$x(t+T) = a_0 + \sum_{n=1}^{K} a_n \cos\omega_0 n(t+T) + b_n \sin\omega_0 n(t+T)$$

$$= a_0 + \sum_{n=1}^{K} a_n \cos\omega_0 n(t + \frac{2\pi}{\omega_0}) + b_n \sin\omega_0 n(t + \frac{2\pi}{\omega_0})$$

$$= a_0 + \sum_{n=1}^{K} a_n \cos(\omega_0 nt + 2n\pi) + b_n \sin(\omega_0 nt + 2n\pi)$$

$$= a_0 + \sum_{n=1}^{K} a_n \cos\omega_0 nt + b_n \sin\omega_0 nt$$

# Evaluation of Fourier Coefficients of Trignometric form

The Constants $a_0, a_1 \ldots b_0, b_1 \ldots b_n$ are called fourier Coefficients.

To evaluate $a_0$ we shall integrate both sides of equation $x(t)$ over one Period ($t_0$ to $t_0+T$) at an arbitraty time $t_0$

$$\int_{t_0}^{t_0+T} x(t)\,dt = a_0 \int_{t_0}^{t_0+T} dt + \int_{t_0}^{t_0+T} \sum_{n=1}^{\infty} \left(a_n \cos n\omega_0 t + b_n \sin n\omega_0 t\right) dt$$

$$= a_0 T + \sum_{n=1}^{\infty} a_n \int_{t_0}^{t_0+T} \cos n\omega_0 t\,dt + \sum_{n=1}^{\infty} b_n \int_{t_0}^{t_0+T} \sin n\omega_0 t\,dt$$

We Know that $\int_{t_0}^{t_0+T} \cos n\omega_0 t\,dt = 0$ and $\int_{t_0}^{t_0+T} \sin n\omega_0 t\,dt = 0$

Since the net areas of Sinusoids of Complete Periods are zero

$$\int_{t_0}^{t_0+T} x(t)\,dt = a_0 T$$

To evaluat $a_n$ and $b_n$

We can use

$$\int_{t_0}^{t_0+T} \cos n\omega_0 t \cos m\omega_0 t\,dt = \begin{cases} 0 & \text{for } m \neq n \\ T/2 & \text{for } m = n \neq 0 \end{cases}$$

$$\int_{t_0}^{t_0+T} \sin n\omega_0 t \sin m\omega_0 t = \begin{cases} 0 & \text{for } m \neq n \\ T/2 & \text{for } m = n \neq 0 \end{cases}$$

there will be proofs

To find $a_n$, multiply equation $x(t)$ by $\cos m\omega_0 t$ and integrate over one period

$$\int_{t_0}^{t_0+T} x(t)\cos m\omega_0 t\,dt = a_0\int_{t_0}^{t_0+T}\cos m\omega_0 t\,dt + \sum_{n=1}^{\infty} a_n \int_{t_0}^{t_0+T}\cos n\omega_0 t\cos m\omega_0 t\,dt + \sum_{n=1}^{\infty} b_n\int_{t_0}^{t_0+T}\sin n\omega_0 t\cos m\omega_0 t\,dt$$

1st and 3rd terms are equal to zero

and 2nd term $= T/2$

$$\therefore \int_{t_0}^{t_0+T} x(t)\cos m\omega_0 t\,dt = a_m\frac{T}{2}$$

$$a_m = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\cos m\omega_0 t\,dt$$

$$a_n = \frac{2}{T}\int_{t_0}^{t_0+T} x(t)\cos n\omega_0 t\,dt$$

To find $b_n$, multiply eqn by $\sin m\omega_0 t$

$$\therefore \int_{t_0}^{t_0+T} x(t)\sin m\omega_0 t\,dt = a_0\int_{t_0}^{t_0+T}\sin m\omega_0 t\,dt + \sum_{n=1}^{\infty} a_n\int_{t_0}^{t_0+T}\cos n\omega_0 t\sin m\omega_0 t\,dt + \sum_{n=1}^{\infty} b_n\int_{t_0}^{t_0+T}\sin n\omega_0 t\sin m\omega_0 t\,dt$$

1st and 2nd are zero.

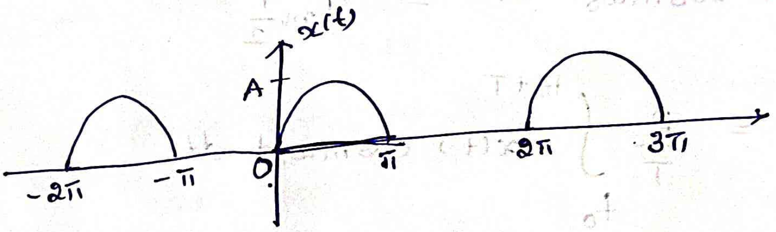
3rd is equal to T/2

$$\therefore \int_{t_0}^{t_0+T} x(t) \sin m\omega_0 t \, dt = b_m T/2$$

$$b_m = \frac{2}{T} \int_{t_0}^{t_0+T} x(t) \sin m\omega_0 t \, dt$$

$$\boxed{b_n = \frac{2}{T} \int_{t_0}^{t_0+T} x(t) \sin n\omega_0 t \, dt}$$

**Eg:** Find the fourier Series expansion of the half wave rectified Sine wave shown in fig 4.1




$$x(t) = \begin{cases} A \sin\omega t = A \sin \frac{2\pi}{2\pi} t = A \sin t & 0 \le t \le \pi \\ 0 & \pi \le t \le 2\pi \end{cases}$$

fundamental Period $T = 2\pi$

$$\omega_0 = \frac{2\pi}{T} = \frac{2\pi}{2\pi} = 1$$

$t_0 = 0$, $t_0 + T = 0 + 2\pi$

$= 2\pi$

$$a_0 = \frac{1}{T}\int_0^T x(t)\,dt$$

$$= \frac{1}{2\pi}\int_0^{2\pi} A \sin t\,dt$$

$$= \frac{A}{2\pi}\left(-\cos t\right)_0^{\pi}$$

$$= \frac{A}{2\pi}(2)$$

$$= \frac{A}{\pi}$$

$$a_n = \frac{2}{T}\int_0^T x(t)\cos n\omega_0 t\,dt$$

$$= \frac{2}{2\pi}\int_0^{\pi} x(t)\cos nt\,dt$$

$$\left[\sin(A+B)+\sin(A-B) = 2\sin A\cos B\right]$$

$$= \frac{1}{\pi}\int_0^{\pi} A\sin t\ \cos nt\,dt$$

$$= \frac{A}{2\pi}\int_0^{\pi} \sin(1+n)t + \sin(1-n)t$$

$$= \frac{A}{2\pi}\left[\frac{-\cos(1+n)t}{1+n} - \frac{\cos(1-n)t}{1-n}\right]_0^{\pi}$$

$$= -\frac{A}{2\pi}\left[\frac{\cos(1+n)\pi - \cos 0}{1+n} + \frac{\cos(1-n)\pi - \cos 0}{1-n}\right]$$

$$= -\frac{A}{2\pi}\left[\frac{\cos(n+1)\pi - 1}{n+1} + \frac{\cos(n-1)\pi - 1}{1-n}\right]$$

$$\cos n\theta = \cos\theta^{n}$$

$$= -\frac{A}{2\pi}\left[\frac{\cos\pi^{n+1} - 1}{1+n} + \frac{\cos\pi^{1-n} - 1}{1-n}\right]$$

$$-\frac{A}{2\pi}\left[\frac{(-1)^{n+1}-1}{1+n}+\frac{(-1)^{n-1}-1}{1-n}\right]$$

for odd $n$ $\quad a_n = -\frac{A}{2\pi}\left[\frac{1+1}{1+n}+\frac{1-1}{1-n}\right]$

$$= 0$$

for even $n$ $\quad a_n = -\frac{A}{2\pi}\left[\frac{-1-1}{1+n}+\frac{-1-1}{1-n}\right]$

$$= -\frac{A}{2\pi}\left[\frac{-2}{1+n}-\frac{2}{1-n}\right]$$

$$= \frac{A}{2\pi}\left[\frac{2}{n+1}-\frac{2}{n-1}\right]$$

$$= -\frac{2A}{\pi(n^2-1)} \qquad Z_0 \quad -\frac{2A}{3\pi}$$

$$b_n = \frac{2}{T}\int_0^T x(t)\sin n\omega_0 t\, dt$$

$$= \frac{2}{2\pi}\int_0^{\pi} A\sin t \sin nt \, dt$$

$$= \frac{A}{\pi}\int_0^{\pi} \sin t \sin nt\, dt \qquad 2\sin A \sin B = \cos(A-B) - \cos(A+B)$$

$$= \frac{A}{2\pi}\int_0^{\pi} \cos(n-1)t - \cos(n+1)t\, dt$$

$$= \frac{A}{2\pi}\left[\frac{\sin(n-1)t}{n-1} - \frac{\sin(n+1)t}{n+1}\right]_0^{\pi} = 0$$

This is zero for all values except for $n=1$

for $n=1$

$$b_1 = \frac{A}{2\pi}$$

The trignometric fourier Series.

$$(x(t)) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\omega_0 t + b_n \sin n\omega_0 t$$

$$= a_0 + \sum_{n=1}^{\infty} a_n \cos nt + b_n \sin nt$$

$$= \frac{A}{\pi} + b_1 \sin t + \sum_{n=1}^{\infty} a_n \cos nt$$

$$= \frac{A}{\pi} + \frac{A}{2\pi} \sin t + \sum_{n=1}^{\infty} \left( -\frac{2A}{\pi(n^2-1)} \cos nt \right)$$

$$= \frac{A}{\pi} + \frac{A}{2\pi} \sin t - \sum_{n=1}^{\infty} \frac{2A}{\pi(n^2-1)} \cos nt$$

## Exponential fourier Series

It is mostly used form of fourier Series, in this function $x(t)$ is expressed as weighted Sum of Complex exponential functions. Exponential form is used for more Conveinient and more Compact.

$$\{ e^{jn\omega_0 t}, n = 0, \pm 1, \pm 2 \cdots \}$$

$e^{j\theta}$ or $e^{j\omega t}$
↓
In Discrete form we Consider $e^{jn\omega t}$

Interval → $(t_0, t_0+T)$

$T = 2\pi/\omega_0$

$$A_n \cos(n\omega_0 t + \theta_n) = A_n \left[ \frac{e^{j(n\omega_0 t + \theta_n)} + e^{-j(n\omega_0 t + \theta_n)}}{2} \right]$$

↓

Substitute this in cosine fourier representation.

(In AC system we consider $\omega t + \theta$ ∴ In discrete form here we consider $n\omega t + \theta$)

$$x(t) = A_0 + \sum_{n=1}^{\infty} A_n \cos(n\omega_0 t + \theta_n)$$

$$= A_0 + \sum_{n=1}^{\infty} \frac{A_n}{2} \left( \frac{e^{j(n\omega_0 t + \theta_n)} + e^{-j(n\omega_0 t + \theta_n)}}{} \right)$$

$$= A_0 + \sum_{n=1}^{\infty} \frac{A_n}{2} e^{j(\omega_0 n t + \theta_n)} + \sum_{n=1}^{\infty} \frac{A_n}{2} e^{-(jn\omega_0 t + \theta_n)}$$

$$= A_0 + \sum_{n=1}^{\infty} \frac{A_n}{2} e^{j\omega_0 n t} \cdot e^{j\theta_n} + \sum_{n=1}^{\infty} \frac{A_n}{2} e^{-jn\omega_0 t} \cdot e^{-j\theta_n}$$

$$= A_0 + \sum_{n=1}^{\infty} \left( \frac{A_n}{2} e^{j\theta_n} \right) e^{j\omega_0 n t} + \sum_{n=1}^{\infty} \left( \frac{A_n}{2} e^{j(-\theta_n)} \right) e^{-j\omega_0 n t} \quad — (1)$$

Let $n = -K$

$$x(t) = A_0 + \sum_{n=1}^{\infty} \left( \frac{A_n}{2} e^{j\theta_n} \right) e^{j\omega_0 n t} + \sum_{K=-1}^{-\infty} \left( \frac{A_K}{2} e^{j\theta_K} \right) e^{jK\omega_0 t} \quad — (2)$$

on comparing two equ's

$A_n = A_K$

$(-\theta_n) = \theta_K \rightarrow n > 0$, $K < 0$

$$C_0 = A_0 \; ; \quad C_n = \frac{A_n}{2} e^{j\theta_n}$$

$$\therefore x(t) = A_0 + \sum_{n=1}^{\infty} \frac{A_n}{2} e^{j\theta_n} e^{j\omega_0 n t} + \sum_{n=-1}^{-\infty} \frac{A_n}{2} e^{j\theta_n} e^{j\omega_0 n t}$$

$$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$$

— This is called Synthesis Solution

# Fourier Spectrum :-

The Fourier Spectrum of a Periodic Signal $x(t)$ is a plot of its fourier Coefficients Versus frequency ($\omega$)

Two types

(a) Amplitude Spectrum

→ The plot of amplitude of fourier Coefficients versus frequency.

(b) Phase Spectrum

The Plot of phase of fourier Coefficients versus frequency is known as Phase Spectrum.

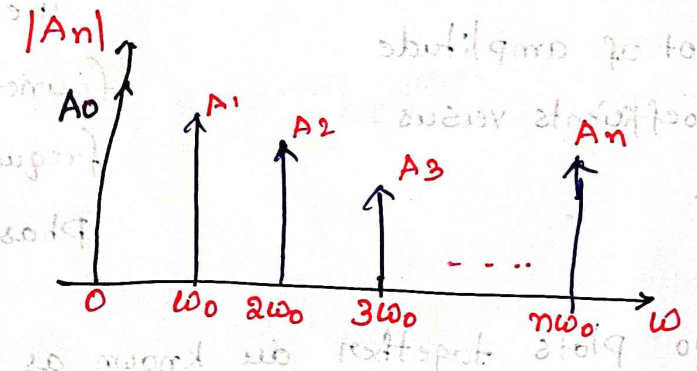
Note: Two plots together are known as fourier frequency Spectra of $x(t)$. This type of representation is also called frequency domain representation

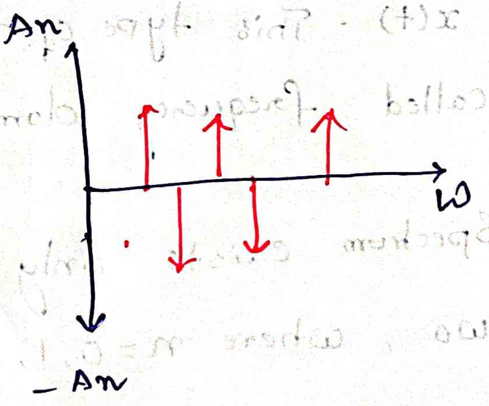
- The fourier Spectrum exists only at discrete frequencies $n\omega_0$, where $n = 0, 1, 2 \ldots$ etc. Hence it is known as discrete Spectrum or line Spectrum.

→ Trigonometric representation of periodic signal contains both sine and cosine terms with positive and negative amplitude coefficients but with no phase angles.

- Fourier coefficients exist only for positive frequencies this spectra is called single sided spectra.

- The spectrum of trignometric fourier series extends from 0 to ∞



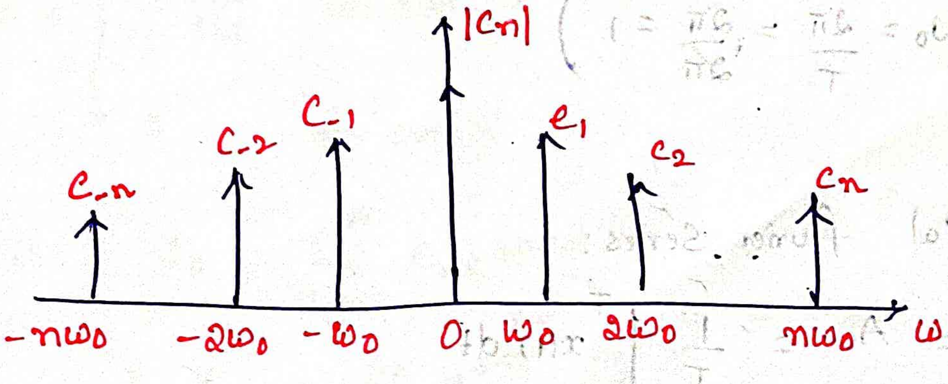
→ The cosine representation of Periodic signal contains only Positive amplitude coefficients with phase angle $\theta_n$

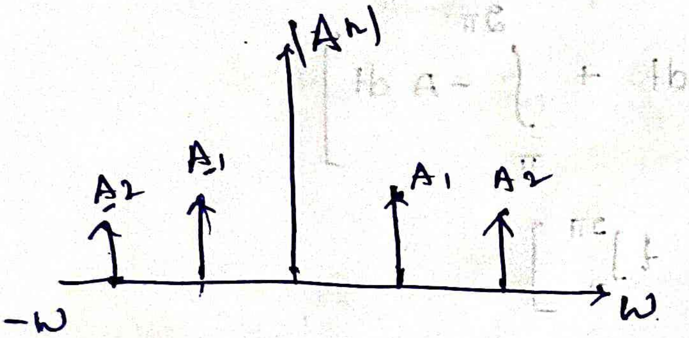
- We can plot amplitude spectra ($A_n$ versus $\omega$) and phase spectra ($\theta_n$ versus $\omega$).

- The exponential representation of Periodic signal contains amplitude coefficients $C_n$ which are complex, they can be represented by magnitude and phase

Exp ∴ We can plot two spectra i.e, magnitude spectrum $|C_n|$ versus $\omega$ and phase spectrum $\angle C_n$ versus $\omega$

- The spectra can be plotted for both +ve and -ve frequencies. The exponential fourier series extends from $-\infty$ to $\infty$. Hence it is called two sided spectra.



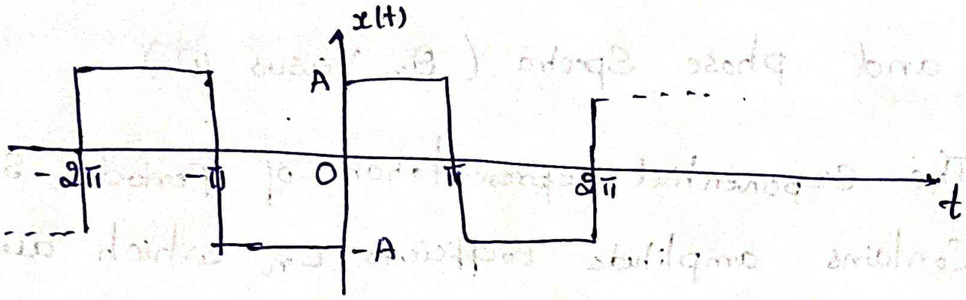




$C_n = |C_n| e^{j\theta_n}$

$C_{-n} = |C_n| e^{-j\theta_n}$

$|C_n| = |C_{-n}|$

Prb: Obtain the exponential fourier Series for the waveform shown in figure. Also draw the freq Spectrum




Sol: The Periodic waveform shown in fig. with a period $T = 2\pi$ can be expressed as

$$x(t) = \begin{cases} A & 0 \le t \le \pi \\ -A & \pi \le t \le 2\pi \end{cases}$$

$$\left( \because t_0 = 0, \; t_0 + T = 2\pi \right.$$

$$\left. \omega_0 = \frac{2\pi}{T} = \frac{2\pi}{2\pi} = 1 \right)$$

Exponential fourier Series:

$$C_0 = A_0 = \frac{1}{T}\int_0^T x(t)\,dt$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi} A\,dt + \int_{\pi}^{2\pi} -A\,dt\right]$$

$$= \frac{A}{2\pi}\left[t\Big]_0^{\pi} - t\Big]_{\pi}^{2\pi}\right]$$

$$= \frac{A}{2\pi}\left[\pi - 0 - (2\pi - \pi)\right]$$

$$= 0$$

$$C_n = \frac{1}{T}\int_0^T x(t)\, e^{-jn\omega_0 t}\, dt$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi} A e^{-jnt} dt + \int_{\pi}^{2\pi} -A e^{-jnt} dt\right]$$

$$= \frac{+A}{2\pi}\left[\left[\frac{e^{-jnt}}{-jn}\right]_0^{\pi} - \left[\frac{e^{-jnt}}{-jn}\right]_{\pi}^{2\pi}\right] = \frac{-A}{j2n\pi}\left[\left(e^{-jn\pi} - e^{0}\right) - \left(e^{-j2n\pi} - e^{-jn\pi}\right)\right]$$

~~$= \frac{-A}{j2n\pi}\left[(-1)^n - 1 - (1 - (-1)^n)\right]$~~

$$= \frac{-A}{j2n\pi}\left[-1 - 1 - (1 - (-1))\right]$$

$$= \frac{-A}{j2n\pi}[-4] = \frac{2A}{jn\pi}$$

$$= \frac{-j2A}{n\pi}$$

(Note: $e^{-j\theta} = \cos\theta - j\sin\theta$

If $\theta = n\pi$, $n = 1$

$\therefore \theta = \pi$

$\cos\pi - j\sin\pi = -1$

$n = 2$, $\theta = 2\pi$

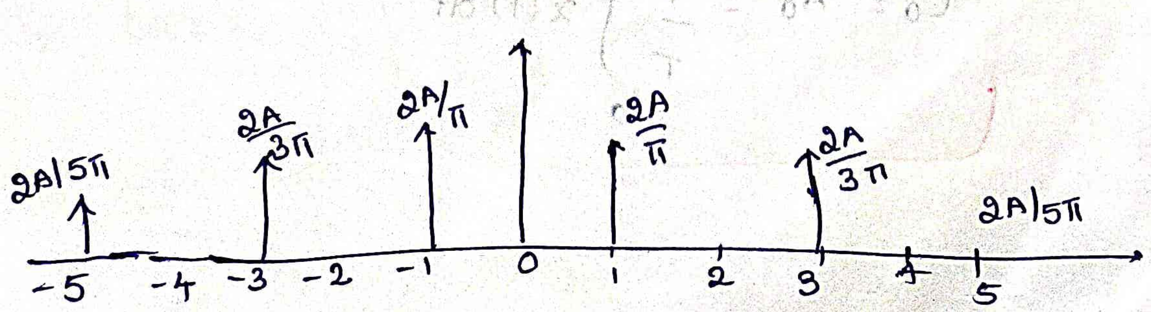
$\cos 2\pi - j\sin 2\pi = 1$ )

$$C_n = \begin{cases} -j\dfrac{2A}{n\pi} & \text{for odd } n \\ 0 & \text{for even } n \end{cases}$$

$$x(t) = C_0 + \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$$

$$= \sum_{n=-\infty}^{\infty} -j\frac{2A}{n\pi} e^{jnt} \quad \text{for odd } n$$

$C_0 = 0$, $C_1 = C_{-1} = \frac{2A}{\pi}$, $C_{-3} = C_3 = \frac{2A}{3\pi}$, $C_5 = C_{-5} = \frac{2A}{5\pi}$



# Determination of Coeff's of Exponential fourier Series

As we know from Exponential fourier Series

$$x(t) = \sum_{n=-\infty}^{\infty} c_n \, e^{jn\omega_0 t} \quad , \quad \omega_0 = \frac{2\pi}{T}$$

Multiply with $e^{-jk\omega_0 t}$ on both sides and integrate over one Period

$$\therefore \int_{t_0}^{t_0+T} x(t)\, e^{-jk\omega_0 t} = \sum_{n=-\infty}^{\infty} c_n \int_{t_0}^{t_0+T} e^{jn\omega_0 t} \cdot e^{-jk\omega_0 t} \, dt$$

$$= c_k \cdot T$$

We know that

$$\int_{t_0}^{t_0+T} e^{jn\omega_0 t} \, e^{-jk\omega_0 t} = \begin{cases} 0 & \text{for } k \neq n \\ T & \text{for } k = n \end{cases}$$

$$\therefore \int_{t_0}^{t_0+T} x(t)\, e^{-jk\omega_0 t} \, dt = T c_k$$

$$c_k = \frac{1}{T} \int_{t_0}^{t_0+T} x(t)\, e^{-jk\omega_0 t} \, dt$$

$$c_n = \frac{1}{T} \int_{t_0}^{t_0+T} x(t)\, e^{-jn\omega_0 t} \, dt$$

$$c_0 = A_0 = \frac{1}{T} \int_{t_0}^{t_0+T} x(t) \, dt$$

Prob 2: Find the exponential fourier series and plot the freq. spectrum for full wave rectified sine wave given in fig 4.18.

Waveform can be expressed over one period

$x(t) = A \sin \omega t$ where $\omega = \frac{2\pi}{2\pi} = 1$

bcoz it is a part of Sine wave with period $= 2\pi$

$x(t) = A \sin t \qquad 0 \le t \le \pi$

The full wave rectified sine wave is Periodic with Period $T = \pi$

$t_0 = 0$

$t_0 + T = 0 + \pi = \pi$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{\pi} = 2$

The Exponential fourier Series:

$$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$$

$$= \sum_{n=-\infty}^{\infty} C_n e^{j2nt}$$

Where $C_n = \frac{1}{T} \int_{t_0}^{t_0+T} x(t) e^{-jn\omega_0 t} dt$

$$= \frac{1}{\pi}\int_0^{\pi} A \sin t \, e^{-j2nt}\, dt$$

$$= \frac{A}{\pi}\int_0^{\pi} \sin t \, e^{-j2nt}\, dt$$

$$= \frac{A}{\pi}\int_0^{\pi} \left(\frac{e^{jt}-e^{-jt}}{2j}\right) e^{-j2nt}\, dt$$

$$= \frac{A}{2\pi j}\left[\int_0^{\pi} e^{j(1-2n)t} - e^{-j(1+2n)t}\, dt\right]$$

$$= \frac{A}{2\pi j}\left[\frac{e^{j(1-2n)t}}{1-2n} - \frac{e^{-j(1+2n)t}}{1+2n}\right]_0^{\pi}$$

$$= \frac{A}{2\pi j}\left[\frac{e^{j(1-2n)\pi}-e^{0}}{1-2n} - \frac{e^{-j(1+2n)\pi}-e^{0}}{1+2n}\right]$$

$$= \frac{A}{2\pi j}\left[\frac{e^{j\pi - j2n\pi}-e^{0}}{1-2n} - \frac{e^{-j\pi - j2n\pi}-e^{0}}{1+2n}\right]$$

$$= \frac{A}{2\pi j}\left[\frac{-1-1}{1-2n} - \frac{(-1-1)}{1+2n}\right]$$

$$= \frac{A}{\pi j}\left[\frac{1}{1-2n} + \frac{1}{1+2n}\right]$$

$$= \frac{A}{\pi j}\left[\frac{2}{1-4n^2}\right] = \frac{2A}{\pi(1-4n^2)}$$

for $n = 1, 2, 3, -1, -2, 3$

find $C_1, C_2, C_3, C_{-1}, C_{-2} \ldots$

# Properties of Continuous time fourier Series

$x_1(t)$ and $x_2(t)$ are two Periodic signals with Period T and with fourier series Coefficients $C_n$ and $D_n$ respectively.

## Linear Property

It states that

$$x_1(t) \longleftrightarrow C_n, \quad x_2(t) \longleftrightarrow D_n$$

then $$A\,x_1(t) + B\,x_2(t) \longleftrightarrow AC_n + BD_n$$

## Time Shifting Property :-

It states that $x(t) \longrightarrow C_n$

then $$x(t-t_0) \longleftrightarrow e^{-jn\omega_0 t}\, C_n$$

## Time Reversal Property :-

It states that

$$x(t) \longleftrightarrow C_n$$

then $$x(-t) \longleftrightarrow C_{-n}$$

## Time Scaling Property :

States that $x(t) \longleftrightarrow C_n$

then $x(\alpha t) \longleftrightarrow C_n$ with $\omega_0 \rightarrow \alpha\omega_0$

## Time Differentian Property:

States that $x(t) \longleftrightarrow C_n$

then $\frac{dx(t)}{dt} \longleftrightarrow jn\omega_0 C_n$

## Time Integration Property:

States that $x(t) \longleftrightarrow C_n$

then $\int_{-\infty}^{\infty} x(t)\, dt \longleftrightarrow \frac{C_n}{jn\omega_0}$ (if $C_0 = 0$)

## Convolution Property:

It states that $x_1(t) \longleftrightarrow C_n$

$x_2(t) \longleftrightarrow D_n$

then $x_1(t) * x_2(t) \xleftrightarrow{FS} T C_n D_n$

## Multiplication Property:

It states that $x_1(t) \longleftrightarrow C_n$

$x_2(t) \longleftrightarrow D_n$

then $x_1(t)\, x_2(t) \longleftrightarrow \sum_{l=-\infty}^{\infty} C_l D_{n-l}$

## Conjugate and Conjugate symmetry Property:

$x(t) \xleftrightarrow{FS} C_n$

Conjugate Property states that $x^*(t) \xleftrightarrow{FS} C_{-n}^*$

Conjugate Symmetry Property states that $C_{-n} = C_n^*$

# Parseval's Relation or Theorem or Property

If $x_1(t) \overset{FS}{\longleftrightarrow} C_n$

$x_2(t) \overset{FS}{\longleftrightarrow} D_n$

then Parsevals relation states that

$$\frac{1}{T}\int_{t_0}^{t_0+T} x_1(t)\, x_2^*(t)\, dt = \sum_{n=-\infty}^{\infty} C_n D_n^*$$

and Parsevals identity states that

$$\frac{1}{T}\int_{t_0}^{t_0+T} |x(t)|^2\, dt = \sum_{n=-\infty}^{\infty} |C_n|^2$$

if $x_1(t) = x_2(t) = x(t)$

Proof: Consider LHS

$$LHS = \frac{1}{T}\int_{t_0}^{t_0+T} x_1(t)\, x_2^*(t)\, dt$$

$$= \frac{1}{T}\int_{t_0}^{t_0+T} \left(\sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}\right) x_2^*(t)\, dt$$

$$= \sum_{n=-\infty}^{\infty} C_n \frac{1}{T}\int_{t_0}^{t_0+T} x_2^* t\, e^{jn\omega_0 t}\, dt$$

$$= \sum_{n=-\infty}^{\infty} C_n \cdot \frac{1}{T}\int_{t_0}^{t_0+T} \left[x_2(t)\, e^{-jn\omega_0 t}\right]^*$$

$$= \sum_{n=-\infty}^{\infty} C_n [D_n]^*$$

$$\therefore \frac{1}{T}\int_{t_0}^{t_0+T} x_1(t)\, x_2^*(t)\, dt = \sum_{n=-\infty}^{\infty} C_n D_n^*$$

Hence proved

Consider Parseval's identity

If $x_1(t) = x_2(t) = x(t)$ then the relation changes to

Consider above equation $\frac{1}{T}\int_{t_0}^{t_0+T} x_1(t)\, x_2^*(t)\, dt = \sum_{n=-\infty}^{\infty} C_n D_n^*$

$$\Rightarrow \frac{1}{T}\int_{t_0}^{t_0+T} x(t)\, x^*(t)\, dt = \sum_{n=-\infty}^{\infty} C_n C_n^*$$

Since $|x(t)|^2 = x(t)\, x^*(t)$

and $|C_n|^2 = C_n C_n^*$

Substituting these values we get

$$\Rightarrow \frac{1}{T}\int_{t_0}^{t_0+T} |x(t)|^2\, dt = \sum_{n=-\infty}^{\infty} |C_n|^2$$

# Fourier Transforms

fourier Series to analyze Periodic Signals.

- It is a combination of exponentials and the fourier coefficients.

- Fourier transforms mostly used to analyze aperiodic Signals and can be used to analyse Periodic also.

- Fourier transform is a technique which transforms Signals from the Continous time domain to Corresponding freq domain and Vice-Versa which applies for both periodic and aperiodic Signals.

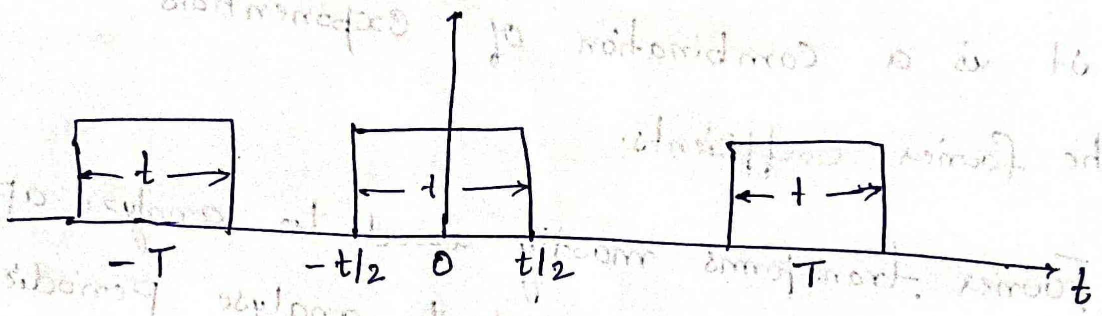
- Fourier transform can be developed by finding the fourieseries of Periodic function, and then tending to $\infty$

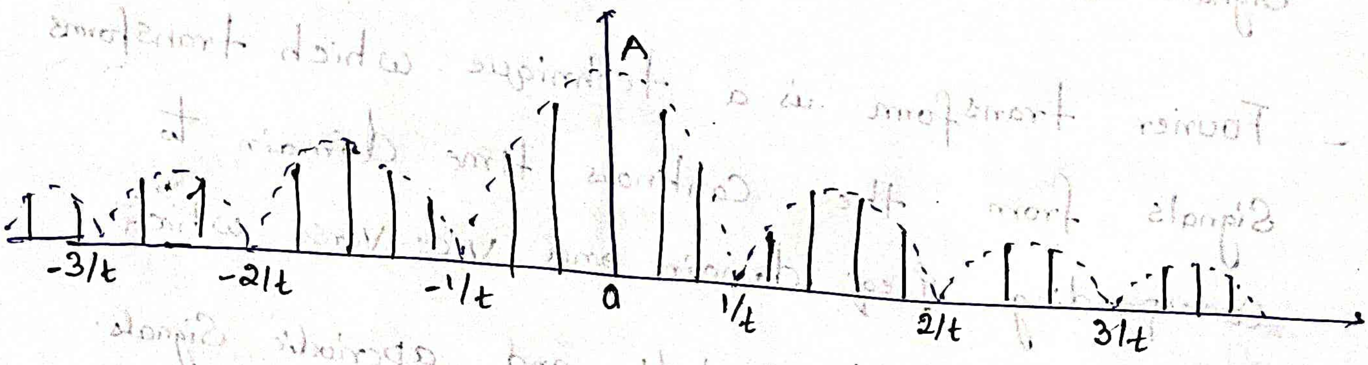
## Fourier Transform representation of Non Periodic function:-

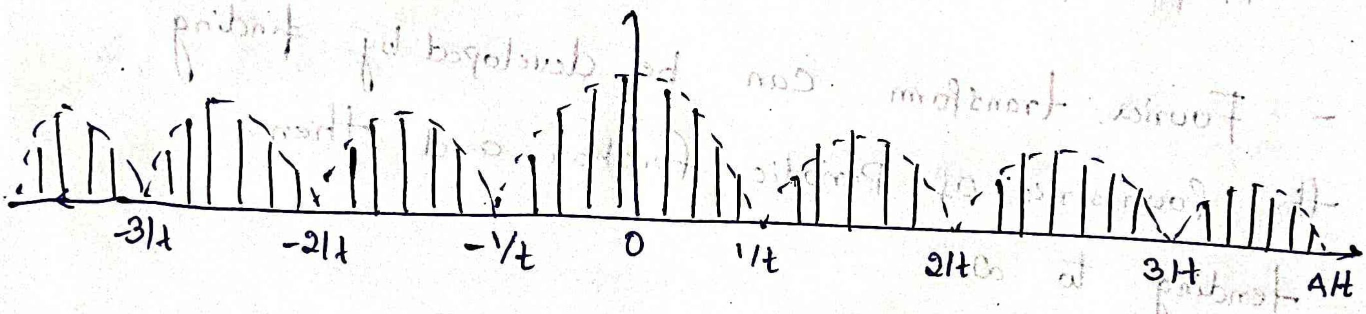
Consider an arbitory function $x(t)$ with a fundamental Period $T$

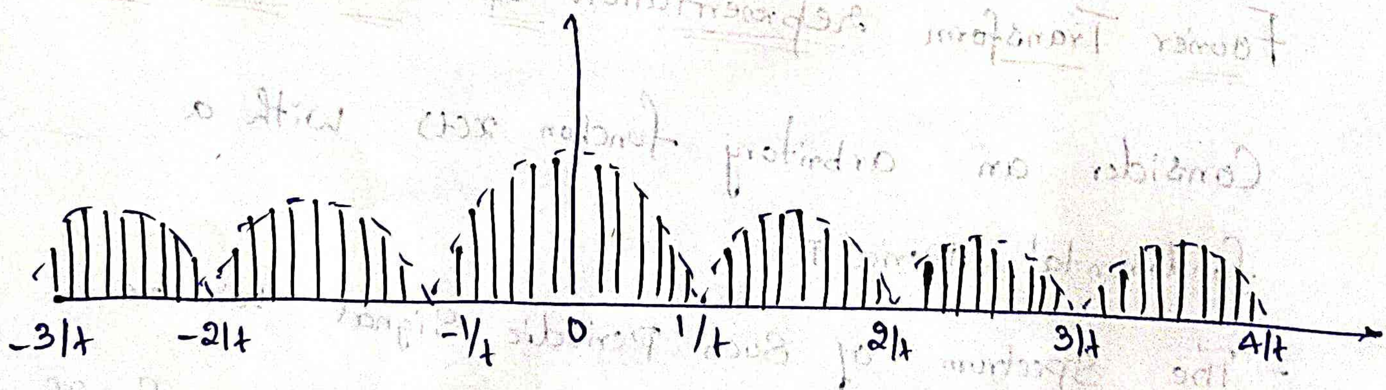
- The Spectrum of Such Periodic Signal will be discrete with Spectral lines of frequencies $0, f_0, 2f_0 \ldots$ with adjacent Spectral lines Separated by frequency interval of $f_0 = 1/T$

A plot of Spectrum of Signal $x(t)$ is given



- The amplitude of a Spectrum is decreased but the general shape remains unchanged.

- As seen in the figure, an increase in fundamental period T results in a Spectrum in which Spectral lines become closer and closer.

  as $f_0 = \frac{1}{T}$, T goes on increasing

  $f_0$ goes on decreasing

  and Spacing between Spectral lines become Smaller and Smaller

- AS T increases, T tends to infinity, $x(t)$ becomes a non periodic function

- At the Same time, Separation between the Spectral lines becomes infinetely Small, a non Periodic Signal will have Continous Spectrum.

## Derivation of fourier transform of Non Periodic Signal from the fourier Series of Periodic Signal:

Let $x(t)$ be non periodic function and $x_T(t)$ be periodic with period $T$

$$x(t) = \lim_{T \to \infty} x_T(t) \quad — (1)$$

Fourier Series of periodic Signal $x_T(t)$ is

$$x_T(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t} \quad — (2)$$

Where $C_n = \frac{1}{T} \int_{-T/2}^{T/2} x_T(t) e^{-jn\omega_0 t}$ $\left(\omega_0 = \frac{2\pi}{T}\right)$

$$TC_n = \int_{-T/2}^{T/2} x(t) e^{-jn\omega_0 t} dt$$

As $T \to \infty$, $n\omega_0 \to \omega$

$$TC_n = \lim_{T \to \infty} \int_{-T/2}^{T/2} x_T(t) e^{-j\omega t} dt$$

$$= \int_{-\infty}^{\infty} \left( \lim_{T \to \infty} x_T(t) \right) e^{-j\omega t} dt$$

$$= \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$= X(\omega)$$

$\therefore T C_n = X(\omega)$ — It is called fourier transform

Or fourier integral of $x(t)$

- $X(\omega)$ represents freq. spectrum of $x(t)$ and is called Spectral density function)

Since $X_T(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$

$$= \sum_{n=-\infty}^{\infty} \frac{X(\omega)}{T} e^{jn\omega_0 t}$$

$$= \sum_{n=-\infty}^{\infty} \frac{X(\omega)}{2\pi} e^{jn\omega_0 t} \omega_0 \qquad \left(\because T = \frac{2\pi}{\omega_0}\right)$$

Substitute $X_T(t)$ in ①

$$x(t) = \lim_{T\to\infty} X_T(t)$$

$$= \lim_{T\to\infty} \frac{1}{2\pi} \sum_{n=-\infty}^{\infty} X(\omega) e^{jn\omega_0 t} \omega_0$$

$$= \frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega) e^{j\omega t}\, d\omega.$$

(As $T \to \infty$, $\omega_0 = \frac{2\pi}{T}$ infinitely small) represented by $d\omega$ and Summation becomes Integral)

$$\therefore x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega) e^{j\omega t}\, d\omega \quad — ③$$

∴ we have the equations

$$X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(\omega)\, e^{j\omega t}\, dt$$

Hence $x(t)$ is called the inverse fourier transform of $X(\omega)$

$X(\omega)$ and $x(t)$ are known as fourier transform Pair and can be denoted as

$$X(\omega) = F(x(t))$$

$$x(t) = F^{-1}\, X(\omega)$$

The other notation can be used to represent fourier transform pair is

$$x(t) \xleftrightarrow{FT} X(\omega)$$

# Properties of Fourier transforms

Dirchlets Conditions:-

The Conditions for a function $x(t)$ to have fourier transform are:

1. $x(t)$ is absolutely integral over the interval $-\infty$ to $\infty$

   i.e., $$\int_{-\infty}^{\infty} |x(t)|\, dt < \infty$$

2. $x(t)$ has finite number of discontinuities

3. $x(t)$ has finite number of maxima and minima in every finite time interval.

## Linearity Property:

If $x_1(t) \xleftrightarrow{FT} X_1(\omega)$ and $x_2(t) \xleftrightarrow{FT} X_2(\omega)$

then $a x_1(t) + b x_2(t) \longleftrightarrow a X_1(\omega) + b X_2(\omega)$

Where a and b are Constants

## Time Shifting Property:

If $x(t) \xleftrightarrow{FT} X(\omega)$

then $x(t-t_0) \xleftrightarrow{FT} e^{-j\omega t_0} X(\omega)$

**Frequency Shifting Property:**

If $x(t) \xleftrightarrow{FT} X(\omega)$

then $e^{j\omega_0 t} x(t) \xleftrightarrow{FT} X(\omega - \omega_0)$

**Time Reversal Property:**

It states that if $x(t) \xleftrightarrow{FT} X(\omega)$

then $x(-t) \xleftrightarrow{FT} X(-\omega)$

**Time Scaling Property:**

$x(t) \xleftrightarrow{FT} X(\omega)$

then $x(at) \xleftrightarrow{FT} \frac{1}{[a]} X\left(\frac{\omega}{a}\right)$.

**Differentiation in time domain Property:**

If $x(t) \xleftrightarrow{FT} X(\omega)$

$\frac{d}{dt} x(t) \xleftrightarrow{FT} j\omega X(\omega)$

**Differentiation in freq domain Property:-**

$x(t) \xleftrightarrow{FT} X(\omega)$

then $t\,x(t) \xleftrightarrow{FT} j\frac{d}{d\omega} X(\omega)$

**Time integration Property:**

If $x(t) \xleftrightarrow{FT} X(\omega)$

then $\int_{-\infty}^{\infty} x(t)\,dt \longleftrightarrow \frac{1}{j\omega} X(j\omega)$ (if $X(0) = 0$)

Convolution Property:

If $x(t) \longleftrightarrow x_1(\omega)$ , $x_2(t) \longleftrightarrow x_2(\omega)$

then $x_1(t) * x_2(t) \longleftrightarrow x_1(\omega)\, x_2(\omega)$

Multiplication Property:

If $x_1(t) \longleftrightarrow x_1(\omega)$ , $x_2(t) \longleftrightarrow x_2(\omega)$

then $x_1(t)\, x_2(t) \longleftrightarrow \frac{1}{2\pi} x_1(\omega) * x_2(\omega)$

Duality Property:

If $x(t) \longleftrightarrow X(\omega)$

then $X(t) \longleftrightarrow 2\pi\, x(-\omega)$

Modulation Property:

If $x(t) \longleftrightarrow X(\omega)$

then $x(t) \cos\omega_c t \longleftrightarrow \frac{1}{2}\left[X(\omega-\omega_c) + X(\omega+\omega_c)\right]$

Conjugation Property:

If $x(t) \longleftrightarrow X(\omega)$

then $x^*(t) \longleftrightarrow x^*(-\omega)$.

Autocorrelation Property:

If $x(t) \longleftrightarrow X(\omega)$

then $R(t) \longleftrightarrow |X(\omega)|^2$

The auto correlation of a time domain signal is equal to square of the module of its spectra.

# Parseval's Theorem

If $x_1(t) \xleftrightarrow{FT} X_1(\omega)$

$x_2(t) \xleftrightarrow{FT} X_2(\omega)$

then Parseval's relation states that

$$\int_{-\infty}^{\infty} x_1(t)\, x_2^*(t)\, dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} X_1(\omega)\, X_2^*(\omega)\, d\omega$$

Parsevals identity states

$$E = \int_{-\infty}^{\infty} |x(t)|^2\, dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(\omega)|^2\, dt$$

**Proof:**

Consider LHS

$$\int_{-\infty}^{\infty} x_1(t)\, x_2^*(t)$$

$$= \int_{-\infty}^{\infty} \frac{1}{2\pi} \int_{-\infty}^{\infty} (X_1(\omega)\, e^{j\omega t}\, d\omega)\, x_2^*(t)\, dt$$

$$= \frac{1}{2\pi} \int_{-\infty}^{\infty} X_1(\omega) \int_{-\infty}^{\infty} (x_2^*(t)\, e^{j\omega t}\, dt)\, d\omega$$

$$= \frac{1}{2\pi} \int_{-\infty}^{\infty} X_1(\omega) \int_{-\infty}^{\infty} \{ x_2(t)\, e^{-j\omega t}\, dt \}^*\, d\omega$$

$$= \frac{1}{2\pi} \int_{-\infty}^{\infty} X_1(\omega)\, (X_2(\omega))^*\, d\omega = \text{RHS}$$

Parsevals identity:

If $x_1(t) = x_2(t) = x(t)$

then Energy of the signal

$$E = \int_{-\infty}^{\infty} x(t)\, x^*(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} X(\omega)\, X^*(\omega)\, d\omega$$

Since $|x(t)|^2 = x(t)\, x^*(t)$

$$|X(\omega)|^2 = X(\omega)\, X^*(\omega)$$

$\therefore$ we get

$$E = \int_{-\infty}^{\infty} |x(t)|^2\, dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} |X(\omega)|^2\, d\omega$$

Hence Proved.

Problem:

Find the fourier transform of following signals

(a) $\cos\omega_0 t\; u(t)$

We know $X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$

$$= \int_{-\infty}^{\infty} \cos\omega_0 t\; u(t)\, e^{-j\omega t}\, dt$$

$$= \int_{-\infty}^{\infty} \left( \frac{e^{j\omega_0 t} + e^{-j\omega_0 t}}{2} \right) u(t)\, e^{-j\omega t}\, dt$$

$$= \frac{1}{2} \int_{0}^{\infty} e^{-j(\omega - \omega_0)t}\, dt + \int_{0}^{\infty} e^{-j(\omega + \omega_0)t}\, dt$$

$$= \frac{1}{2} \left[ \frac{e^{-j(\omega - \omega_0)t}}{-j(\omega - \omega_0)} + \frac{e^{-j(\omega + \omega_0)}}{-j(\omega + \omega_0)} \right]_0^{\infty}$$

At $\omega = \omega_0$, $\omega = -\omega_0$

$$\Rightarrow = \frac{1}{2} \left[ \frac{e^{0}}{-j(\omega - \omega_0)} + \frac{e^{-0}}{-j(\omega + \omega_0)} \right]$$

$$= \frac{1}{2} \left[ \frac{1}{-j(\omega - \omega_0)} + \frac{1}{-j(\omega + \omega_0)} \right]$$

$$= \frac{1}{2} \left[ \frac{j\omega}{(\omega^2 - \omega_0^2)} \right]$$

(b) $x(t) = e^{-t} \sin 5t\, u(t)$

$$= e^{-t} \left[ \frac{e^{j5t} - e^{-j5t}}{2j} \right]$$

$$X(\omega) = F\left[ e^{-t} \sin 5t\, u(t) \right]$$

$$= F\left[ e^{-t} \left( \frac{e^{j5t} - e^{-j5t}}{2j} \right) \right]$$

$$= \frac{1}{2j}\int_{-\infty}^{\infty} \left[e^{-t}\left(e^{j5t} - e^{-j5t}\right) u(t)\right] e^{-j\omega t}\, dt$$

$$= \frac{1}{2j}\left[\frac{e^{-[1+j(\omega-5)]t}}{-[1+j(\omega-5)]} - \frac{e^{-[1+j(\omega+5)]t}}{-[1+j(\omega+5)]}\right]_0^{\infty}$$

$$= \frac{1}{2j}\left[\frac{1}{-[1+j(\omega-5)]} - \frac{1}{-[1+j(\omega+5)]}\right]$$

$$= -\frac{1}{2j}\left[\frac{1+j(\omega+5) - (1+j(\omega-5))}{[1+j(\omega-5)][1+j(\omega+5)]}\right]$$

$$= -\frac{1}{2j}\left[\frac{j(\omega+5) - j(\omega-5)}{(1+j\omega)^2+5^2}\right]$$

$$= -\frac{1}{\cancel{2j}}\left[\frac{\overset{5}{\cancel{10j}}}{(1+j\omega)^2+5^2}\right]$$

$$= -\frac{5}{(1+j\omega)^2+5^2}$$

$(1+j\omega-5j)$

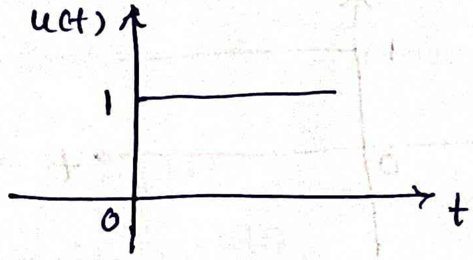
$(1+j\omega+5j)$

$(1+j\omega)^2 - (5j)^2$

$\left((1+j\omega)^2+5^2\right)$

**Unit Step function:** It is defined as

$$u(t) = \begin{cases} 1 & \text{for } t \geq 0 \\ 0 & \text{for } t \leq 0 \end{cases}$$




$(t>0)$

for u(t)

$t=0, \quad u(0)=0$

$t=1, \quad u(1)=1$

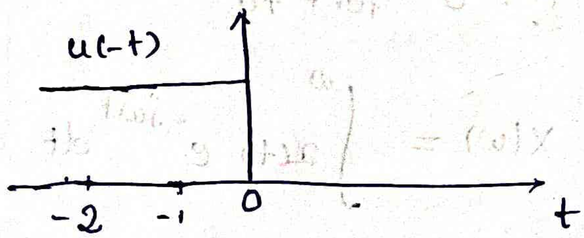
$t=2, \quad u(2)=2$

for $u(-t)$

| | |
|---|---|
| $t=0, \quad u(-0)=0$ | $t=-1, \quad u(-(-1))=u(1)=1$ |
| $t=1, \quad u(-1)=0$ | $t=-2, \quad u(-(-2))=u(2)=2$ |
| $t=2, \quad u(-1)=2$ | |

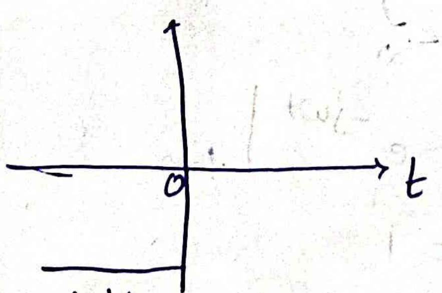
$u(-t) = 1 \quad t \leq 0$

$\quad\quad\quad\; 0 \quad t>0$




(∵ Step function is defined for 0 to ∞ only ∴ $u(-t)$ is zero for all positive t values.)

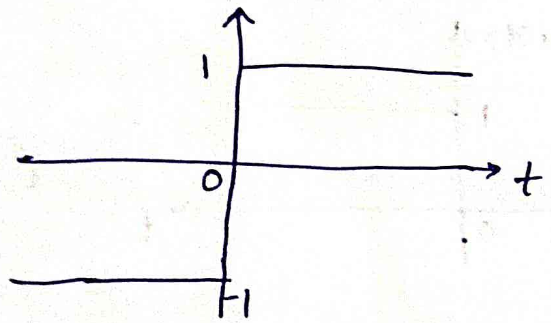
If we consider $-u(-t)$




$-u(-t)$

Generally we have Sign function as

$$\text{Sign}(t) = \begin{cases} 1 & \text{for } t > 0 \\ -1 & \text{for } t < 0 \end{cases}$$

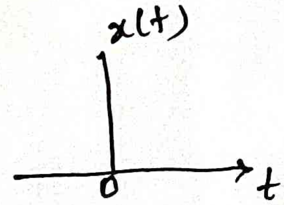



$$\text{Sign}(t) = u(t) - u(-t)$$

**Impulse function:** It is denoted as $\delta(t)$

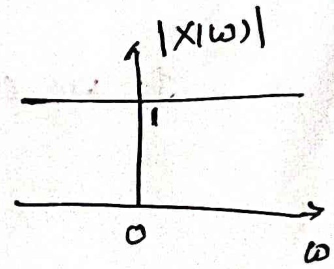
Given $x(t) = \delta(t)$

$$\delta = \begin{cases} 1 & \text{for } t = 0 \\ 0 & \text{for } t \neq 0 \end{cases}$$



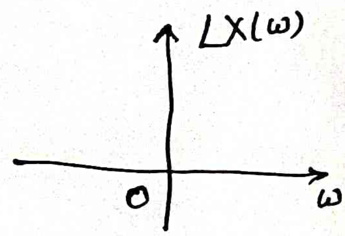

then $X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$

$$= \int_{-\infty}^{\infty} \delta(t) e^{-j\omega t}\, dt$$




$$= e^{-j\omega t}\Big|_{t=0}$$

$$= 1$$




$\therefore F[\delta(t)] = 1$

$|X(\omega)| = 1$

$\angle X(\omega) = 0$

**Signum function :- Sgn(t)**

$$\text{Sgn}(t) = \begin{cases} 1 & \text{for } t > 0 \\ -1 & \text{for } t < 0 \end{cases}$$

Let us consider the function $e^{-a(t)}\,\text{Sgn}(t)$

$$x(t) = \text{Sgn}(t)$$

$$= \lim_{a \to 0} e^{-a(t)}\,\text{Sgn}(t)$$

$$= \lim_{a \to 0} \left[ e^{-a(t)} u(t) - e^{+at} u(-t) \right]$$

$$X(\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$= \int_{-\infty}^{\infty} \lim_{a \to 0} \left( e^{-at} u(t) - e^{+at} u(-t) \right) e^{-j\omega t}\, dt$$

$$= \lim_{a \to 0} \left[ \int_{-\infty}^{\infty} e^{-at} e^{-j\omega t} u(t)\, dt - \int_{-\infty}^{\infty} e^{+at} e^{-j\omega t} u(-t)\, dt \right]$$

$$= \lim_{a \to 0} \left[ \int_{0}^{\infty} e^{-(a+j\omega)t}\, dt - \int_{-\infty}^{0} e^{(a-j\omega)t}\, dt \right]$$

$$= \lim_{a \to 0} \left[ \int_{0}^{\infty} e^{-(a+j\omega)t}\, dt - \int_{0}^{\infty} e^{+(a+j\omega)t}\, dt \right]$$

$$= \lim_{a \to 0} \left[ \left. \frac{e^{-(a+j\omega)t}}{-(a+j\omega)} \right|_{0}^{\infty} - \left. \frac{e^{+(a-j\omega)t}}{-(a+j\omega)} \right|_{0}^{\infty} \right]$$

$$= \lim_{a \to 0} \left[ \frac{e^{-\infty} - e^{0}}{-(a+j\omega)} - \frac{e^{-\infty} - e^{0}}{-(a-j\omega)} \right]$$

$$= \lim_{a \to 0} \left[ \frac{1}{a+j\omega} - \frac{1}{a-j\omega} \right]$$

$$= \frac{a - j\omega - (a+j\omega)}{(a+j\omega)(a-j\omega)}$$

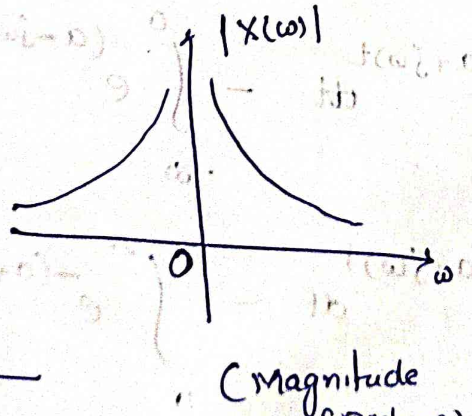
$$= \frac{-j\omega - j\omega}{-(j\omega)^2} = \frac{-2j\omega}{-j^2\omega^2}$$

$$= \frac{2}{j\omega}$$

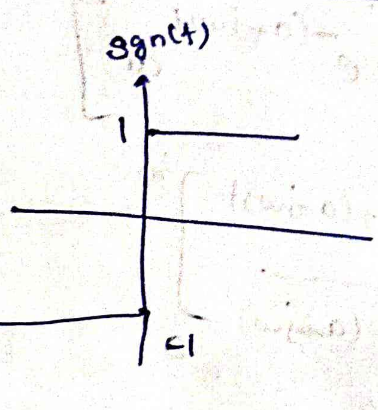
$$F(sgn(t)) = \frac{2}{j\omega}$$

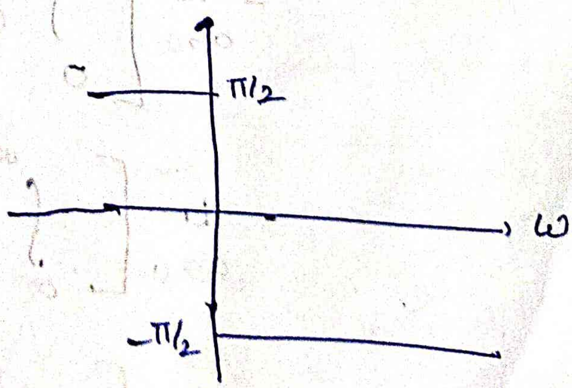
$$\therefore |X(\omega)| = \frac{2}{\omega}, \quad \angle X(\omega) = \frac{\pi}{2} \text{ or } \omega < 0$$

$$-\pi/2 \text{ or } \omega > 0$$




(Magnitude Spectrum)




(Phase Spectrum)

## Introduction to Hilbert Transform:

When the phase angles of all positive freq spectral components of given signal are shifted by +90° and all phase angle of negative freq spectral components are shifted by +90°, the resulting function of time is called Hilbert transform.

The amplitude spectrum of signal is unchanged by Hilbert operation, only phase spectrum of signal is changed.

The Hilbert transform $\hat{x}(t)$ of a signal $x(t)$ is obtained by convolving $x(t)$ with $\frac{1}{\pi t}$

$$\hat{x}(t) = x(t) * \frac{1}{\pi t}$$

$$\hat{x}(t) = \frac{1}{\pi}\int_{-\infty}^{\infty} \frac{x(\tau)}{t-\tau}\,d\tau \quad \text{or} \quad \hat{x}(t) = \frac{1}{\pi}\int_{-\infty}^{\infty} \frac{x(t-\tau)}{\tau}\,dt$$

The above definition of Hilbert transform is applicable to all signals that are fourier transformable

The inverse Hilbert transform, by means of which

The Original Signal $x(t)$ is recovered from $\hat{x}(t)$ is defined by

$$x(t) = -\frac{1}{\pi} \int_{-\infty}^{\infty} \frac{\hat{x}(\tau)}{t-\tau} d\tau$$

The functions $x(t)$ and $\hat{x}(t)$ are said to constitute a Hilbert transform pair.

For the time function $1/\pi t$, we have

$$\frac{1}{\pi t} \longleftrightarrow -j\, sgn(\omega) \quad (\text{from duality property})$$

Where $sgn(\omega)$ is the Signum function in the freq. domain given by

$$sgn(\omega) = \begin{cases} 1 & \omega > 0 \\ -1 & \omega < 0 \end{cases}$$

$$sgn(t) \longleftrightarrow \frac{2}{j\omega}$$

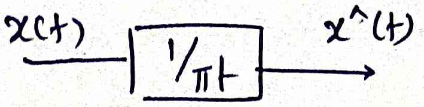
The fourier transform $\hat{x}(\omega)$ of $\hat{x}(t)$ is given by

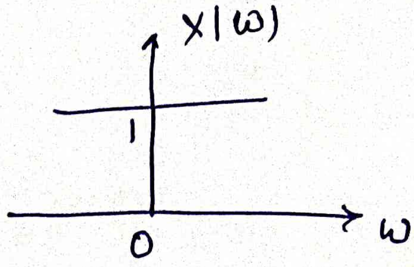
$$\hat{x}(t) = \frac{1}{\pi t} * x(t)$$

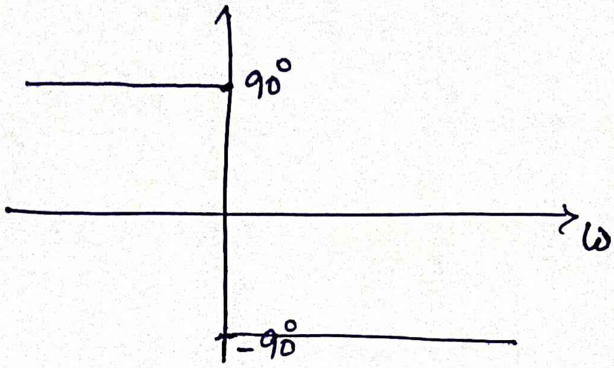
$$\hat{x}(\omega) = -j\, sgn(\omega)\, X(\omega)$$

$$(\because sgn(\omega) = 1)$$

$$\hat{x}(\omega) = \begin{cases} -j\, X(\omega) & \omega > 0 \\ j\, X(\omega) & \omega < 0 \end{cases}$$




This device may be considered as on one that produces a phase shift of $-90°$ for all positive frequency and $+90°$ for all negative frequencies.

The amplitudes are unaffected

$$\therefore \quad |x^{\wedge}(\omega)| = |X(\omega)|$$

Such an ideal device called Hilbert transformer. It may be viewed as ideal all pass 90° phase shifter.

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# II B.Tech I Semester Regular Examinations, February/March 2023

## ELECTRICAL CIRCUIT ANALYSIS
**(Electrical and Electronics Engineering)**

**Time: 3 hours** **Max Marks: 70**

**Instructions:**

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.
4. **CO** means Course Outcomes. **BL** means Blooms Taxonomy Levels.

### PART – A
**(Answer ALL questions. All questions carry equal marks)**

**10 * 2 = 20 Marks**

| | | | | | |
|---|---|---|---|---|---|
| **1. a.** | Write the expression for the exponential form of the Fourier series. | [2] | CO1 | BL1 |
| **b.** | State the Dirichlet's conditions for Fourier series. | [2] | CO1 | BL2 |
| **c.** | What is steady state response? | [2] | CO2 | BL1 |
| **d.** | What is the statement of composition theorm? | [2] | CO2 | BL2 |
| **e.** | List out the advantages of Three-Phase system | [2] | CO3 | BL1 |
| **f.** | What is mean by Dot convention in Coupled circuit | [2] | CO3 | BL2 |
| **g.** | list the various ways to find the Inverse Laplace transform | [2] | CO4 | BL1 |
| **h.** | What is the transfer function? | [2] | CO4 | BL2 |
| **i.** | Why are Y-parameters called short circuit admittance parameter? | [2] | CO5 | BL1 |
| **j.** | Write the conditions for symmetry and reciprocity for h parameters. | [2] | CO5 | BL2 |

### PART – B
**(Answer ALL questions. All questions carry equal marks)**

**5 * 10 = 50 Marks**

| | | | | |
|---|---|---|---|---|
| **2.** | Obtain the Fourier series for the wave form shown in fig. (1). | [10] | CO1 | BL2 |

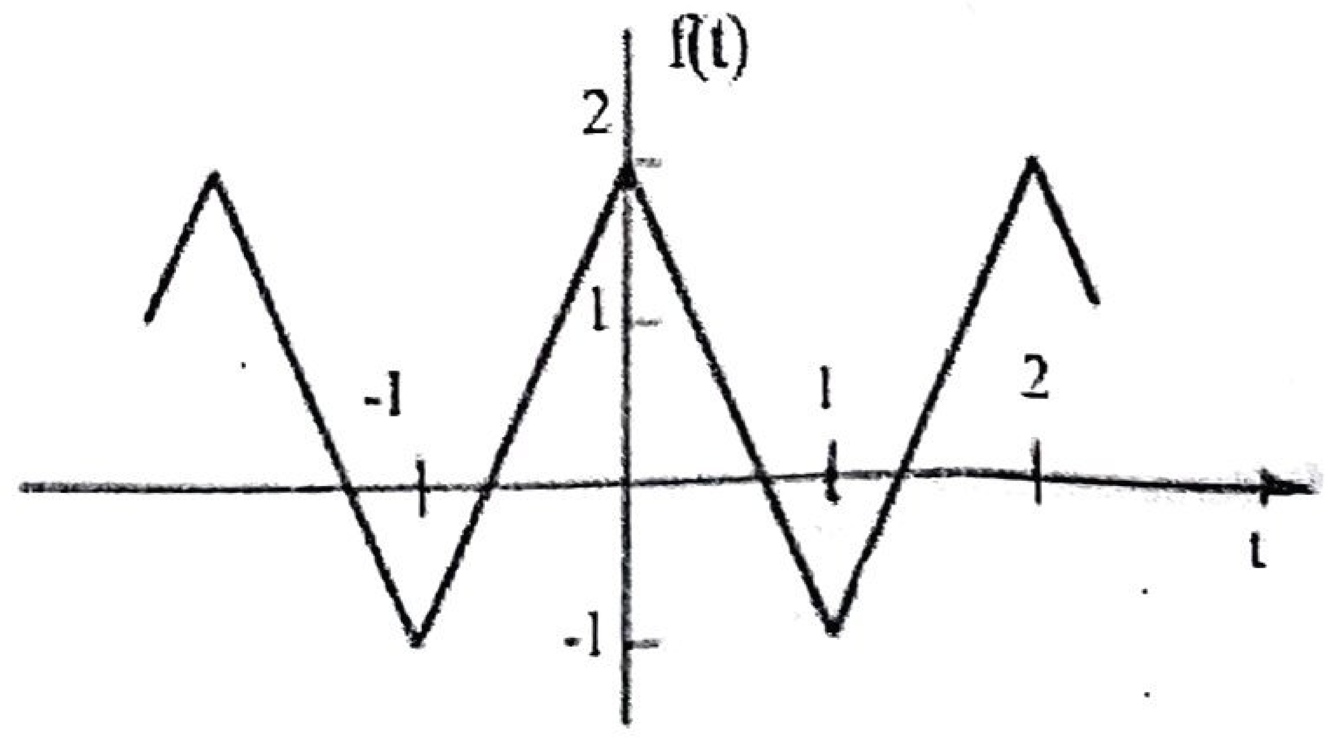


Fig. (1)

**OR**

3. Obtain the trigonometric Fourier series for the periodic waveform shown in fig. (2). [10] CO1 BL3

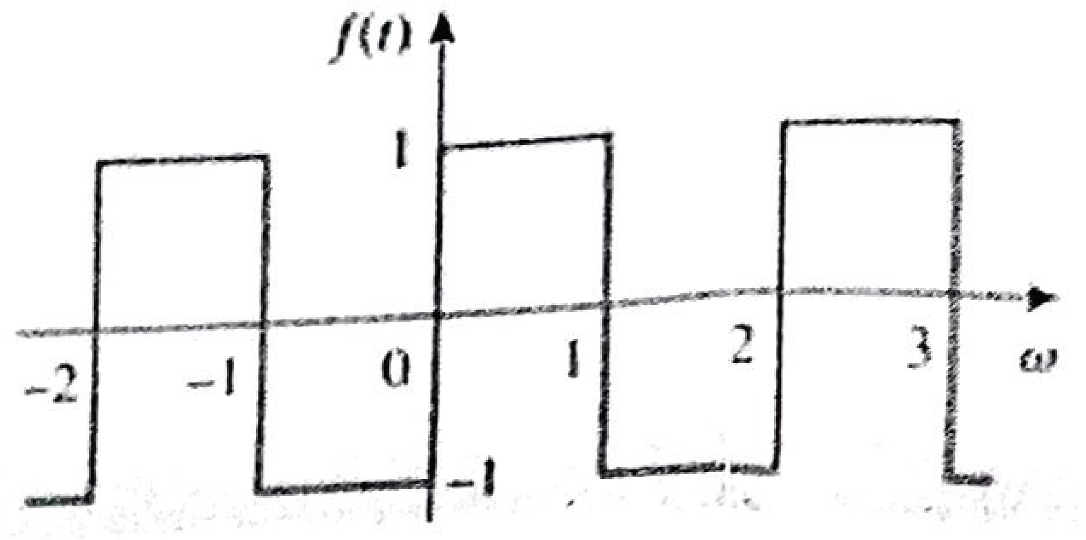


Fig. (2)

4. **(a)** State and explain Millman's theorem. [10] CO2 BL2

**(b)** State Telligence Theorem with one example.

**OR**

5. **(a)** For the network shown in Fig.(4) find the value of the resistance RL for maximum power transfer and calculate maximum power. [10] CO2 BL3

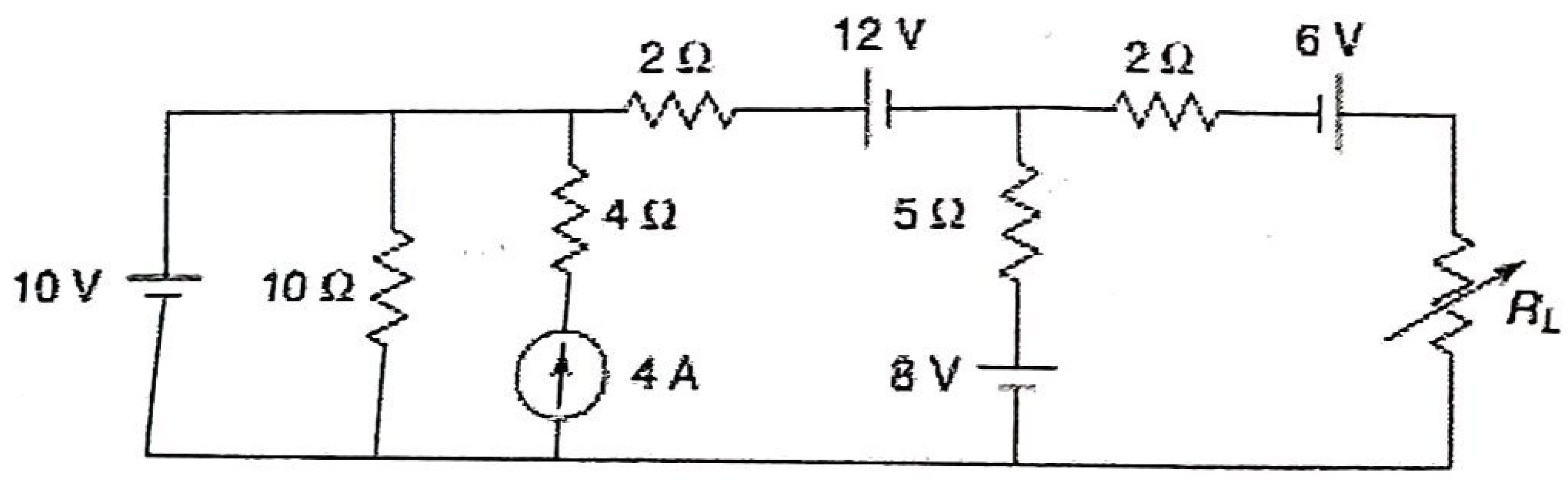


Fig. (4)

**(b)** State reciprocity theorem with one example.

6. (a) A three-phase, 400 V, 4-wire system of fig. (5) has a star-connected load with $Z_A$ (10+ j0) Ω, $Z_B$ = (15 + j10) Ω, $Z_C$ (0 + j5) Ω. Find the line currents and current through neutral conductor. [10] CO3 BL2

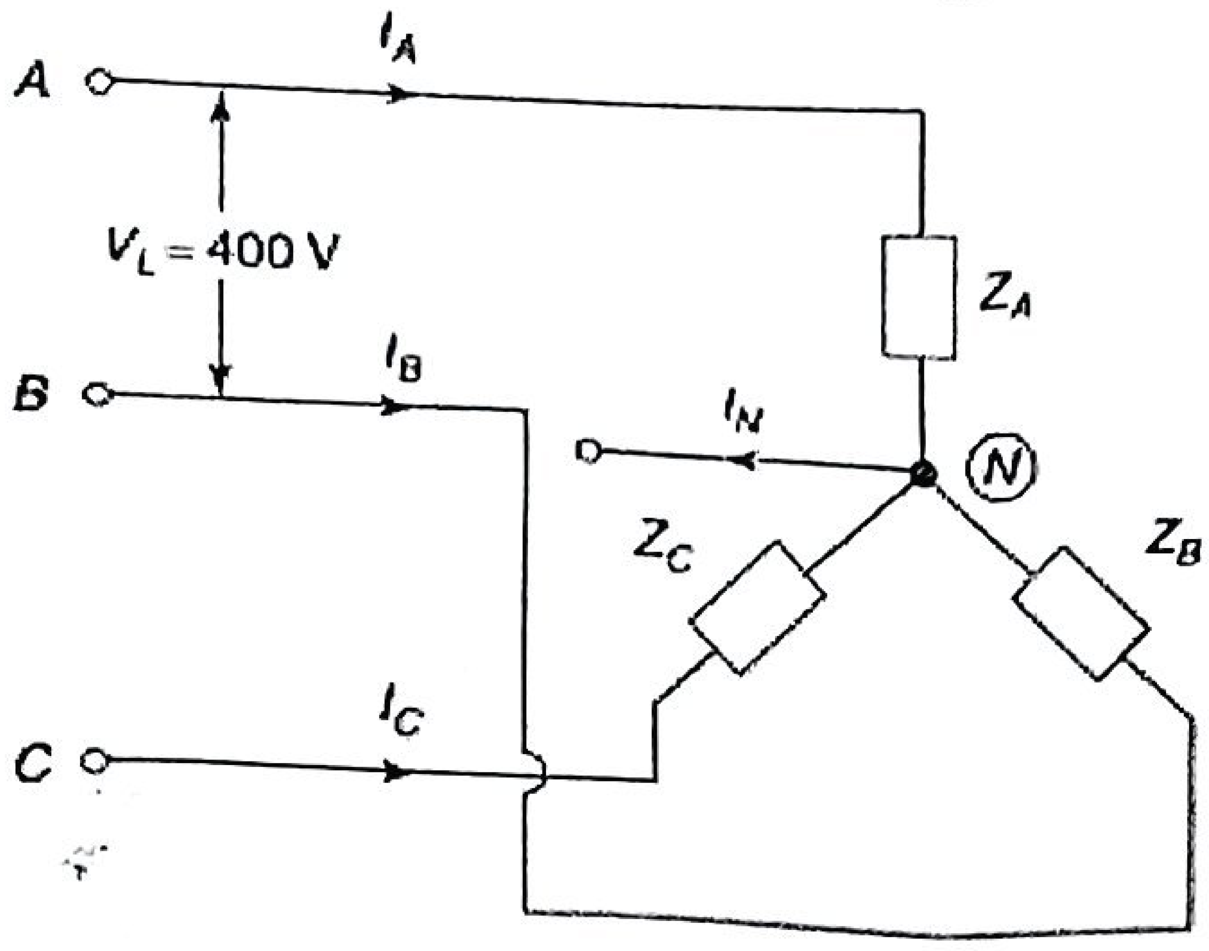


Fig. (5)

(b) Explain the procedure to measure the three phase Power by Two-wattmeter Method.

**OR**

7. (a) Derive the relationship between line and phase quantities in a 3-phase delta connected system balanced delta connected system and draw the phasor diagram. [10] CO3 BL3

(b) A three-phase, 10 kVA load has a power factor of 0.342. The power is measured by the two-wattmeter method. Find the reading of each wattmeter when the (i) power factor is leading, and the (ii) power factor is lagging.

8. (a) Find the Laplace transform of $\frac{\varepsilon^{-at}\varepsilon^{-bt}}{t}$ [10] CO4 BL3

(b) For the network shown in Fig. (6), the switch is open for a long time and closes at t = 0. Determine $V_C$ (t).

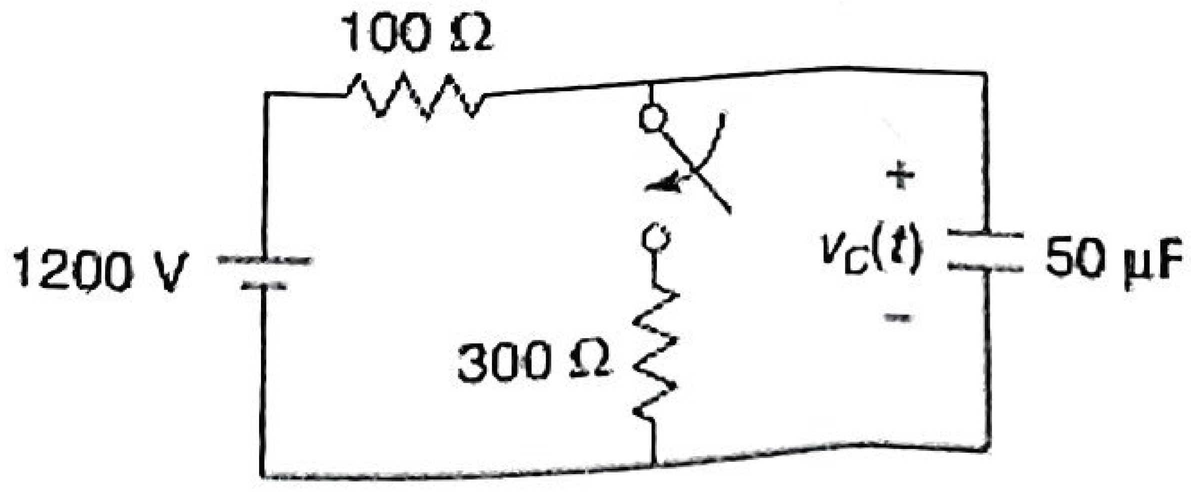


Fig. (6)

**OR**

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|---|---|---|

**9.** **(a)** Determine the inverse Laplace transform of the given functions [10] CO4 BL3

$$F(s) = \frac{(s+1)(s+4)(s+7)}{s(s+2)(s+5)}$$

**(b)** In the network of Fig. (7), the switch is opened at t = 0. Find i(t)

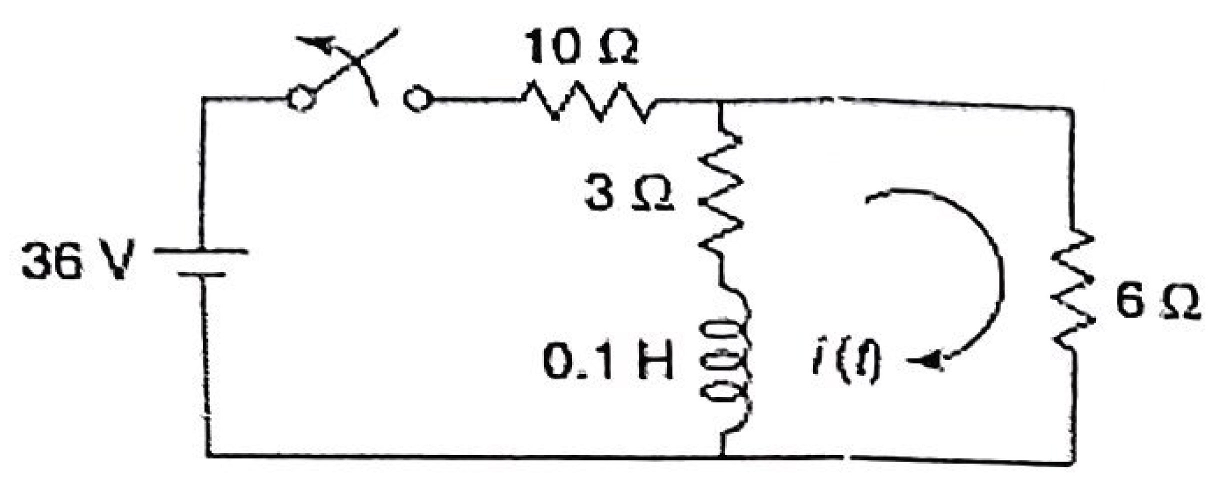



Fig. (7)

**10.** Find Z and ABCD parameters for the network shown in Fig. (8) [10] CO5 BL2

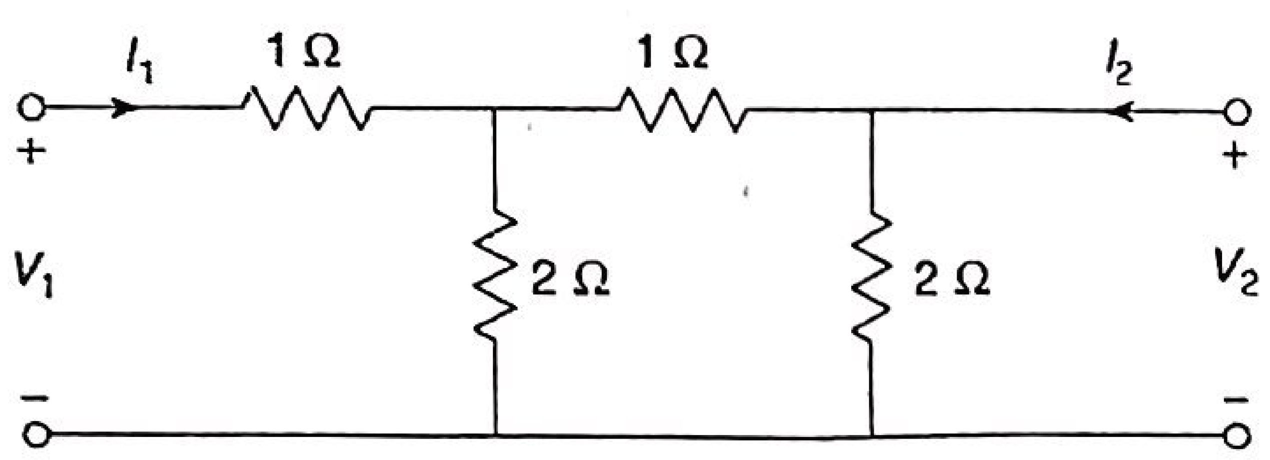



Fig. (8)

**OR**

**11.** The Z parameters of a Two Port Network are $Z_{11}$=10Ω, $Z_{22}$=20Ω, $Z_{12}$=12 and $Z_{21}$= 14 Ω Compute Y and h Parameters. [10] CO5 BL2

*****

①

D. Karuna kumar / 760

II B.Tech I sem Reg/ Supply - Feb/March - 2023

Electrical circuit Analysis

(GR20A2023)

scheme of Valuation

1) a)

A:- Expression for the exponential form of Fourier series

(i) Cosine Fourier representation

$x(t) = A_0 + \sum_{n=1}^{\infty} A_n \cos n\omega_0 t$

$x(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t}$ — 1M

$C_n = \frac{1}{T}\int_{t_0}^{t_0+T} x(t) e^{-jn\omega_0 t} dt$

(ii) trigonometric Fourier Series — 1M

$x(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\omega_0 t + \sum_{n=1}^{\infty} b_n \sin n\omega_0 t$

b)

A:- Dirichlet's Conditions to Fourier Series:- — 2M

(i) In every period the function x(t)

(ii) Must be single valued function

2) Has only finite no of max. & minima over the range of time period

3) Has a finite no of discontinuities

4) Absolutely integrable over one period.

c) steedy state response:- —2M

It is the behaviour of a circuit after a long time when steady conditions have been reached after an external excitation.

d) Compensation theory:- —2M

It state that any element in linear bilateral network may be replaced by voltage source whole value is equal to the current passing through the element multiplied by value of element; provided the current & voltage sources in other parts of the circuit remains unaltered.

e) —2M

A: Advantages of 3-φ system:-

1. For the same size & weight, a 3-φ machine can produce higher outputs than 1-φ machine

2. A 3-φ machine can be smaller than 1-φ machine for the same power

3. With one type of 3-φ connection, there are two voltage available: 230/440V.

(2)

f). Dot Convention in Coupled circuit:- —2M

→ Dot Convention is a technique; which gives the details about voltage polarity at the dotted terminal.

→ When there exists mutual inductance b/w the coils present in that circuit coil nothing but the series combination of resistor and inductor.

g) methods of finding inverse laplace transform —2M

1. Using Table
2. Method of partial fractions
3. Series expansion formula
4. methods of differential equation
5. the complex inversion formula

h) Transfer function: —2M

the ratio of laplace transform of output to the laplace transform of input

$$T(s) = \frac{L(y(s))}{L(x(s))}$$

(i) y-parameters are known as short circuit admittance parameters because in both the cases, one port is shorts ($V_1=0$; $V_2=0$) the Constants $Y_{11}, Y_{12}, Y_{21}, Y_{22}$ are called 'admittance' or y parameter of the two port network — 2M

(j) Condition for symmetry for h-parameter

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$I_2 = h_{21} I_1 + h_{22} V_2$$ 1M

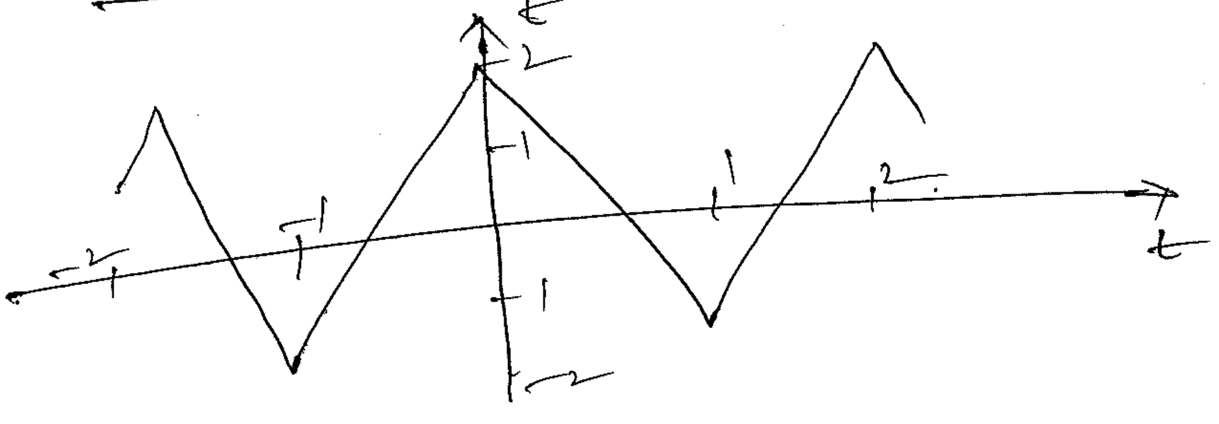
$$h_{11} h_{22} - h_{12} V_{21} = 1$$

Condition for reciprocity :- 1M

$$h_{21} = -h_{12}$$

2) Fourier series for the waveform

A:-



(3)

$$f(t) = \begin{cases} 3t+2 & \text{for } -1 \le t \le 0 \\ -3t+2 & \text{for } 0 \le t \le 1 \end{cases}$$

$x(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\omega_0 t + b_n \sin n\omega_0 t \, dt$ } 2M

$b_n = 0$. for even symmetry

$a_0 = \frac{2}{T} \int_0^{T/2} x(t)\,dt \quad T = 2$

$= \frac{2}{2} \int_0^1 3(t)+2\,dt = \int_0^1$

$= 3 \frac{t^2}{2} \Big]_0^1 + 2t = 3\left(\frac{1}{2}\right) + 2 = 3.5$

— 1M

$a_n = \frac{2}{T} \int_{t_0}^{t_0+T} x(t) \cos n\omega_0 t \, dt$

$= \frac{1}{2} \int (3t+2) \cos n\omega_0 t \, dt + \int_0^1 (3t+2) \cos n\omega_0 t$

$= \frac{1}{2} \int^0 (3t+2)\,dt$

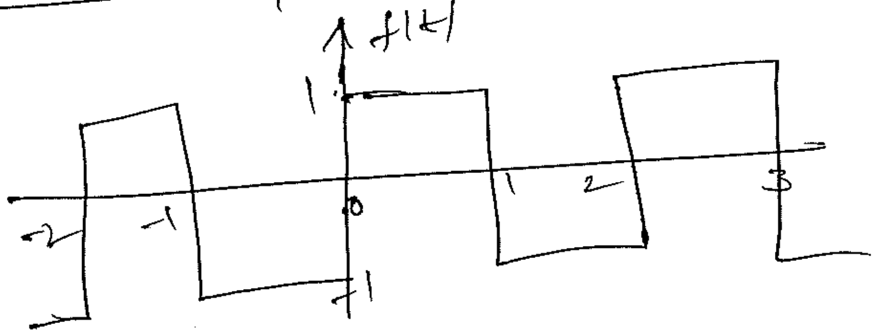
$b_n = \frac{4}{T} \int_0^{T/2} x(t) \sin n\omega_0 t \, dt$ — 1M

$b_n = \frac{4}{2} \int^0 (+3t-2) \sin n\omega_0 t \, dt + \int_0^1 (3t+2) \cos n\omega$

$= 2 \sin \omega_0 t \, dt$

$x(t) = a_0 + \sum_{n=1}^{\infty} \cos n\omega_0 t \, dt + b_n \sin n\omega_0 t \, dt$

3)
A)- Trigonometric Fourier Series




$f(t) = -f(-t) = \cdot\ f(t) = -f(t \pm T/2)$ — 2M

$f(t) = \begin{cases} 1 & 0 \le t < 1 \\ -1 & 1 < t < 2 \end{cases}$ $a_0 = 0$; $a_n = 0 \Rightarrow$ odd symmetry

$b_n = \frac{2}{T} \int_{t_0}^{t_0+T} f(t) \sin n\omega_0 t\, dt$ $T = 2$

$\omega_0 = 2\pi f_1 = 2\pi/2 = \pi$

$b_n = \frac{8}{T} \int_0^{T/4} f(t) \sin n\omega_0 t\, dt$

$b_n = \frac{8}{2} \int_0^1 f(t) \sin n\omega_0 t\, dt$

$= \frac{8}{2} \int_0^1 \sin n\pi t\, dt$

$= 4 \left( \frac{-\cos n\pi t}{n} \right)_0^1 = 4(-\cos n\pi - \cos 0)$

$= 4(-(-1)^n - 1)$

$b_n = \begin{cases} 0 & \text{for odd } n \\ 8 & \text{for even } n \end{cases}$ — 2M

$f(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\omega_0 t + b_n \sin n\omega_0 t$

$= \sum_{n=odd}^{\infty} b_n \sin n\omega_0 t$

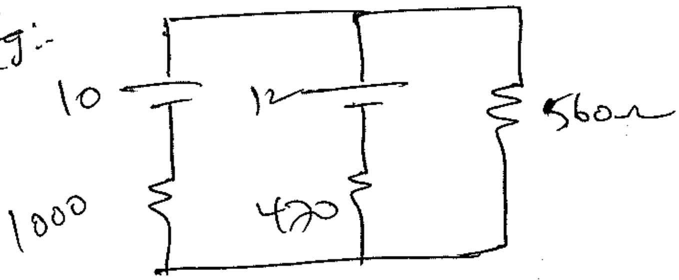
$f(t) = \begin{cases} 0 & \text{for odd } n \\ 8 & \text{for even } n \end{cases}$ — 1M

4) (4)

a) Millman's theorem :- — 2M

It state that in any network, the Voltage source $V_1, V_2 -- V_n$. in series with internal resistance $R_1, R_2, -- R_n$ respectively are in parallel. then these sources may be replaced by single voltage source $V'$ in series with $R'$. — 3M

Eg:-

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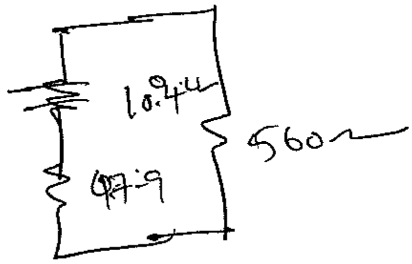
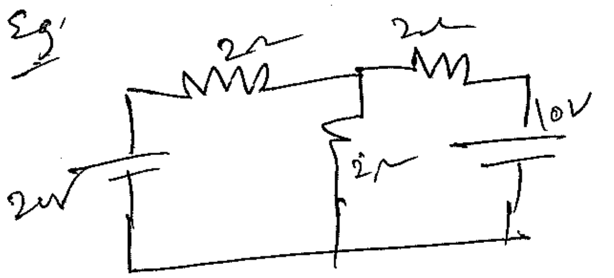



b)

A:- Telligence theorem:- — 2M

It state that the summation of direct power used by different elements with in different branches is equivalent to zero for any type of network. — 3M

Eg:



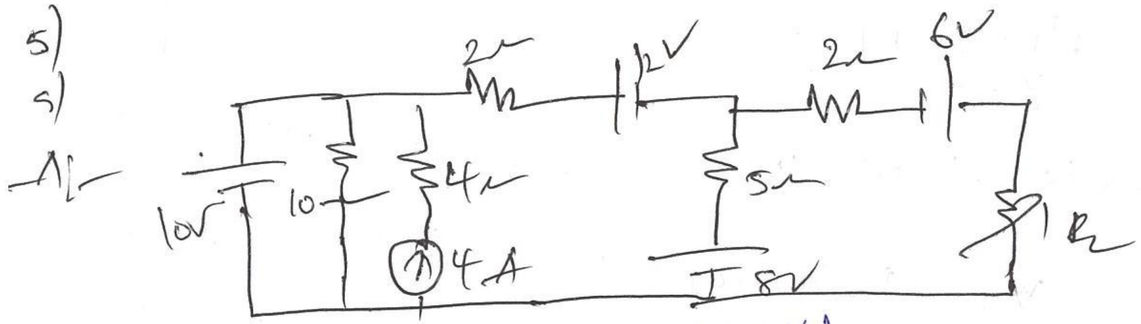

power supplied = power absorbed

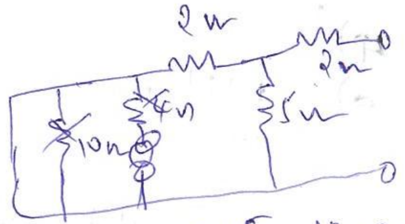
100W = 100W

20×5=100 = $5^2×2 + 5^2×2$

100W = 100W

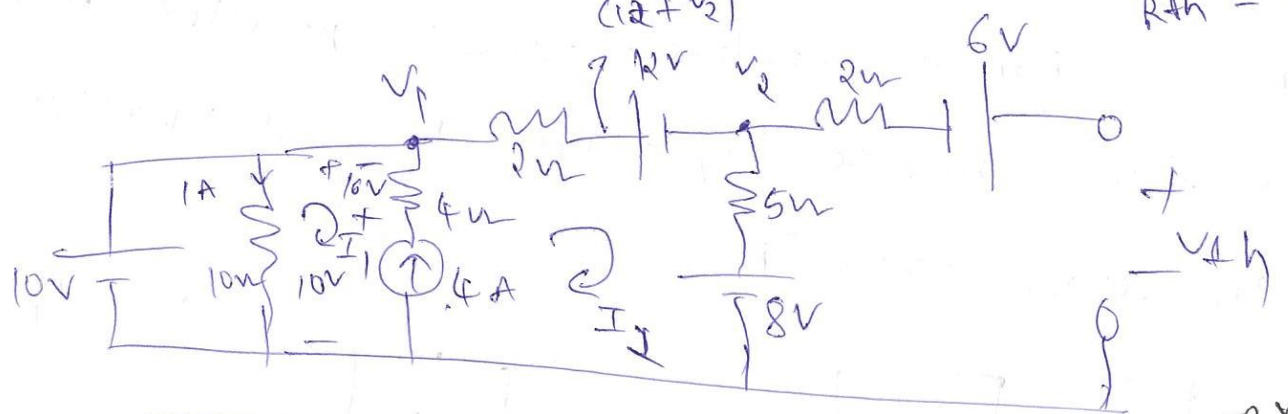
5)




$= \frac{2\times5}{7} = \frac{10}{7} + 2$

$R_{th} = 3.42$



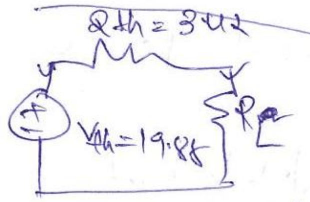

−2M

$-V_1 + 2I_1 + 12 + V_2 = 0$

$I_1 = \frac{V_1 - (12 + V_2)}{2}$

~~$-V_1 + V_1$~~

$10I_1 +$ ~~$4(I_1 - I_2) - 1$~~




$P_{max} = \frac{V_{th}^2}{4R_{th}}$

$= \frac{(19.88)^2}{4\times3.42}$

$P_{max} = 28.88$ watts — 1M

$2I_2 + 12 + 5I_2 + 8 = 0$

$10I_1 + 7I_2 + 20 = 0$

$10I_1 + 7I_2 = -20 \rightarrow (1)$

$I_2 - I_1 = 4 \rightarrow (2)$

$I_1 = -2.82, \quad I_2 = 1.1765$

$-V_{th} + 6 + 2\times0 + 5\times1.1765 + 8 = 0$

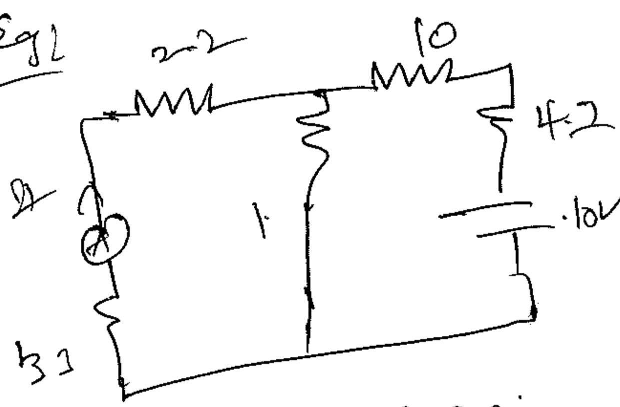
$V_{th} = 6 + 5.8825 + 8 = 19.8825$ — 2M

5) 6) Reciprocity theorem:

A) In linear passive and bilateral single source network the ratio of response to the excitation is constant even though the source is interchanged from input terminals to output terminals. — 2M

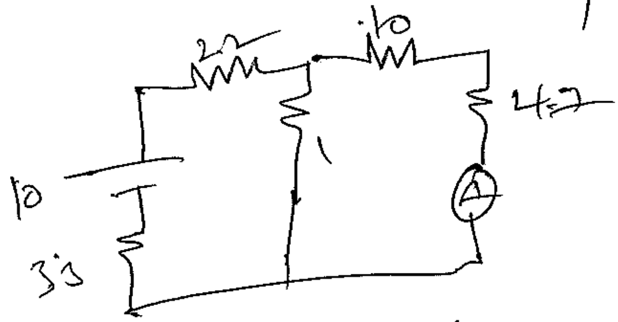
3M

Eg:



$I_1 = 0.098\,m$

$V/I = \frac{10}{0.09} = 102.04$



$I = 0.098\,mA$

$V/I = \frac{10}{0.098} = 102.04$

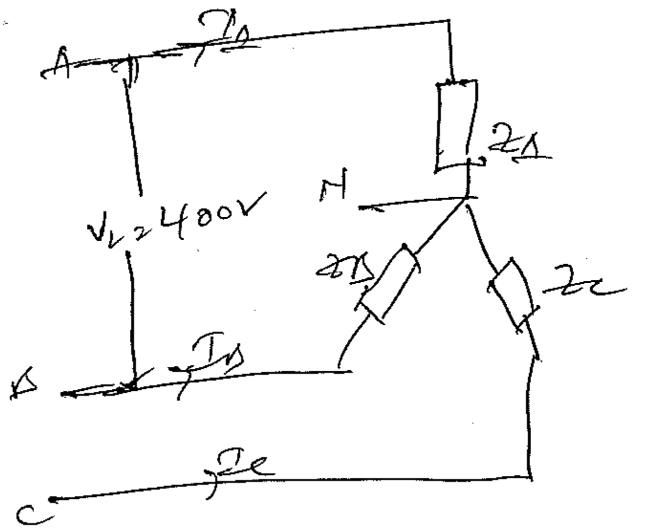
6)
a)

A:
$Z_A = (16+j0)$

$Z_B = (15+j10)\,\Omega$

$Z_C = (0+j5)\,\Omega$

$V_L = 400V$




$I_C = \frac{400\angle 0}{18\angle 0} = 40\angle 0A = 40+j0$ — 2M

$I_B = \frac{400\angle 120}{15+j10} = \frac{400\angle 120}{18.02\angle 0.588} = 22.19\angle 119.4 = 22.18+j0.432$

$I_C = \frac{400\angle 0}{(0+j5)} = \frac{400\angle 0}{5\angle 1.5} = 80\angle -1.5 = 5.65 - j79.79$

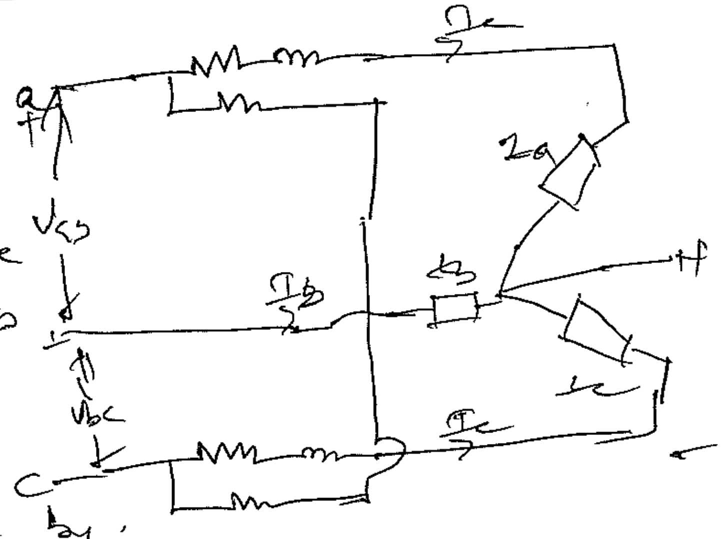
$I_N = -(I_a + I_b + I_c)$

$= -(40+j30 + 22.18 + j0.432 + 5.65 - j79.79)$

$= -(67.83 - j79.35) \Rightarrow -67.83 + j79.35$ — 3M

$I_N = 105.7\angle 2.292A$

6)
b)
A:— two-wattmeter method:




→ The phase difference b/w the phase current $I_c$ and line voltage $V_{ab}$ is $\theta+30$ — 2M

→ the average power read by wattmeter $W_1$ is

$P_1 = V_{ab} I_c (\cos(\theta+30)) = V_L I_c \cos(\theta+30)$ — 2M

→ the average power read by wattmeter 2 is

$P_2 = V_{cb} I_c \cos(\theta-30) = V_L I_c \cos(\theta-30)$

$P_1 + P_2 = V_L I_c (\cos(\theta+30) + \cos(\theta-30))$

$P_1 + P_2 = V_L I_c \, 2\cos\theta \cos 30 = \sqrt{3} V_L I_c \cos\theta$ — 1M

⑥ 7) a) A:-

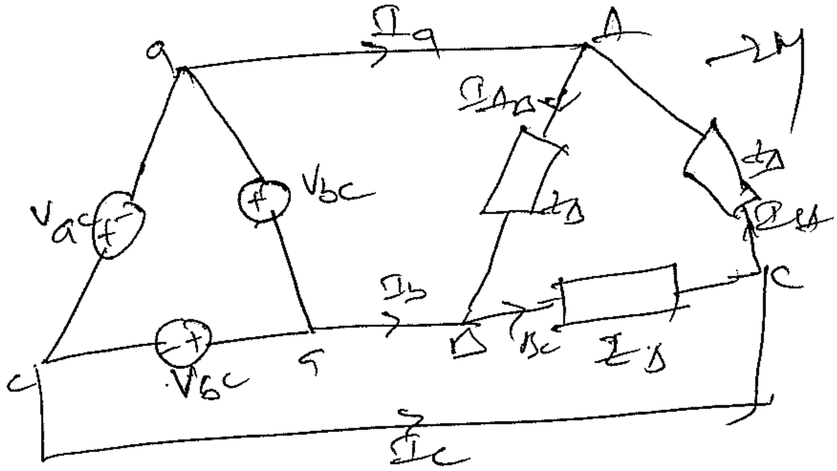
$V_{ab} = V_p \angle 0$

$V_{bc} = V_p \angle -120$

$V_{ca} = V_p \angle 120$

$V_{ab} = V_{AB}$ ; $V_{bc} = V_{BC}$

$V_{ca} = V_{CA}$



$I_{AB} = \frac{V_{AB}}{Z_\Delta} = \frac{V_{ab}}{Z_\Delta}$ ;

$I_{BC} = \frac{V_{BC}}{Z_\Delta} = \frac{V_{bc}}{Z_\Delta}$ ; $I_{CA} = \frac{V_{CA}}{Z_\Delta} = \frac{V_{ca}}{Z_\Delta}$ — 2M

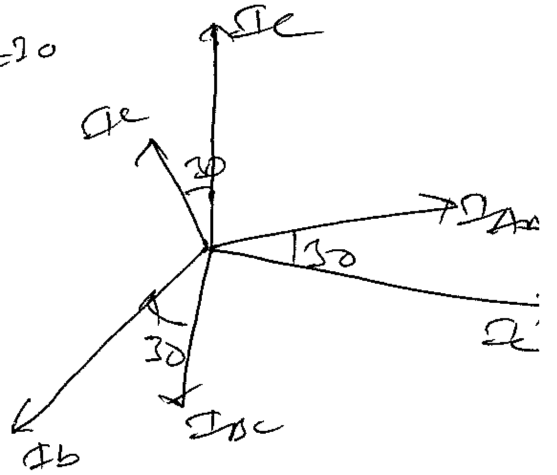
$I_a = I_{AB} - I_{CA}$ ; $I_b = I_{BC} - I_{AB}$ $I_c = I_{CA} - I_{BC}$

$I_a = I_{AB} \times \sqrt{3} \angle -30 = \sqrt{3} \times I_{AB} \angle -30$

$I_L = I_a = I_b = I_c$

$I_p = I_{AB} = I_{BC} = I_{CA}$

$I_L = \sqrt{3} I_p$ — 1M



7) b) A:-

3-φ, 10 KVA — $\cos\phi = 0.342$

$P = \sqrt{3} V_L I_L = 10 KVA = V_L I_L = \frac{10 \times 10^3}{\sqrt{3}} = 5773$

p.f = 0.342

c) power factor in leading — 2M

$W_1 = V_L I_L \cos(30 - \theta)$ $W_2 = V_L I_L \cos(30 + \theta)$

$= 5773 \cdot \cos(30 - 70)$ $= -1.0025 kW$

$= 4.42 kW$.

2) power factor is lagging — 3M

$W_1 = V_L I_L \cos(30+\theta)$

$= 5773 \cos(30+70)$

$= -1.0025 kW$

$W_2 = V_L I_L \cos(30-\theta) = 4.42 kW.$

8)
a)
A) the place transform $\frac{e^{-at} - e^{-bt}}{t}$

$$L\left(\frac{e^{-at} - e^{-s(t)}}{t}\right) = \int_0^{\infty} \frac{e^{-(a+b)t} \cdot e^{-st}}{t} dt$$ — 2M

$$= \int_0^{\infty} \frac{e^{-(a+b+s)t}}{t} dt$$

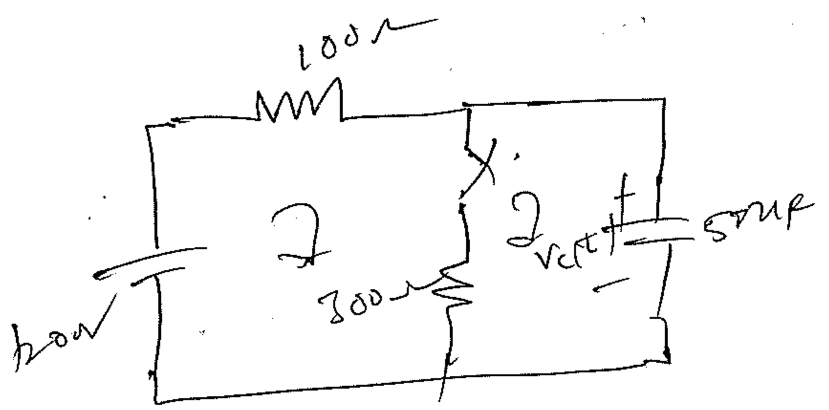
$$= \frac{1}{t} \int_0^{\infty} e^{-(s+(a+b))t} dt$$

$L\left(\frac{f(t)}{t}\right) = \int_0^{\infty} F(s)$

$$= \left[\frac{e^{-(s+a+b)t}}{-s(s+a+b)}\right]_s^{\infty}$$

$$= \frac{e^{-s+a+b}}{-s(s+a+b)}$$ — 3M

(7)
8) b) A.




← 2M

$100 i_1(t) + 300 (i_1(t) - i_2(t)) = 1200$

$0 = 300 (i_2(t) - i_1(t)) + 50 \frac{dv_c(t)}{dt} dt$

Apply taking the Laplace transform

$100 i_1(s) + 300 i_1(s) + 300 i_2(s) = 1200$

$0 = 300 i_2(s) - 300 i_1(s) + 50 s V(s)$

$300 i_2(s) = 1200 - 400 i_1(s)$

$i_2(s) = \frac{1200 - 400 i_1(s)}{300}$

$I_1(s) = \frac{20}{3} \left( \frac{s+250}{s(s+500/3)} \right) = \frac{10}{s} - \frac{10/3}{s+500/3}$

$I_2(s) = \frac{20}{3} \left( \frac{1}{s+500/3} \right)$ → 2M

taking the inverse transform we get

$i_1(t) = 10 - \frac{10}{3} e^{-(500/3)t}$

$i_2(t) = \frac{20}{3} e^{-(500/3)t}$ — 1M

9) Call $F(s) = \frac{(s+1)(s+4)(s+7)}{s(s+2)(s+5)} = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{s+5}$

$s=0$ $A = s \cdot F(s) = \frac{s(s+1)\cdot(s+4)(s+7)}{s(s+2)(s+5)}$ — 2M

$= \frac{1\times4\times7}{2\times5} = \frac{28}{10} = 2.8$

$s=-2$ $B = (s+2)\cdot F(s) = \frac{(s+2)(s+1)(s+4)(s+7)}{s(s+2)(s+5)}$

$= \frac{(-2+1)(-2+4)(-2+7)}{-2\times3}$

$= \frac{1\times2\times5}{-6} = \frac{10}{6}$

$s=-5$ $= C = (s+5)\,F(s) = \frac{(s+5)(s+7)(s+4)(s+1)}{s(s+2)(s+5)}$

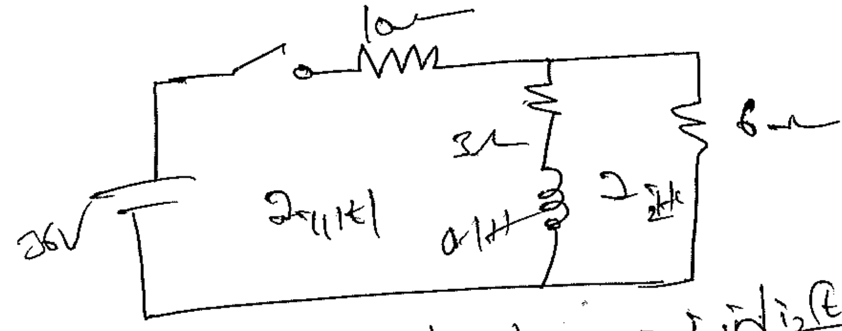
$= \frac{(-5+1)(-5+4)(-5+7)}{-5\times(-5+2)}$

$= \frac{-4\times-1\times2}{-5\times-3} = \frac{8}{15}$ — 2M

$F(s) = \frac{28}{10s} + \frac{10}{6(s+2)} + \frac{8}{15(s+5)}$

$F(t) = \left(\frac{28}{10} + 1.6\,e^{-2t} + 0.53\,e^{-5t}\right)$ — 1M

9) b)




— 2M

$36 i_1(t) \cdot 0.1 \frac{di_1(t)}{dt} + 0.1 \frac{di_2(t)}{dt} + 3 i_1(t) - 3 i_2(t) + 10 i_1(t) - 3 i_1(t)$

$0 = 6 i_2(t) + 0.1 \frac{di_2(t)}{dt} - 0.1 \frac{di_1(t)}{dt} + 3 i_2(t)$

Taking the Laplace transform for the above eq:

$0.5 I_1(s) + 0.1 I_2(s) + 3 i_1(s) - 3 i_2(s) + 10 i_1(s) = 36$

$\frac{36}{s} = (13.5 \cdot 0.1 s) I_1(s) - 3 i_2(s)$

$0 = 6 I_2(s) + 0.1 s I_2(s) - 0.1 s I_1(s) + 3 i_2(s)$

$0 = 9 I_1(s) + 0.1 s I_2(s) - 0.1 I_1(s)$

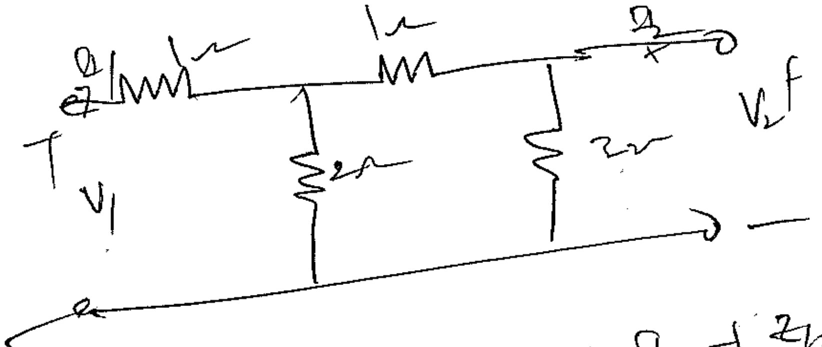
$I_2(s) = I_1(s) \left(\frac{s}{s+9}\right)$

$i_1(t) = 36 - \frac{36}{2} e^{(0.1)t}$

$i_2(t) = \frac{9}{2} e^{-(9/2)t}$

— 3M

10) A:



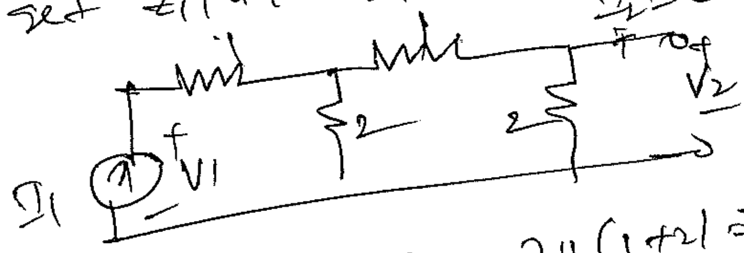

— 2M

Z-parameter:

$V_1 = Z_{11} I_1 + Z_{12} I_2$

$V_2 = Z_{21} I_1 + Z_{22} I_2$

To get $z_{11}$ and $z_{21}$ —



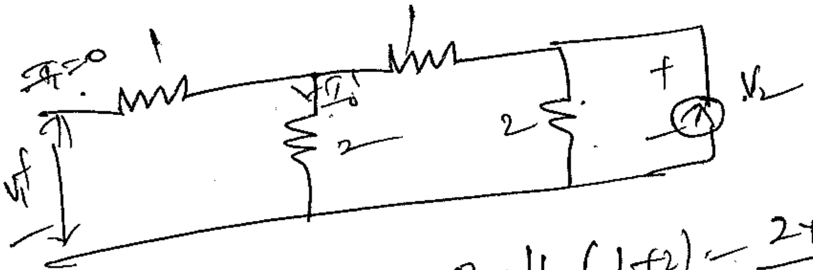
$z_{11} = \frac{V_1}{I_1} = (1+2) \| (1+2) = 1.5\Omega$

$I_0 = \frac{1}{2} I_1$; $V_2 = 2I_0 = I_1$

$z_{21} = \frac{V_2}{I_1} = 0.8\Omega$

— 2M

To get $z_{22}$ and $z_{12}$



$z_{22} = \frac{V_2}{I_2} = 2 \| (1+2) = \frac{2 \times 3}{2+3} = 6/5 = 1.2\Omega$

$z_{12} = \frac{V_1}{I_2} =$ $\quad I_0 = \frac{2 I_2}{2+3} = 2/5 I_2$

$V_1 = 2I_0' = \frac{2}{5} \times 2 I_2 = \frac{4}{5} I_2$

$z_{12} = \frac{V_1}{I_2} = 0.8 I_2 = 0.8$

$[Z] = \begin{bmatrix} 1.5 & 0.8 \\ 0.8 & 1.2\Omega \end{bmatrix}$ — 1M

ABCD parameters:

$C = \frac{1}{z_{21}} = \frac{1}{0.8} = 1.25$ — 2M

$A = \frac{z_{11}}{z_{21}} = \frac{1.5}{0.8} = 1.875$

$D = \frac{z_{22}}{z_{21}} = \frac{1.2}{0.8} = 1.5$

$B = \frac{\Delta z}{z_{21}} = \frac{1.5 \times 1.2 - 0.8 \times 0.8}{0.8} = 1.45$

$ABCD = \begin{bmatrix} 1.875 & 1.45 \\ 1.45 & 1.5 \end{bmatrix}$ — 3M

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

# LESSON/ UNIT PLAN

Academic Year : 2022-23

Semester : II

Name of the Program: B.Tech Year: II

Course/Subject: Sensors **Electric Circuit Analysis** Course Code: **GR20A2023**

Name of the Faculty: G Sandhyarani Dept.:EEE

| UNIT No. | Lesson No. | No. of Periods | Lesson Title | Objectives | Outcomes | References (Text Book, Journal…) Page Nos.: ____to ____ |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | Representation of continuous-time periodic signals by Fourier series | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 1 | 2 | 2 | Dirichlet's conditions; Properties of Fourier series | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 1 | 3 | 4 | Parseval's theorem; Trigonometric and Exponential Fourier series; | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 1 | 4 | 2 | Complex Fourier spectrum; Fourier transform via Fourier series; | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat |

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| 1 | 5 | 2 | Fourier transform of periodic and aperiodic signals, Convergence of FT | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 1 | 6 | 2 | Properties of Fourier transforms Parseval's theorem; | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 1 | 7 | 2 | Fourier transforms involving impulse & Signum function & Hilbert Transform | COBJ1 | CO1 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 2 | 8 | 2 | Maximum Power Transfer theorem, Reciprocity theorem | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 2 | 9 | 2 | Millman theorem, Compensation theorem | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 2 | 10 | 3 | Telligence Theorem, Concept of duality and dual network | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |

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|---|---|---|---|---|---|---|
| 2 | 11 | 2 | Solution of first and second order differential equations for Series RL, RC, RLC circuits | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 2 | 12 | 3 | Solution of first and second order differential equations for parallel RL, RC, RLC circuits | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 2 | 13 | 2 | Initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. | COBJ2 | CO2 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 14 | 1 | Introduction to Three-phase circuits | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 15 | 2 | Star-star, delta-delta analysis of balanced circuits of three phase 3 wire, 4 wire, delta circuits, | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 16 | 2 | Star-star, delta-delta analysis of unbalanced analysis of three phase 3 wire, 4 wire, delta circuits | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 17 | 3 | Measurement of power by three and two watt meters, | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill |

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|---|---|---|---|---|---|---|
| | | | | | | **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 18 | 2 | Measurement of reactive power by single wattmeter, | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 3 | 19 | 3 | Mutual coupled circuits, Dot Convention in coupled circuits. | COBJ3 | CO3 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 4 | 20 | 2 | Review of Laplace Transform | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 4 | 21 | 1 | Analysis of electrical circuits using Laplace Transform for standard inputs | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 4 | 22 | 1 | Convolution integral | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 4 | 23 | 2 | Inverse Laplace Transform | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |

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|---|---|---|---|---|---|---|
| 4 | 24 | 2 | Transformed network with initial conditions, | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 4 | 25 | 2 | Transfer function representation & Poles and Zeros. | COBJ4 | CO4 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 26 | 2 | Two Port Networks | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 27 | 1 | Terminal pairs, relationship of two port variables, | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 28 | 1 | Impedance & admittance parameters, | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 29 | 2 | Hybrid and transmission parameters, condition for symmetry and reciprocity | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 30 | 1 | Interrelationship between various parameters | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly "Engineering circuit Analysis' ,MC Grawhill |

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|---|---|---|---|---|---|---|
| | | | | | | **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |
| 5 | 31 | 2 | Interconnections of two port networks (series, parallel and cascade) | COBJ5 | CO5 | W.H Hayt and J.E.kemmerly “Engineering circuit Analysis’ ,MC Grawhill **Ref**: Circuit theory by A. Chakrabarthy ,Dhanpat rai |

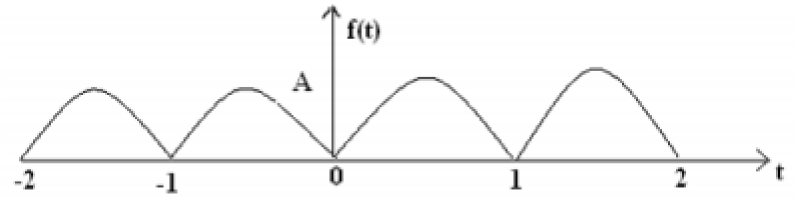
TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.

# Gokaraju Rangaraju Institute of Engneering and Technology
## Electrical Circuit Analysis (GR20A2023)
## <u>ECA Assignment-I</u>

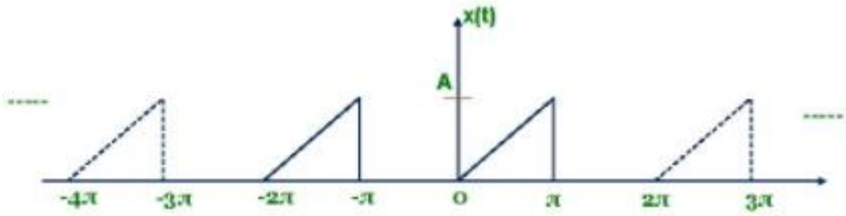
1. a) Derive the expression for Trigonometric Fourier series equation and coefficients.
   b) Derive the expression for Exponential Fourier series equation and coefficients

2. a) State and prove the Parseval's property or Parsavels power theorem of Fourier Series.
   b) State the Dirichilet's conditions for existence of Fourier series.

3. a) Find the Exponential Fourier series for the rectified Sine wave as shown in figure.




   b) Find the Trigonometric Fourier series for the wave form shown in figure.



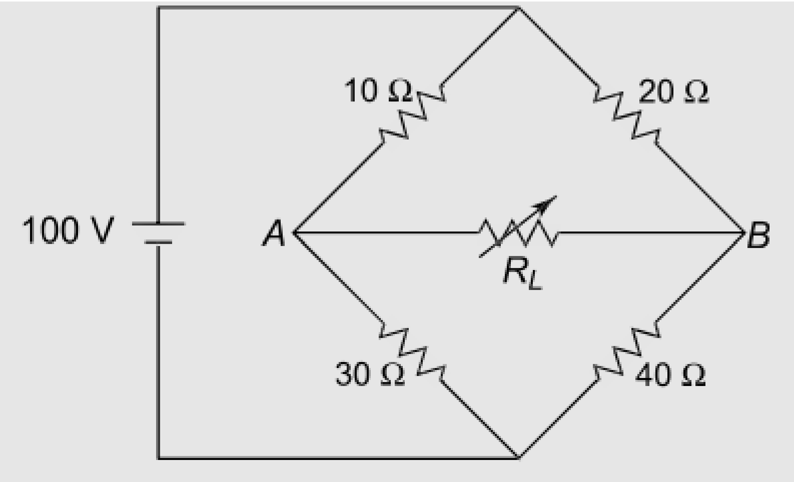

4. a) Obtain Fourier transform through exponential Fourier series.
   b) State and prove the Parseval's property or Parsavel's energy theorem of Fourier transform.

5. a) Find the Fourier transform of $x(t) = e^{-2t}\, Cos5t\, u(t)$
   b) Find the Fourier transform of $x(t) = Cos\omega_0 t\, u(t)$

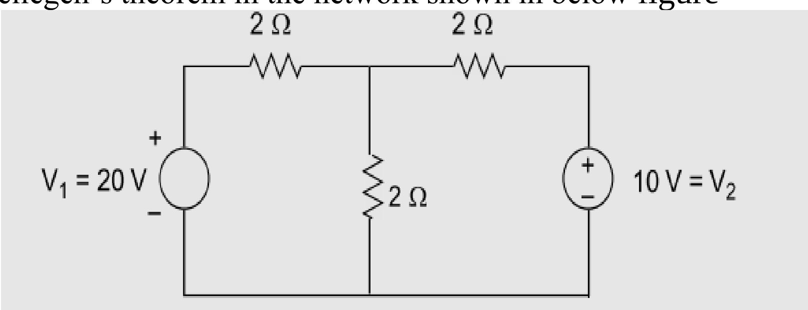
6. a) List out the properties of Fourier series.
   b) List out the properties of Fourier transform.

# ECA Assignment-2

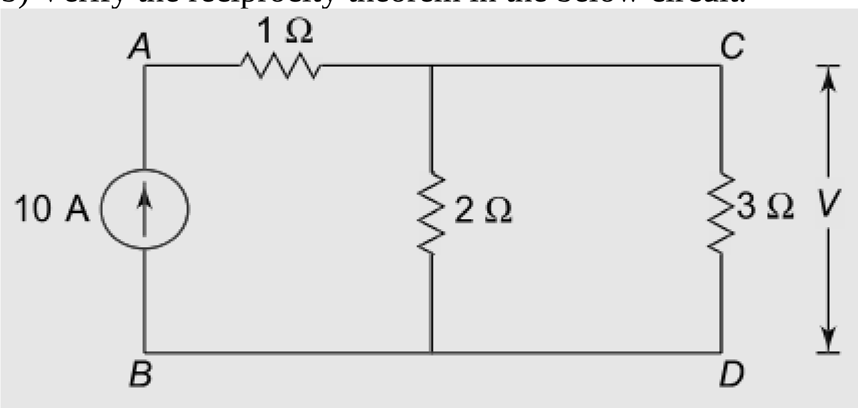
1. a) State maximum power transfer theorem.
   b) Determine the load resistance to receive maximum power from the source; also find the maximum power delivered to the load in the circuit shown in below figture.




2. a) State Tellegen's theorem.
   b) Verify Tellegen's theorem in the network shown in below figure




3. a) State reciprocity theorem
   b) Verify the reciprocity theorem in the below circuit.




4. a) State Millman's theorem
   b) Find the current $I_L$. Use Millman's theorem.

# ECA Assignment-3

1. A balanced delta connected load of (8+j6) ohms per phase is connected to a 3-phase, 50Hz, 230V supply. Calculate
   a. line current
   b. Power factor
   c. Reactive volt-ampere and
   d. Total volt-ampere

2. Derive the relationship between line and phase quantities in a 3-phase delta connected
system balanced delta connected system and draw the phasor diagram.

3. Explain the measurement of three phase power by two wattmeter method

4. Two wattmeter's are used to measure power in a 3-phase three wire load. Determine the total power, power factor and reactive power, if the two wattmeter's read i) 1000W each, both positive ii) 1000W each, but of opposite sign.

5. A balanced star-connected load of (4 + J3) W per phase is connected to a balanced 3-phase 400 V supply. The phase current is 12 A. Find (i) the total active power (ii) reactive power and (iii) total apparent power.

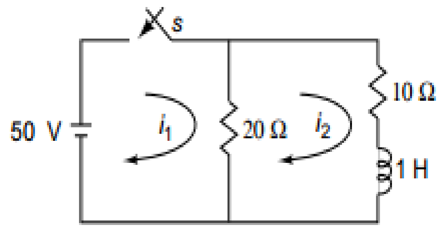
6. A balanced delta-connected load of (2 + j3) W per phase is connected to a balanced three-phase 440 V supply. The phase current is 10 A. Find the (i) total active power (ii) reactive power and (iii) apparent power in the circuit.

7. The two wattmeter method is used to measure power in a threephase load. The wattmeter readings are 400 W and – 35 W. Calculate (i) total active power (ii) power factor, and (iii) reactive power

8. Define Coefficient of Coupling. What is the significance of Dot Convention?
9. Define Mutual Inductance and self-inductance.

# ECA Assignment-4

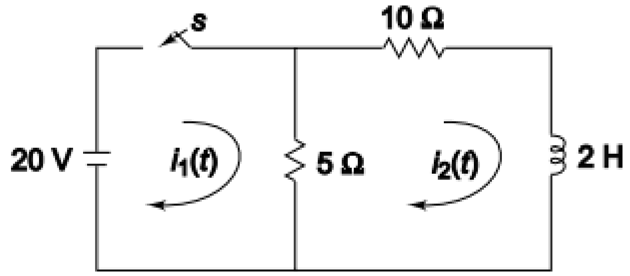
1. In the circuit shown in Figure, obtain the equations for $i_1(t)$ and $i_2(t)$ when the switch is closed at t = 0.




2. Determine the inverse Laplace transform of the given functions

$$(i)\ \ F(S) = \frac{s-3}{s^2+4s+13} \quad (ii)\ \ F(S) = \frac{s^2+12}{s(s+2)(s+3)}$$

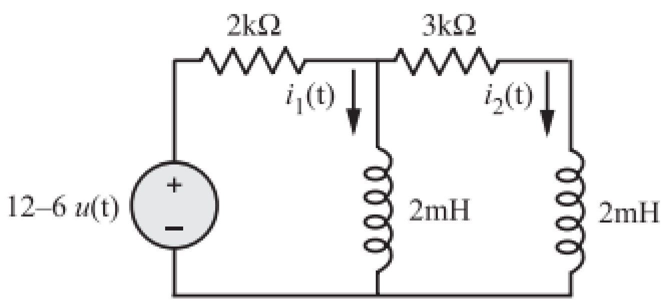
3. For the circuit shown in Fig. determine the current in the 10 W resistor when the switch is closed at t = 0. Assume initial current through the inductor is zero




4. Find the inverse Laplace transform of

$$F(S) = \frac{s^2+2s+5}{(s+3)(s+3)^2}$$

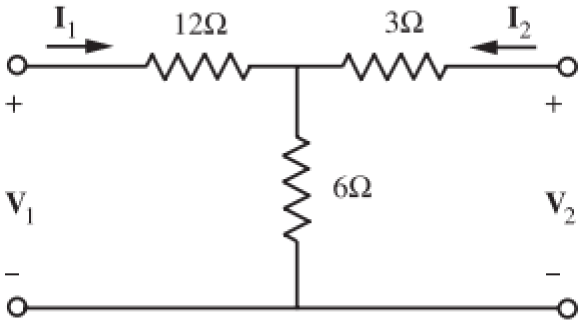
5. Find $i_1(t)$and $i_2(t) for\ t > 0$ for the circuit shown in Fig. using Laplace transform.



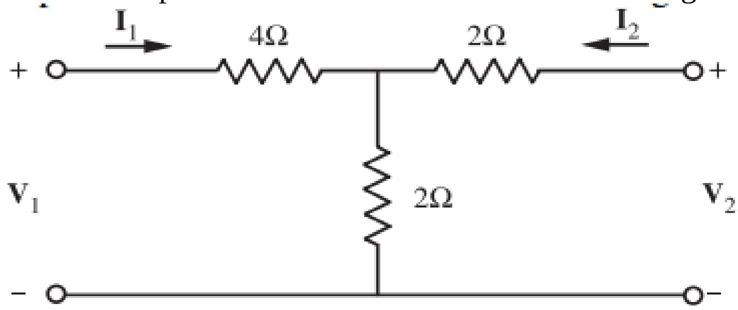

6. Define Transfer function

# ECA Assignment-5

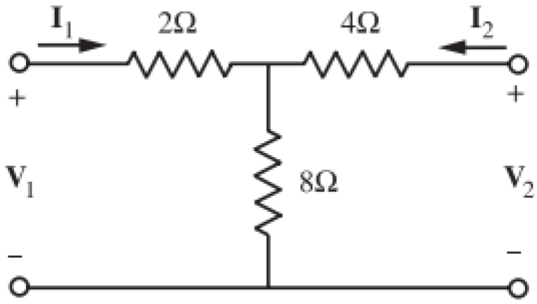
1. The Z parameters of a Two Port Network are $Z_{11}$=6Ω, $Z_{22}$=4 Ω, $Z_{12}$=$Z_{21}$= 3 Ω Compute Y and ABCD Parameters.
2. Find the **z** parameters of this circuit shown below Figure.



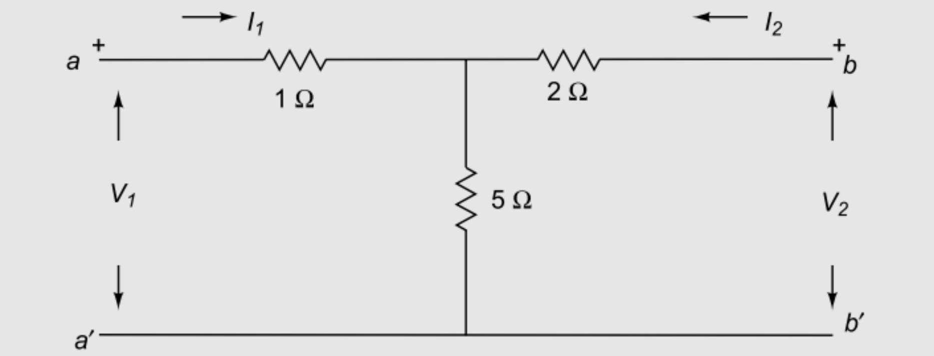

3. Determine the admittance parameters of the T network shown in Fig.




4. Find the hybrid parameters for the two-port network shown in Fig.




5. Find the transmission or general circuit parameters for the circuit shown in Fig.




6. Write the conditions for reciprocity and symmetry conditions for all parameters

II B.Tech I Sem Supply - Examinations -
Electrical Circuits Analysis
(GR20A2023)

1)
a) Fourier Transform is the conversion/transformation of — 2M
A:- periodic & aperiodic signals which are in continuous time domain to corresponding frequency domain & vice-versa

b) Fourier transform of $e^{-a|x|}$ — 2M
A:- $F(k) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(x) e^{-ikx} dx = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-a|x|} e^{-ikx} dx$

$F(k) = \frac{1}{\sqrt{2\pi}} \left[ \int_{-\infty}^{0} e^{ax} e^{-ikx} dx + \int_{0}^{\infty} e^{-ax} e^{-ikx} dx \right]$

$= \frac{1}{\sqrt{2\pi}} \left[ \left( \frac{1}{a-ik} - 0 \right) + \left( 0 + \frac{1}{a+ik} \right) \right] = \frac{1}{\sqrt{2\pi}} \times \frac{2a}{a^2+k^2} = \sqrt{\frac{2}{\pi}} \frac{a}{a^2+k^2}$

c) Compensation theorem:- — 2M
A:- → Compensation theorem state that any resistance R in a branch of a network in which element current I is flowing can be replaced, for the purposes of calculations, by a voltage equal to IR.

d) — 2M
A:- the evaluation of voltages and currents and their derivatives at t=0+, are known as initial conditions and evaluation of conditions at t=∞ are known as final conditions

e) Advantages of 3-φ systems! — 2M
A:- → the 3-φ system needs less conductor material

as compared to the single phase system

→ the size of 3-φ system operated machine is less than the machine operated at 1-φ voltage

→ poly phase supply produces power at constant rate (load)

→ 3-φ m/cs are less costly and more efficient

f)
A) Dot convention in coupled circuits:- — 2M

→ If both currents enter the dotted ends of coupled coils or if both currents enter undotted ends, then the sign of mutual inductance will be same then in

g)
A) Advantages of Laplace transform: — 2M

→ that its converts an ODE into an algebraic equation of the same order that is simpler to solve, even though it is a function of complex variable.

→ solving linear ODEs follows from the facts the exponential function is an of LTI systems

h)
A) Laplace transform of unit ramp signal:- — 2M

$x(t) = t u(t)$ ; $\mathcal{L}[x(t)] = \mathcal{L}[t u(t)] = \int_0^\infty t u(t) e^{-st} dt$

$\mathcal{L}[t u(t)] = \int_0^\infty t e^{-st} dt \Rightarrow \left[\frac{t e^{-st}}{-s}\right]_0^\infty - \int_0^\infty 1 \frac{e^{-st}}{-s} dt$

$\mathcal{L}[t u(t)] = 0 - \left[\frac{e^{-st}}{s^2}\right]_0^\infty \Rightarrow \left[0 - \frac{1}{s^2}\right] = \frac{1}{s^2}$

i) Symmetry :- z- parameters ⇒ $z_{11} = z_{22}$ — 1M

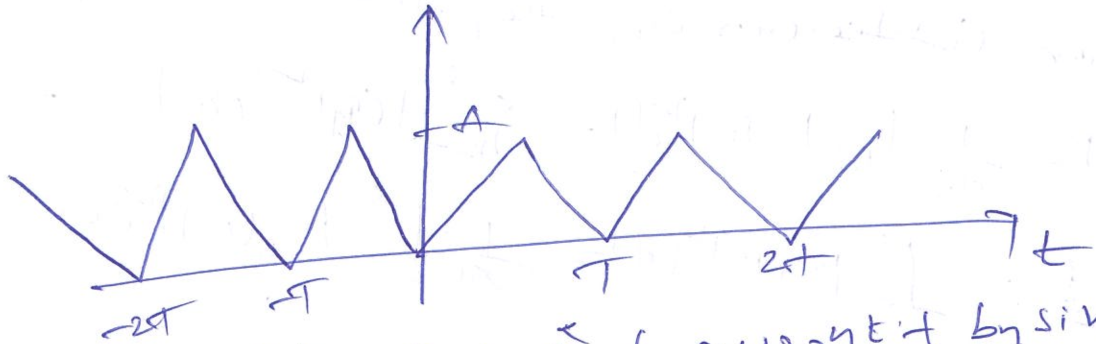
y- parameters ⇒ $y_{11} = y_{22}$ — 1M

1:- ABCD parameters:- $V_1 = AV_2 + BI_2$ - 1M

$I_1 = CV_2 + DI_2$ - 1M

2)

A:-




$x(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos \omega_0 n t + b_n \sin \omega_0 n t)$

$a_0 = \frac{1}{T}\int_0^T x(t)dt = \frac{1}{2\pi}\int_0^{2\pi} A \sin t\, dt = \frac{A}{2\pi}(2) = A/\pi$ - 3M

$a_n = \frac{2}{T}\int_0^{\pi} x(t)\cos nt\, dt \Rightarrow \frac{A}{2\pi}\int_0^{\pi} \sin(1+n)t + \sin(1-n)t\, dt$

for odd $= \frac{-A}{2\pi}\left[\frac{\cos\pi^{n+1} - 1}{1+n} + \frac{\cos\pi - n - 1}{1-n}\right) = 0$ - 2M

for even $a_n = \frac{-A}{2\pi}\left\{\frac{2}{n+1} - \frac{2}{n-1}\right] = \frac{-2A}{3\pi}$

$b_n = \frac{2}{T}\int_0^T x(t)\sin \omega_0 t\, dt \Rightarrow \frac{2}{2\pi}\int_0^{\pi} A \sin t \sin nt\, dt$

$= \frac{A}{2\pi}\left[\frac{\sin(n-1)}{n-1} - \frac{\sin(n+1)}{n+1}\right]_0^{\pi} = 0$ - 2M

$x(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\omega_0 t + b_n \sin \omega_0 t$

$= \frac{A}{\pi} + \frac{A}{2\pi}\sin t - \sum_{n=1}^{\infty} \frac{2A}{\pi(n^2-1)} \cos nt$ - 3M

3)

a) Properties of Fourier Transform:- - 5M

1. Linearity - $a_1 x_1(j\omega) + a_2 x_2(j\omega)$
2. Time Shifting
3. Symmetry
4. time reversal
5. Differentiation
6. Multiplication

3) b) :- Parseval's theorem :- — 2M

→ Let x(t) is a continuous time signal with period T0 and fourier coefficients $c_n$, then the average power of x(t)

$$P = \frac{1}{T_0}\int_{T_0} |x(t)|^2 dt = \sum_{n=-\infty}^{\infty} |C_n|^2 \quad (a)$$ — 3M

$$E = \int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$$

4) a) Maximum power transfer theorem :- — 3M

A:- → maximum power transfered to the load when the load resistance equals to $R_{th}$ ∴ $\boxed{R_L = R_{th}}$ — 3M

$$P = i^2 R_L = \left(\frac{V_{th}}{R_{th}+R_L}\right)^2 R_L$$

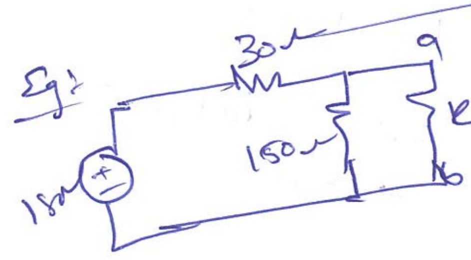
$$\frac{dP}{dR_L} = V_{th}^2 \left[\frac{(R_{th}+R_L)^2 + 2R_L(R_{th}+R_L)}{(R_{th}+R_L)^4}\right]$$

$$0 = (R_{th} + R_L - 2R_L) = R_{th} - R_L = 0 \quad \therefore R_{th} = R_L$$

$$R_L = R_{th}$$

$$\boxed{P_{max} = \frac{V_{th}^2}{4R_{th}}}$$ — 4M

Eg:

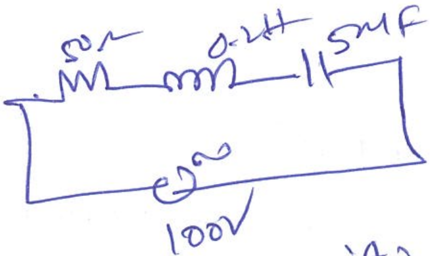



$R_{th} = R_{ab} = 25\Omega$

$$P_{max} = \frac{V_{th}^2}{4R_{th}}$$

$$\Rightarrow \frac{150^2}{4 \times 25} = 2.25W.$$

5) A:- — 3M




R = 50Ω  V = 100V

L = 0.2H  t = 0

C = 5MF

i(t) = ?

$$100 = 50i + 0.2\, di/dt + \frac{1}{5\times10^{-6}}\int i\,dt$$

$100 = 50i + 0.2\frac{di}{dt} + \frac{1}{50\times10^{-6}}\int i\,dt$

differentiating the eqn — 3M

$0 = 0.02\frac{d^2i}{dt^2} + 5\,di/dt + \frac{1}{50\times10^{-6}}i = 0$

$\frac{d^2i}{dt^2} + 250\frac{di}{dt} + 10^6 i = 0 \quad (D^2 + 2500 + 10^6)i = 0$

$i = e^{-k_1 t}(c_1 \cos k_2 t + c_2 \sin k_2 t) \quad D_1 = -125 + j3159.8,\; D_2 = -125 - j3159.8$

$i = e^{-125t}[2.04 \sin 929.8t)A$ — 4M

6)

a)

A:-

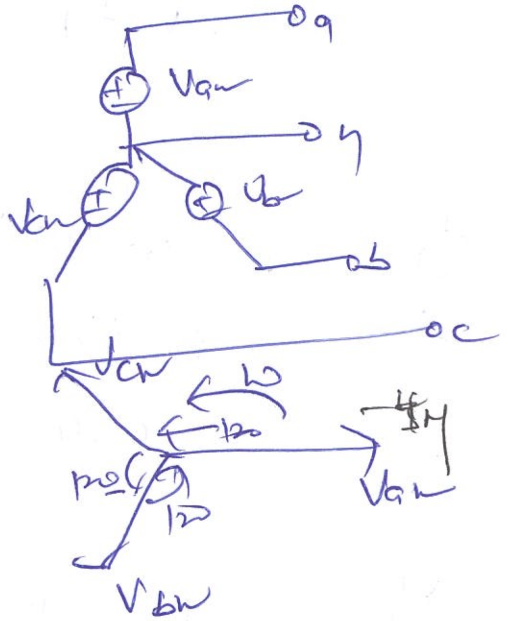
$V_{an} + V_{bn} + V_{cn} = 0$ — 3M

$|V_{an}| = |V_{bn}| = |V_{cn}|$

$V_{an} = V_p\angle 0;\; V_{bn} = V_p\angle{-120}\quad V_{cn} = V_p\angle{-240}$

$V_L = \sqrt{3}V_p$ — 2M

$I_L = I_{ph}$

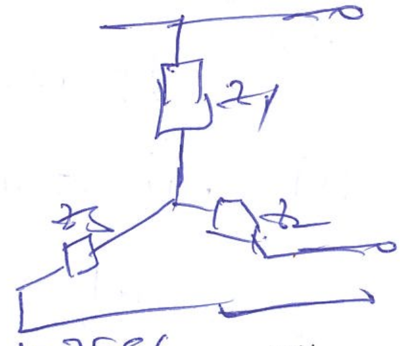



6) b)

A:-

$Z_1 = (4+j16) = 16\angle 75.96 \quad Z_2 = (5+j20) \quad Z_3 = (8-j4)$

$I_L = ?\quad I_n = ?\quad P = ?\quad V = 400V$




$I_A = \frac{V_{AN}}{Z_A} = \frac{400\angle 0}{16.49\angle 75.96} \Rightarrow 24.25\angle{-75.96}$ — 3M

$I_B = \frac{V_{BN}}{Z_B} = \frac{400\angle{-120}}{20.61\angle 75.96} = 19.40\angle{-195.96}$

$I_C = \frac{V_{CN}}{Z_C} = \frac{400\angle{-240}}{8.94\angle 26.56} = 44.94\angle{-266.56}$

$+I_N = (I_A + I_B + I_C) =$

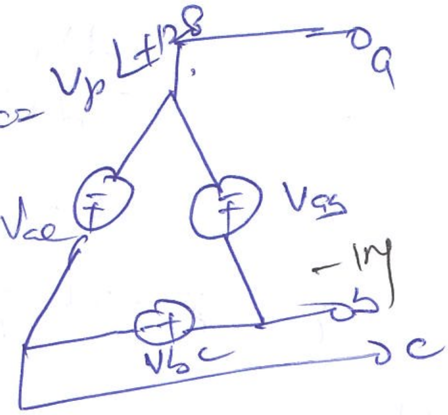
$I_N = -(I_A + I_B + I_C) = (24.25\angle -75.96 + 19.40\angle -195.96 + 44.94\angle 60)$

$= [(5.88 - j23.52) + (-18.65 + j5.33) + (-2.69 + j44.85)]$

$= (-15.46 + j26.66) = 30.818\angle 120.10$ — 2M

Power = $V_{AN} \times I_N$ = $2400\angle 0 \times 30.818\angle 120.10$ = 12.322 kW

7) a) $V_{ab} = V_p\angle 0$, $V_{bc} = V_p\angle -120$, $V_{ca} = V_p\angle +120$ — 2M




Vab: $V_{ph} = V_L$ — 1M

$I_L = \sqrt{3} I_p$ ; $I_L = |I_a| = |I_b| = |I_c|$ — 2M

7) b) Ans $v = 50\sin(\omega t + 60)$ & $i = 2\sin(\omega t + 100A)$ — 2M

$P = E_{rms} I_{rms} \cos\phi = \frac{50}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \times \cos\frac{\pi}{3} \Rightarrow 25 \times 0.5 = 12.5$ — 3M

$\cos\phi = \cos\pi/3 \Rightarrow 0.5$

8) a) Ans a) Laplace transform = $f(t) = 3\cos(6t)$

$\mathcal{L}\{3\cos(6t)\} = F(s) = 3 \cdot \frac{s}{s^2+6^2} = \frac{3s}{s^2+36}$ — 2M

(ii) $f(t) = \sin(t) + \sin 3(t)$ — 3M

$\mathcal{L}\{\sin(t)\} \Rightarrow \frac{1}{s^2+1} \Rightarrow \mathcal{L}\{\sin 3(t)\} = \frac{3}{s^2+9}$

$f(t) \Rightarrow \frac{1}{s^2+1} + \frac{3}{s^2+9} \Rightarrow \frac{(s^2+9) + 3(s^2+1)}{(s^2+1)(s^2+9)}$

$\Rightarrow \frac{3s^2 + s^2 + 9 + 3}{s^4 + 9s^2 + s^2 + 9} \Rightarrow \frac{4s^2+12}{s^4+10s^2+9} \Rightarrow \frac{4(s^2+3)}{s^4+10s^2+9}$

8) b) $L^{-1}$ inverse Laplace transform — 2M

$$F(s) = \frac{10}{s(s+1)(s+10)} \Rightarrow L^{-1}\left\{\frac{10}{s(s+1)(s+10)}\right\} \Rightarrow \frac{A}{s} + \frac{B}{s+1} + \frac{C}{s+10}$$

$$L^{-1}\left(\frac{1}{s} + \frac{1}{-9(s+1)} + \frac{10}{s+10}\right) \Rightarrow L^{-1} = 1 + \frac{e^{-t}}{9} - \frac{10}{90}e^{-t}$$

$$A = s \cdot M(s) = \frac{10}{(1)(10)} = 1 \Rightarrow L^{-1}\left(\frac{1}{s}\right) = 1$$

$$B = (s+1)\cdot M(s) = \frac{1}{9(-1+10)} = \frac{1}{-9} \qquad L^{-1}\left(\frac{1}{-9(1+s)}\right) = -\frac{1}{9}e^{-t}$$

$$C = (s+10)\cdot M(s) = \frac{1}{-10(-10+1)} \qquad L^{-1}\left(\frac{1}{90(s+10)}\right) = \frac{-1}{90}e^{-10t}$$

8) (ii) $L^{-1}\left(\frac{3s+2}{s^2+4s+20}\right) \Rightarrow \frac{A}{s-2+j4} + \frac{B}{s-2-j4}$ — 3M

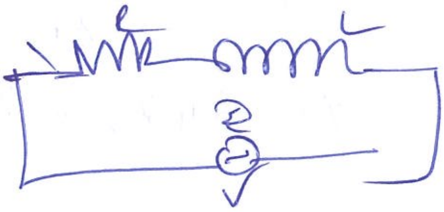
$$A = F(s)\cdot(s-2+j4) \Rightarrow \frac{3(2-j4)+2}{(2-j4-2-j4)}$$
$s = +2 - j4$

$$A = \frac{8-j4}{-j8} \Rightarrow -1/8$$

$$B = F(s)\cdot(s-2+j4) \Rightarrow \frac{3(+2+j4)+2}{(2+j4-2-j4)} \Rightarrow \frac{8+j4}{4} \Rightarrow \frac{-1}{2}$$

$$L^{-1}_{FL} = L\left\{\frac{1}{8(s-2+j4)} - \frac{1}{2(s-2-j4)}\right) \Rightarrow \frac{1}{8}e^{(+2+j4)} - \frac{1}{2}e^{(+2-j4)}$$

9)
A) —



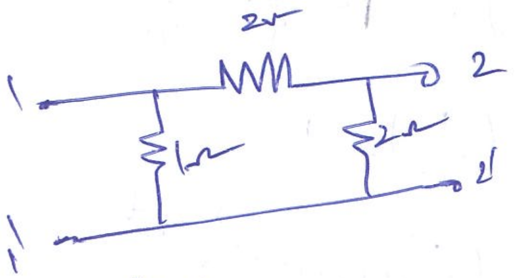

Apply the KVL — 2M
$Ri(t) + L\,di/dt = V$

Apply the Laplace transform — 3M
$$RI(s) + L\left[sI(s) - i(0)\right] = V/s$$
$$RI(s) + sLI(s) = V/s$$
$$I(s) = \frac{V/L}{s(s+R/L)}$$

$I(s) = \dfrac{V/L}{s(s+R/L)}$

$i(t) = V/R\,(1 - e^{-(R/L)t})$ — 3M

10) a)
Ans:



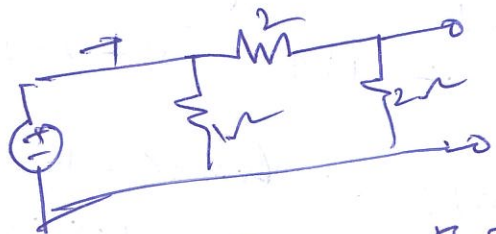

$V_1 = A V_2 - B I_2$
$I_1 = C V_2 - D I_2$ } — 2M

T- parameters

$A = V_1/V_2 \big|_{I_2=0}$  $B = V_1/{-I_2} \big|_{V_2=0}$  $C = I_1/V_2 \big|_{I_2=0}$  $D = \dfrac{I_1}{-I_2}\Big|_{V_2=0}$

$I_2 = 0$  $A = V_1/V_2$

$V_1 = 1 I_1$  $V_2 = 2 I_1$




$A = \dfrac{1 I_1}{2 I_1} = 1/2$  $C = \dfrac{1}{2}$

$B = \dfrac{-V_1}{I_2}\Big|_{V_2=0} = \dfrac{2}{3} V_1$  $B = \dfrac{2}{3}$  $D = 7/5$ — 3M

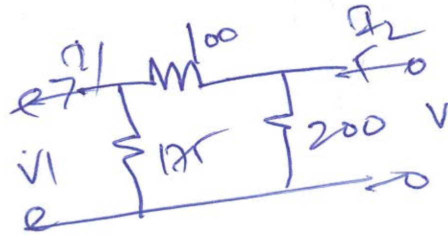
b)
Ans: $V_1 = z_{11} I_1 + z_{12} I_2$  $I_1 = y_{11} V_1 + y_{12} V_2$
$V_2 = z_{21} I_1 + z_{22} I_2$  $I_2 = y_{21} V_1 + y_{22} V_2$ } 2M

$z_{11} = \dfrac{y_{22}}{\Delta y}$  $z_{12} = \dfrac{-y_{12}}{\Delta y}$  $y_{11} = \dfrac{z_{22}}{\Delta z}$  $y_{12} = \dfrac{z_{12}}{\Delta z}$

$z_{21} = \dfrac{-y_{21}}{\Delta y}$  $z_{22} = \dfrac{y_{11}}{\Delta y}$  $y_{21} = \dfrac{-z_{21}}{\Delta z}$  $y_{22} = \dfrac{z_{11}}{\Delta z}$

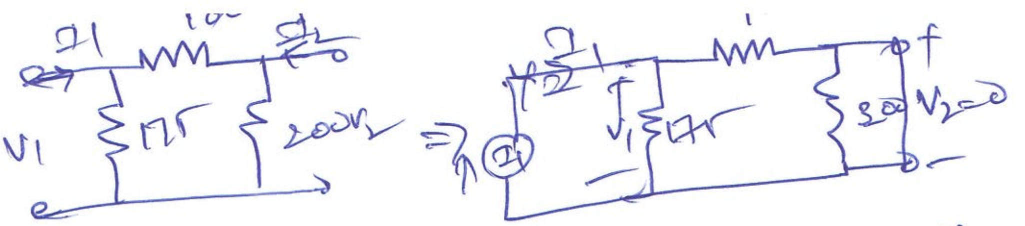
$\Delta y = y_{11} y_{22} - y_{12} y_{21}$  $\Delta z = z_{11} z_{22} - z_{12} z_{21}$ — 3M

11)
a)
Ans:




y - parameters

$I_1 = y_{11} V_1 + y_{12} V_2$
$I_2 = y_{21} V_1 + y_{22} V_2$ } 2M



$\Rightarrow I_1 = \dfrac{V_1}{\frac{175\times100}{175+100}} \Rightarrow \dfrac{11}{700}V_1 \Rightarrow y_{11} = \dfrac{I_1}{V_1} \Rightarrow \dfrac{11}{700}$

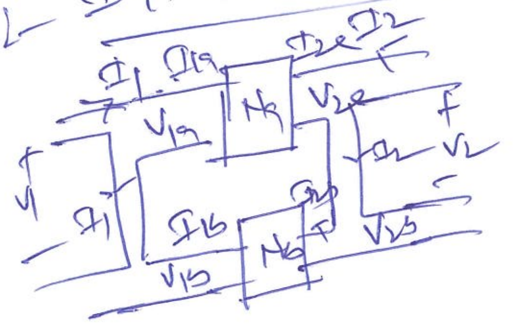
$y_{21} = \dfrac{I_2}{V_1} \Rightarrow \dfrac{175}{275} I_1 \Rightarrow \dfrac{175}{275}\times\dfrac{200}{100} \Rightarrow \dfrac{350}{275} \Rightarrow \dfrac{14}{11}$

$y_{22} \Rightarrow \dfrac{V_2}{\frac{100+200}{300}} \Rightarrow \dfrac{3}{2}$ ; $y_{12} = \dfrac{-I_1}{V_2}\Big|_{V_1=0} \Rightarrow \dfrac{200}{300}\times\dfrac{300}{475} = \dfrac{8}{19}$

$y_{11} = \dfrac{11}{700}$ ; $y_{21} = \dfrac{14}{11}$ ; $y_{22} = \dfrac{3}{2}$ ; $y_{12} = \dfrac{-8}{19}$ — 3M

b)

A) Interconnecting two port networks:-



$\Rightarrow V_{1a} = Z_{11a}I_{1a} + Z_{12a}I_{2a}$

$V_{2a} = Z_{21a}I_{1a} + Z_{22a}I_{2a}$ — 2M

$\Rightarrow V_{1b} = Z_{11b}I_{1b} + Z_{12b}I_{2b}$

$V_{2b} = Z_{21b}I_{1b} + Z_{22b}I_{2b}$

$I_1 = I_{1a} = I_{1b}$

$I_2 = I_{2a} = I_{2b}$

$V_1 = V_{1a} + V_{1b} = (Z_{11a} + Z_{11b})I_1 + (Z_{12a} + Z_{12b})I_2$

$V_2 = V_{2a} + V_{2b} = (Z_{21a} + Z_{21b})I_1 + (Z_{22a} + Z_{22b})I_2$ — 3M

$$\begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} Z_{11a} + Z_{11b} & Z_{12a} + Z_{12b} \\ Z_{21a} + Z_{21b} & Z_{22a} + Z_{22b} \end{bmatrix}$$

$Z = Z_a + Z_b$

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**II B.Tech I Semester Supplementary Examinations, August/September 2023**

# ELECTRICAL CIRCUIT ANALYSIS

**(Electrical and Electronics Engineering)**

**Time: 3 hours** **Max Marks: 70**

**Instructions:**

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.
4. CO means Course Outcomes. BL means Blooms Taxonomy Levels.

## PART – A

**(Answer ALL questions. All questions carry equal marks)**

**10 * 2 = 20 Marks**

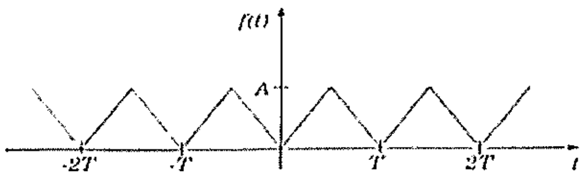
| | | | | |
|---|---|---|---|---|
| 1. a. | Define Fourier Transform. | [2] | CO1 | BL1 |
| b. | What is the Fourier transform of $e^{ax}$? | [2] | CO1 | BL2 |
| c. | Write the statements of compensation theorem. | [2] | CO2 | BL1 |
| d. | What are initial conditions? | [2] | CO2 | BL2 |
| e. | What are the benefits of three phase system? | [2] | CO3 | BL1 |
| f. | Define Dot convention in coupled circuits. | [2] | CO3 | BL2 |
| g. | What are the advantages of Laplace transform over differential equations. | [2] | CO4 | BL1 |
| h. | What is the Laplace transform of unit ramp signal? | [2] | CO4 | BL2 |
| i. | What are the conditions for symmetry in terms of Z and Y parameters? | [2] | CO5 | BL1 |
| j. | What are the defining equations of ABCD parameters? | [2] | CO5 | BL2 |

## PART – B

**(Answer ALL questions. All questions carry equal marks)**

**5 * 10 = 50 Marks**

| | | | | |
|---|---|---|---|---|
| 2. | Find the Trigonometric Fourier series of the following signal. | [10] | CO1 | BL2 |




**OR**

| | | | | |
|---|---|---|---|---|
| 3. | (a) Explain the properties of Fourier Transform<br>(b) Briefly explain about Parsevel's theorem. | [10] | CO1 | BL3 |

4. State and explain the maximum power transform theorem with an example. [10] CO2 BL3

**OR**

5. A series RLC circuit has R = 50 Ω, L = 0.2H and C = 50 μF constant voltage of 100 V is impressed upon the circuit at t = 0. Find the expression for the transient current assuming initially relaxed conditions. [10] CO2 BL3

6. (a) Derive the relation between phase and line values in a 3-phase balanced star connected system with neat circuit diagram. [10] CO3 BL3
   (b) An unbalanced four wire, star connected load has a balanced voltage of 400 V, the loads are: $Z_1$= (4+j16) Ω, $Z_2$= (5+j20) Ω, $Z_3$= (8+j4) Ω. Calculate the: (i) The line currents. (ii) Current in the neutral wire and (iii) The total power.

**OR**

7. (a) Derive the relationship between phase values of voltage and current for balanced delta connected system [10] CO3 BL2

   (b) Determine the power factor and the input power for a circuit with v = 50 sin (ωt+60 ) and I = 2 sin (ωt+100) A.

8. (a) Fin the laplace transform of the following functions [10] CO4 BL3
   (i) f(t) = 3cos(6t)
   (ii) f(t) = sin(t) + sin(3t)
   (b) Deermine the inverse Laplace transform of the following

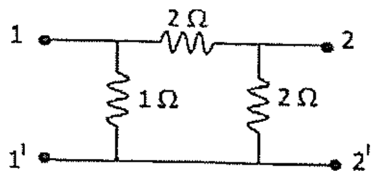
   i. $F(s)=\dfrac{10}{s(s+1)(s+10)}$

   ii. $F(s)=\dfrac{3s+2}{s^2+4s+20}$

**OR**

9. Derive an expression for the current response in R-L series circuit with a sinusoidal source using Laplace transform. [10] CO4 BL3

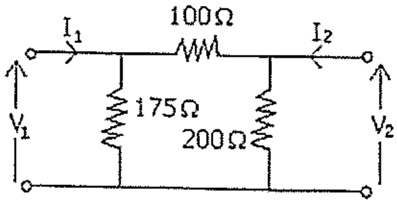
10. (a) Find the transmission parameters for the resistance network shown in figure below. [10] CO5 BL3




(b) Briefly explain the relation between Z and Y parameters

**OR**

11. (a) Find the y-parameters of the network shown in figure. [10] CO5 BL3




(b) Explain the interconnection of two port networks when connected in series.

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**II B.Tech I Semester Regular Examinations, February 2022**

**Electric Circuit Analysis**

**(Electrical and Electronics Engineering)**

**Time: 3 hours** **Max Marks: 70**

**Instructions:**

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

**PART – A**

**(Answer ALL questions. All questions carry equal marks)**

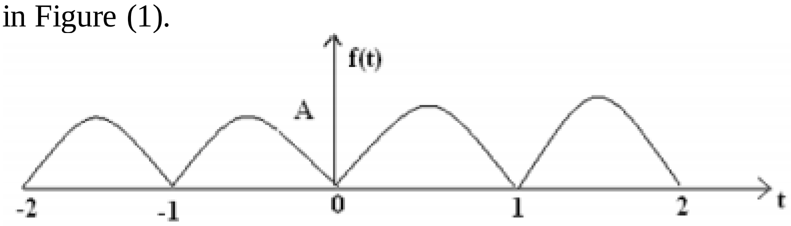
**10 * 2 = 20 Marks**

| | | | | |
|---|---|---|---|---|
| **1. a.** | State the Dirichlet's conditions for existence of Fourier series. | **[2]** | **CO1** | **BL1** |
| **b.** | State and prove the Parseval's property or Parsavel's energy theorem of Fourier transform. | **[2]** | **CO1** | **BL1** |
| **c.** | State Millman theorem. | **[2]** | **CO2** | **BL1** |
| **d.** | What are the time constants for series RL and RC Circuits | **[2]** | **CO2** | **BL2** |
| **e.** | Write the relationship between line and phase quantities in a 3 phase delta balanced connected system. | **[2]** | **CO3** | **BL2** |
| **f.** | Write the expression for active power and reactive power in a balanced 3 phase circuit? | **[2]** | **CO3** | **BL2** |
| **g.** | Sate the convolution integral property. | **[2]** | **CO4** | **BL1** |
| **h.** | Define the transfer function. | **[2]** | **CO4** | **BL1** |
| **i.** | What is symmetry condition of Y and ABCD Parameters? | **[2]** | **CO5** | **BL2** |
| **j.** | Write the conditions for reciprocity of Z and h parameters. | **[2]** | **CO6** | **BL2** |

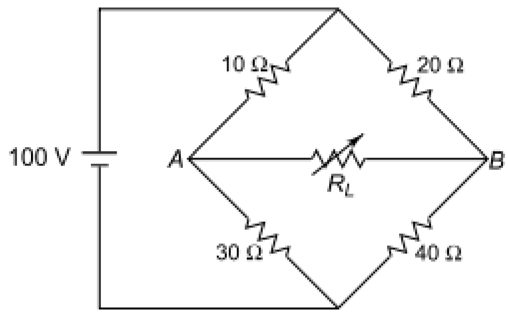
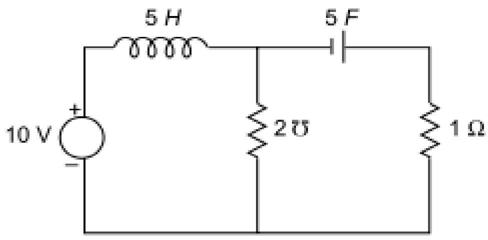
**PART – B**

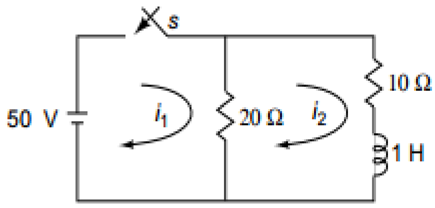
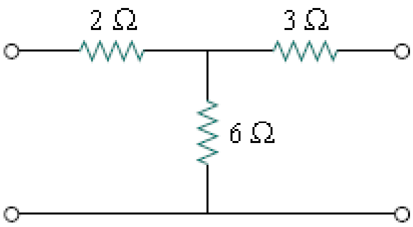
**(Answer ALL questions. All questions carry equal marks)**

**5 * 10 = 50 Marks**

| | | | | |
|---|---|---|---|---|
| **2.** | **(a)** Find the Exponential Fourier series for the rectified Sine wave as shown in Figure (1).   Figure (1) | **[10]** | **CO1** | **BL3** |

**OR**

| | | | | |
|---|---|---|---|---|
| **3.** | **(a)** Find the Fourier transform of $x(t) = Cos\omega_0 t\, u(t)$<br>**(b)** List out the properties of Fourier transform. | **[10]** | **CO1** | **BL3** |
| **4.** | **(a)** Determine the load resistance to receive maximum power from the source; also find the maximum power delivered to the load in the circuit shown in below Figure (2).<br><br><br>Figure (2) | **[10]** | **CO2** | **BL2** |
| | **OR** | | | |
| **5.** | **(a)** State Reciprocity theorem with one example.<br>**(b)** Draw the dual network for the given network shown in Figure (3)<br><br><br>Figure (3) | **[10]** | **CO2** | **BL2** |
| **6.** | **(a)** Derive the relationship between line and phase quantities in a 3-phase delta connected system balanced delta connected system and draw the phasor diagram.<br>**(b)** A balanced delta connected load of (8+j6) ohms per phase is connected to a 3-phase, 50Hz, 230V supply. Calculate<br>a. line current<br>b. Power factor<br>c. Reactive volt-ampere and<br>d. Total volt-ampere | **[10]** | **CO3** | **BL3** |
| | **OR** | | | |
| **7.** | **(a)** Explain the measurement of three phase power by two wattmeter method | **[10]** | **CO3** | **BL3** |

| | | | | |
|---|---|---|---|---|
| | **(b)** Two wattmeter's are used to measure power in a 3-phase three wire load. Determine the total power, power factor and reactive power, if the two wattmeter's read i) 1000W each, both positive ii) 1000W each, but of opposite sign. | | | |
| **8.** | **(a)** In the circuit shown in Figure(4), obtain the equations for $i_1(t)$ and $i_2(t)$ when the switch is closed at t = 0.<br><br><br>Figure(4) | **[10]** | **CO4** | **BL3** |
| **OR** | | | | |
| **9.** | **(a)** Determine the inverse Laplace transform of the given functions<br>$(i)\ \ F(S) = \frac{s-3}{s^2+4s+13}\quad (ii)\ \ F(S) = \frac{s^2+12}{s(s+2)(s+3)}$ | **[10]** | **CO4** | **BL3** |
| **10.** | **(a)** The Z parameters of a Two Port Network are $Z_{11}$=6Ω, $Z_{22}$=4 Ω, $Z_{12}$=$Z_{21}$= 3 Ω Compute Y and ABCD Parameters. | **[10]** | **CO5** | **BL3** |
| **OR** | | | | |
| **11.** | **(a)** Find hybrid parameters for the network shown below Figure (5).<br><br><br>Figure (5) | **[10]** | **CO5** | **BL3** |

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| CODE: GR18A2023 | GR 18 | SET - 2 |
| --- | --- | --- |

**II B.Tech I Semester Supplementary Examinations, February/March 2023**

# ELECTRICAL CIRCUIT ANALYSIS

**(Electrical and Electronics Engineering)**

**Time: 3 hours** **Max Marks: 70**

**Instructions:**

1. Question paper comprises of **Part-A** and **Part-B**
2. **Part-A** (for 20 marks) must be answered at one place in the answer book.
3. **Part-B** (for 50 marks) consists of **five questions with internal choice,** answer all questions.

## PART – A

**(Answer ALL questions. All questions carry equal marks)**

**10 * 2 = 20 Marks**

**1. a.** State Thevinens theorem. **[2]**

**b.** Define reciprocity theorem. **[2]**

**c.** What is the steady state response? **[2]**

**d.** Define the term 'Time constant' of a circuit, in general. **[2]**

**e.** Solve (8+6i)*(4+3i) and express the result in rectangular form. **[2]**

**f.** Show mathematically, the power in a pure inductive AC circuit is equal to zero. **[2]**

**g.** Define Q-Factor of a series circuit. **[2]**

**h.** What are the advantages of initial conditions? **[2]**

**i.** What are the defining equations of Z parameters? **[2]**

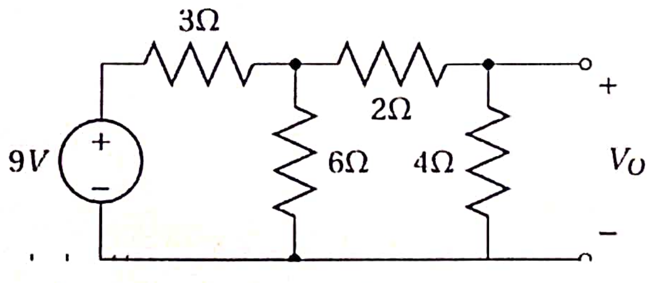
**j.** Express Y parameters in Z parameters. **[2]**

## PART – B

**(Answer ALL questions. All questions carry equal marks)**

**5 * 10 = 50 Marks**

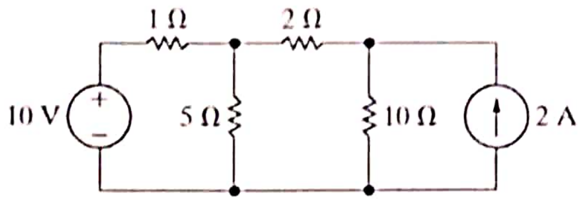
**2.** **(a)** Using Theremins' theorem reduce the circuit into equivalent circuit and find the voltage. **[10]**




**(b)** Explain Millmans theorem with an example.

**OR**

3. (a) Verify Superposition principle for the circuit shown in figure [10]




(b) Explain the Maximum power transfer theorem when the load is an impedance with fixed resistance and variable inductance.

4. (a) In a series RLC circuit, R=6 ohms, L=2 H, C=2 F. A DC voltage of 50 V is applied at t=0. Obtain the expression for i(t) using differential equation approach. [10]

(b) Derive the expression for current in a series RC circuit excited by a sinusoidal source V=Vm Sinωt

**OR**

5. (a) A series RLC circuit has R = 50 Ω, L = 0.2H and C = 50 μF constant voltage of 100V is impressed upon the circuit at t = 0. Find the expression for the transient current assuming initially relaxed conditions. [10]

(b) Find the expression for the transient current for a RL series circuit with DC input.

6. (a) Derive Average value, RMS value, Form factor and Peak factor for a sinusoidal waveform. [10]

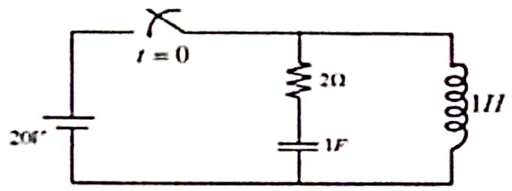
(b) A capacitor of 100mF is connected in series with resistor of 50 W. The combination is connected across a 230 V, 50 Hz a.c. supply. Calculate the (i) impedance, (ii) current (iii) power factor and (iv) active power.

**OR**

7. (a) A coil of resistance 40 W and inductance 0·75 H forms part of series circuit for which the resonant frequency as 55 Hz if the supply is 250 V, 50 Hz. Find (i) line current, (ii) power factor and (iii) voltage across coil. [10]

(b) What is an Ideal Transformer? Explain.

8. For the circuit shown in Fig, determine the current delivered by the source when the switch is closed at t=0, using Laplace transformation. Assume there is no initial charge on the capacitor and no initial current though the inductor. [10]

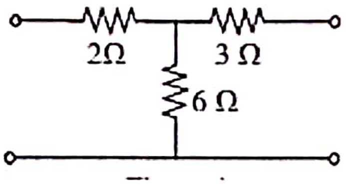



OR

9. Briefly explain series and Parallel resonant circuits and derive the expression for resonant frequency. [10]

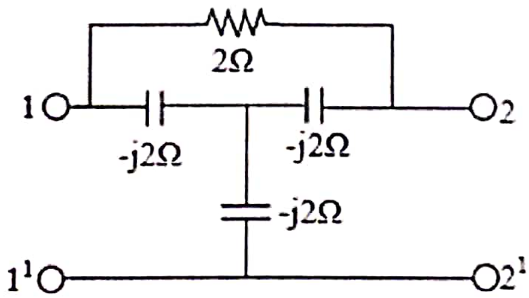
10. (a) Express hybrid parameters as a function of transmission parameters. [10]

(b) Find the hybrid parameters of the network shown in Figure




OR

11. (a) Find y parameters for the circuit shown [10]




(b) Find the equivalent parameters when two port networks are connected in series.

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Gokaraju Rangaraju Institute of Engineering & Technology

# II B.Tech I Sem (EEE) Result Analysis

Academic Year: 2022-23 Total No. of Students Registered: 69

| Course | Total No. of Students appeared | Total No. of Students Passed | No. of Students Failed | Count of Students with Grade Point | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | GP (10) | GP (9) | GP (8) | GP (7) | GP (6) | GP (5) |
| VEGC | 69 | 67 | 02 | 20 | 33 | 09 | 03 | 01 | 01 |
| CI | 69 | 67 | 02 | 14 | 22 | 19 | 09 | 02 | 01 |
| ECA | 69 | 50 | 19 | 00 | 03 | 04 | 14 | 17 | 12 |
| PAE | 69 | 66 | 03 | 01 | 14 | 24 | 13 | 10 | 04 |
| DCMT | 69 | 57 | 12 | 00 | 00 | 06 | 15 | 20 | 16 |
| EMF | 69 | 57 | 12 | 00 | 02 | 11 | 19 | 18 | 07 |
| JPE | 69 | 66 | 03 | 00 | 05 | 23 | 22 | 11 | 05 |
| PAE Lab | 69 | 65 | 04 | 16 | 09 | 15 | 13 | 07 | 05 |
| DCMT Lab | 69 | 60 | 09 | 06 | 09 | 08 | 08 | 18 | 11 |
| PGT | 69 | 65 | 04 | 00 | 02 | 15 | 30 | 13 | 05 |

Arrears Position – II year / I Semester

| No.of students | All Pass | One Arrear | Two Arrears | Three Arrears | More than three arrears | Overall % of pass |
|---|---|---|---|---|---|---|
| 69 | 46 | 07 | 07 | 04 | 05 | 66.67% |

Performance overall Class Three Toppers

| ROLL NO. | NAME | SGPA |
|---|---|---|
| 21241A0257 | Siripuram Manisree | 8.93 |
| 22245A0202 | Divya Namani | 8.50 |
| 21241A0245 | Palleti Sri Padma Latha Reddy | 8.40 |

**Class coordinator** **HOD, EEE**

II B.Tech - I Sem (EEE)

| SECTION | Courses | VEGC | CI | ECA | PAE | DCMT | EMF | JPE | PAE LAB | DCMT LAB | PGT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Course codes** | GR20A2002 | GR20A2003 | GR20A2023 | GR20A2024 | GR20A2025 | GR20A2026 | GR20A2028 | GR20A2029 | GR20A2030 | GR20A2033 |
| A | TOTAL | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| | PASS | 67 | 67 | 50 | 66 | 57 | 57 | 66 | 65 | 60 | 65 |
| | PASS(%) | 97.1 | 97.10 | 72.46 | 95.65 | 82.60 | 82.60 | 95.65 | 94.20 | 86.95 | 94.20 |
| | **FACULTY NAME** | M. Prashanth | D. Karuna Kumar | G Sandhya Rani | P Ravi Kanth | Dr B Phaneendra Babu | Dr T Suresh Kumar | D. Preethi | U. Vijaya Lakshmi/ M. Prashanth | V. Vijayarama Raju/ M. Rekha | V. Vijayarama Raju |
| | **FACULTY ID** | 1279 | 760 | 888 | 1178 | 1563 | 1494 | | 692/1279 | 361/933 | 361 |

**Class coordinator** **HOD, EEE**

Gokaraju Rangaraju Institute of Engineering & Technology

III B.Tech I Sem (EEE) Result Analysis

Academic Year: 2021-22 Total No. of Students Registered: 131

| **Course** | **Total No. of Students appeared** | **Total No. of Students Passed** | **No. of Students Failed** | **Count of Students with Grade Point** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **GP (10)** | **GP (9)** | **GP (8)** | **GP (7)** | **GP (6)** | **GP (5)** |
| SS | 131 | 122 | 9 | 23 | 42 | 29 | 16 | 8 | 4 |
| PS-I | 131 | 126 | 5 | 3 | 21 | 44 | 39 | 16 | 3 |
| PE | 131 | 124 | 7 | 20 | 16 | 26 | 40 | 20 | 2 |
| MC | 131 | 124 | 7 | 12 | 12 | 29 | 38 | 31 | 14 |
| AIT | 59 | 56 | 3 | 7 | 20 | 16 | 8 | 2 | 3 |
| WSES | 72 | 70 | 2 | 6 | 36 | 20 | 8 | 00 | 00 |
| PS-I Lab | 131 | 129 | 02 | 58 | 63 | 49 | 13 | 3 | 1 |
| PE Lab | 131 | 129 | 02 | 52 | 44 | 21 | 12 | 00 | 00 |
| MC Lab | 131 | 129 | 02 | 44 | 56 | 19 | 5 | 3 | 2 |
| FME | 131 | 127 | 04 | 2 | 14 | 51 | 42 | 17 | 1 |
| **Cloud Computing (MOOCs)** | 131 | 84 | 47 | 00 | 1 | 1 | 31 | 47 | 4 |

Arrears Position – III year / I Semester

| No.of students | All Pass | One Arrear | Two Arrears | Three Arrears | More than three arrears | Overall % of pass |
|---|---|---|---|---|---|---|
| 131 | 120 | 04 | 00 | 01 | 06 | 91.603% |

Performance overall Class Three Toppers

| ROLL NO. | NAME | SGPA |
|---|---|---|
| 19241A0204 | Aggarapu Siri | 9.24 |
| 19241A0210 | Ch. Sindhu | 9.20 |
| 19241A0287 | Nagilla Anjali | 9.12 |

**Class coordinator** **HoD**

III B.Tech - I Sem (EEE)

| SECTION | Courses | SS | PS-I | PE | MC | AIT | WSES | PS-I LAB | PE LAB | MC LAB | FME | Cloud Computing (moocs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Course codes** | GR18 A2052 | GR18 A3013 | GR18 A3014 | GR18 A3015 | GR18 A3016 | GR18 A3017 | GR18 A3020 | GR18 A3021 | GR18A 3022 | GR18 A3115 | GR18A60 12 |
| A | TOTAL | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 | 64 |
| | PASS | 58 | 60 | 58 | 58 | 62 | 63 | 63 | 63 | 63 | 61 | 43 |
| | PASS(%) | 90.625 | 93.75 | 90.625 | 90.625 | 96.875 | 98.437 | 98.437 | 98.437 | 98.437 | 95.312 | 67.187 |
| | **FACULTY NAME** | R. Anil Kumar | V Vijaya Rama Raju | Dr T Suresh Kumar | Dr D Raveendhra | Dr P Sri Vidya Devi | Dr Pakkiraiah B | G Sandhya Rani/V Usha Rani | Dr. Pakkiraiah B / Y Satyavani | Dr.P Sri Vidya Devi /P Prashanth Kumar | K. Sunil Kumar | U. Vijaya Lakshmi |
| | **FACULTY ID** | **657** | **361** | **1494** | **1605** | **931** | **1593** | **888/1045** | **1593/788** | **931/1055** | | **692** |
| B | TOTAL | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 |
| | PASS | 64 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 41 |
| | PASS(%) | 95.522 | 98.507 | 98.507 | 98.507 | 98.507 | 98.507 | 98.507 | 98.507 | 98.507 | 98.507 | 61.194 |
| | **FACULTY NAME** | R. Anil Kumar | V Vijaya Rama Raju | Dr T Suresh Kumar | P Prashanth Kumar | Dr P Sri Vidya Devi | Dr Pakkiraiah B | G Sandhya Rani/V Usha Rani | D Karuna Kumar /Y Satyavani | Dr.P Sri Vidya Devi /P Prashanth Kumar | K. Sunil Kumar | U. Vijaya Lakshmi |
| | **FACULTY ID** | **657** | **361** | **1494** | **1055** | **931** | **1593** | **888/1045** | **760/788** | **931/1055** | | **692** |

**Class coordinator** **HoD**

IV B.Tech I Sem (EEE) Result Analysis

Academic Year: 2021-22 Total No. of Students Registered: 131

| **Course** | **Total No. of Students appeared** | **Total No. of Students Passed** | **No. of Students Failed** | **Count of Students with Grade Point** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **GP (10)** | **GP (9)** | **GP (8)** | **GP (7)** | **GP (6)** | **GP (5)** |
| PS-III | 131 | 128 | 03 | 20 | 37 | 36 | 21 | 14 | 00 |
| ED | 131 | 127 | 04 | 01 | 29 | 34 | 31 | 26 | 06 |
| EHV | 131 | 128 | 03 | 08 | 53 | 41 | 18 | 07 | 01 |
| HVE | 131 | 127 | 04 | 01 | 12 | 38 | 37 | 28 | 11 |
| ED Lab | 131 | 129 | 02 | 67 | 37 | 14 | 08 | 03 | 00 |
| PW Phase-I | 131 | 130 | 01 | 48 | 49 | 30 | 02 | 01 | 00 |
| ES | 131 | 127 | 04 | 42 | 39 | 19 | 17 | 08 | 02 |
| **Cloud Computing (Moocs)** | 131 | 34 | 97 | 00 | 00 | 01 | 07 | 18 | 08 |

Arrears Position – IV year / I Semester

| No.of students | All Pass | One Arrear | Two Arrears | Three Arrears | More than three arrears | Overall % of pass |
|---|---|---|---|---|---|---|
| 131 | 126 | 01 | 01 | 00 | 03 | 96.1832% |

Performance overall Class Three Toppers

| ROLL NO. | NAME | SGPA |
|---|---|---|
| 19245A0206 | KYATHAM TEJASWI | 9.29 |
| 18241A02B3, 19245A0207 | SUSHMA SWARAJ PADALA, MIDDE SHIVA KUMAR | 9.17 |
| 18241A0242 | PRIYANKA SETTIPALLI | 9.08 |

**Class coordinator** **HoD**

IV B.Tech - I Sem (EEE)

| **SECTION** | **Courses** | **PS-III** | **ED** | **EHV** | **HVE** | **ED LAB** | **PW Phase-I** | **ES** | **Cloud Computing (Moocs)** |
|---|---|---|---|---|---|---|---|---|---|
| | **Course codes** | GR18A4012 | GR18A4013 | GR18A4014 | GR18A4021 | GR18A4022 | GR18A4061 | GR18A4102 | GR18A6012 |
| A | TOTAL | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| | PASS | 64 | 63 | 64 | 64 | 64 | 65 | 64 | 11 |
| | PASS(%) | 96.9696 | 95.454 | 96.9696 | 96.9696 | 96.9696 | 98.484 | 96.9696 | 16.67 |
| | **FACULTY NAME** | Dr. J. Sridevi | D G Padhan | Dr. B. Phaneendra Babu | A Vinay Kumar | P. Ravi Kanth/ M. Naga Sandya Rani | R. Anil Kumar /Dr. J. Sridevi | Dr D S Naga Malleswara Rao | M. Naga Sandya Rani |
| | **FACULTY ID** | **516** | **1283** | **1563** | **881** | **1178/882** | **657/516** | **1598** | **882** |
| B | TOTAL | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| | PASS | 64 | 64 | 64 | 63 | 65 | 65 | 63 | 23 |
| | PASS(%) | 98.461 | 98.461 | 98.461 | 96.923 | 100 | 100 | 96.923 | 35.3846 |
| | **FACULTY NAME** | V Usha Rani | D G Padhan | M Prashanth | A Vinay Kumar | P. Ravi Kanth/ M. Naga Sandya Rani | M. Prashanth/ V. Vijayarama Raju | Dr D S Naga Malleswara Rao | M. Naga Sandya Rani |
| | **FACULTY ID** | **1045** | **1283** | **1055** | **881** | **1178/882** | **361/1279** | **1598** | **882** |

**Class coordinator** **HoD**

# FEEDBACK OF FACULTY CONDUCTING II BTECH CLASS WORK

**BRANCH - EEE - II Year SEMESTER - I ACADEMIC YEAR : 2022-2023 FEEDBACK NO:1 DATE: 14-12-2022**

| S.NO | SECTION | SUBJECTS | FACULTY ID | FACULTY NAME | DEPT | FEEDBACK 1 OF STUDENTS (4 Points) | RELATIVE FEEDBACK 1 (AVG OF ALL SUBJECTS) |
|---|---|---|---|---|---|---|---|
| 1 | A | ECA | 888 | G. Sandhya Rani | EEE | 3.15 | 3.17 |
| 2 | | PAE | 1178 | P. Ravikanth | EEE | 3.12 | |
| 3 | | DCMT | 1563 | Dr B. Phaneendra Babu | EEE | 3.31 | |
| 4 | | EMF | 1494 | Dr. T. Suresh Kumar | EEE | 3.42 | |
| 5 | | PGT | 361 | V. Vijayarama Raju | EEE | 3.12 | |
| 6 | | JPE | 1710 | D. Preethi | EEE | 2.79 | |
| 7 | | PAEL | 692 | U. Vijaya Lakshmi | EEE | 3.05 | |
| 8 | | PAEL | 1279 | M. Prashanth | EEE | 3.16 | |
| 9 | | DCMTL | 361 | V. Vijayarama Raju | EEE | 3.33 | |
| 10 | | DCMTL | 933 | M. Rekha | EEE | 3.26 | |
| 11 | | COI | 760 | D. Karuna Kumar | EEE | 3.16 | |
| 12 | | VEGC | 1279 | M. Prashanth | EEE | 3.16 | |

B. phr Dr

HOD Signature

# FEEDBACK OF FACULTY BY STUDENTS

**DEPT: EEE YEAR: II B.TECH SEMESTER : I ACADEMIC YEAR: 2022-23**

**FB-1 Dt: 14-12-2022**

| S.NO | FACULTY ID | FACULTY NAME | DEPT | SUBJECT NAME | SECTION | NO. OF SECTIONS | FEEDBACK 1 ( 4 POINTS) ( AVG OF ALL SECTIONS) |
|---|---|---|---|---|---|---|---|
| 1 | 888 | G. Sandhya Rani | EEE | Electrical Circuit Analysis | A | 1 | 3.15 |
| 2 | 1178 | P. Ravikanth | EEE | Principles of Analog Electronics | A | 1 | 3.12 |
| 3 | 1563 | Dr B. Phaneendra Babu | EEE | DC Machines and Transformers | A | 1 | 3.31 |
| 4 | 1494 | Dr. T. Suresh Kumar | EEE | Electromagnetic Fields | A | 1 | 3.42 |
| 5 | 361 | V. Vijayarama Raju | EEE | Power Generation and Transmission | A | 1 | 3.12 |
| 6 | 1710 | D. Preethi | EEE | Java Programming for Engineers | A | 1 | 2.79 |
| 7 | 692 | U. Vijaya Lakshmi | EEE | Principles of Analog Electronics Lab | A | 1 | 3.05 |
| 8 | 1279 | M. Prashanth | EEE | Principles of Analog Electronics Lab | A | 1 | 3.16 |
| 9 | 361 | V. Vijayarama Raju | EEE | DC Machines and Transformers Lab | A | 1 | 3.33 |
| 10 | 933 | M. Rekha | EEE | DC Machines and Transformers Lab | A | 1 | 3.26 |
| 11 | 760 | D. Karuna Kumar | EEE | Constitution of India (CI) | A | 1 | 3.16 |
| 12 | 1279 | M. Prashanth | EEE | Value Ethics and Gender Culture | A | 1 | 3.16 |

HOD Signature

**GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**

**Summation of Teacher's Appraisal by Students**

| | |
|---|---|
| **Name of the Instructor** | G. Sandhya Rani |
| **Faculty ID** | 888 |
| **Branch** | EEE |
| **Class and Semester** | II-A SEM I |
| **Academic Year** | 2022-23 |
| **Subject Title** | Electrical Circuit Analysis |
| **Total No. of Responses/class strength** | 67/69 |

**Average rating on a scale of 4 for the responses considered:**

| S.No. | Questions | Average |
|---|---|---|
| 1 | How does the teacher explain the subject? | 2.91 |
| 2 | Knowledge and Preparation of teacher | 3.55 |
| 3 | The language and communication skills of the teacher is | 3.19 |
| 4 | Overall, how were the online classes conducted? | 2.97 |
| 5 | Rate your teacher's ability in interaction and clarifying the doubts | 3.15 |
| 6 | Rate your teacher's commitment in completing the syllabus | 3.33 |
| 7 | Rate your teacher's punctuality, usage of Audio, Visuals in online classes | 3.40 |
| 8 | Usage of teaching aids, real time examples and applications | 3.09 |
| 9 | Study material, PPTs, Conducting activities like quiz, etc., | 2.85 |
| 10 | What is your overall opinion about the teacher ? | 3.06 |
| | | 3.15 |

**Net Feedback on a Scale of 1 to 4** 3.15

**Remarks by HOD:**

**Remarks by Principal:**

**Remarks by Director:**

# GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

## FEEDBACK OF FACULTY CONDUCTING BTECH CLASS WORK

## FACULTY WISE

**EEE- B.Tech- II Year SEMESTER - I ACADEMIC YEAR : 2022-2023 FEEDBACK NO:2 DATE: 14-02-2023**

| S.NO | FACULTY ID | FACULTY NAME | SUBJECT NAME | SECTION | DEPT | NO. OF SECTIONS | FEEDBACK 3 ( 4 POINTS) (AVG OF ALL SECTIONS) |
|---|---|---|---|---|---|---|---|
| 1 | 888 | G. Sandhya Rani | Electrical Circuit Analysis | A | EEE | 1 | 2.92 |
| 2 | 1178 | P. Ravikanth | Principles of Analog Electronics | A | EEE | 1 | 3.08 |
| 3 | 1563 | Dr B. Phaneendra Babu | DC Machines and Transformers | A | EEE | 1 | 3.24 |
| 4 | 1494 | Dr. T. Suresh Kumar | Electromagnetic Fields | A | EEE | 1 | 3.4 |
| 5 | 361 | V. Vijayarama Raju | Power Generation and Transmission | A | EEE | 1 | 3.08 |
| 6 | 1710 | D. Preethi | Java Programming for Engineers | A | EEE | 1 | 2.88 |
| 7 | 692 | U. Vijayalakshmi | Principles of Analog Electronics Lab | A | EEE | 1 | 2.8 |
| 8 | 1279 | M. Prashanth | Principles of Analog Electronics Lab | A | EEE | 1 | 2.8 |
| 9 | 361 | V. Vijayarama Raju | DC Machines and Transformers Lab | A | EEE | 1 | 3.12 |
| 10 | 933 | M. Rekha | DC Machines and Transformers Lab | A | EEE | 1 | 3.12 |
| 11 | 760 | D. Karuna Kumar | Constitution of India (CI) | A | EEE | 1 | 3.12 |
| | 1279 | M. Prashanth | Value Ethics and Gender Culture | A | EEE | 1 | 2.8 |

HOD Signature

# GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

## FEEDBACK OF FACULTY CONDUCTING BTECH CLASS WORK

## FACULTY WISE

**EEE- B.Tech- II Year SEMESTER - I ACADEMIC YEAR : 2022-2023 FEEDBACK NO:2 DATE: 14-02-2023**

| S.NO | SECTION | SUBJECTS | FACULTY ID | FACULTY NAME | DEPT | FEEDBACK PERCENTAGE | FEEDBACK 2 | RELATIVE FEEDBACK (AVG OF ALL |
|---|---|---|---|---|---|---|---|---|
| 1 | A | Electrical Circuit Analysis | 888 | G. Sandhya Rani | EEE | 73 | 2.92 | 3.03 |
| 2 | | Principles of Analog Electronics | 1178 | P. Ravikanth | EEE | 77 | 3.08 | |
| 3 | | DC Machines and Transformers | 1563 | Dr B. Phaneendra Babu | EEE | 81 | 3.24 | |
| 4 | | Electromagnetic Fields | 1494 | Dr. T. Suresh Kumar | EEE | 85 | 3.4 | |
| 5 | | Power Generation and Transmission | 361 | V. Vijayarama Raju | EEE | 77 | 3.08 | |
| 6 | | Java Programming for Engineers | 1710 | D. Preethi | EEE | 72 | 2.88 | |
| 7 | | Principles of Analog Electronics Lab | 692 | U. Vijayalakshmi | EEE | 70 | 2.8 | |
| 8 | | Principles of Analog Electronics Lab | 1279 | M. Prashanth | EEE | 70 | 2.8 | |
| 9 | | DC Machines and Transformers Lab | 361 | V. Vijayarama Raju | EEE | 78 | 3.12 | |
| 10 | | DC Machines and Transformers Lab | 933 | M. Rekha | EEE | 78 | 3.12 | |
| 11 | | Constitution of India (CI) | 760 | D. Karuna Kumar | EEE | 78 | 3.12 | |
| 12 | | Value Ethics and Gender Culture | 1279 | M. Prashanth | EEE | 70 | 2.8 | |

HOD Signature

## Summation of Teacher's Appraisal by Students

| | |
|---|---|
| Name of the Instructor | G. Sandhya Rani |
| Branch | Electrical and Electronics Engineering |
| Class and Semester | III rd year -I Semester |
| Academic Year | 2022-23 |
| Subject Title | Power Electronics Lab |
| Total No. of Responses/class strength | 47/65 |

**Average rating on a scale of 4 for the responses considered:** 2.83

| S.No. | Questions | Average |
|---|---|---|
| 1 | How does the teacher explain the subject? | 2.79 |
| 2 | The teacher pays attention to | 3.11 |
| 3 | The language and communication skills of the teacher is | 2.91 |
| 4 | Is the session interactive | 2.74 |
| 5 | Rate your teacher's explanation in clearing doubts | 2.83 |
| 6 | Rate your teacher's commitment in completing the syllabus | 2.89 |
| 7 | Rate your teacher's punctuality | 2.96 |
| 8 | Rate your teachers use of teaching aids | 2.79 |
| 9 | Rate your teachers guidance in other activities like NPTEL,MOODLE,Swayam, projects | 2.55 |
| 10 | What is the overall opinion about the teacher? | 2.77 |

**Net Feedback on a Scale of 1 to 4** 2.83

**Remarks by HOD:** Try to use virtual Labs from IITs, give extra time/slot for student who is not attdg Lab. B.prasad

[signature]

**Remarks by Principal:**

**Remarks by Director:**

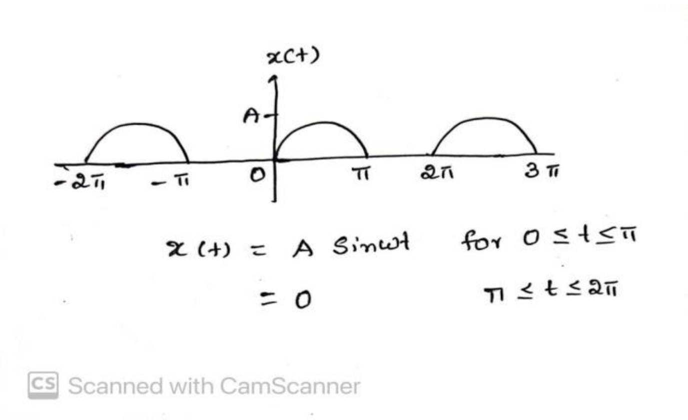
**GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**(Autonomous)**
**Department of Electrical and Electronics Engineering**

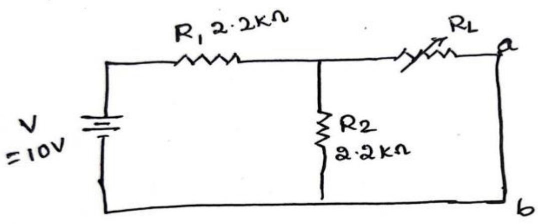
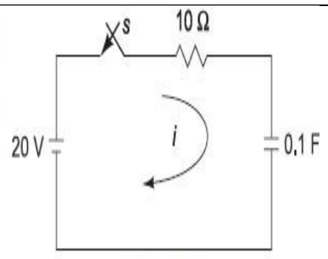
Academic Year: **2022-23**
Year:**II**
Semester:**I**

**MID Exam – I (Descriptive)**
**Electric Circuit analysis**
**Subject Code: GR20A2023**

Date:09/12/2022
Duration:**90 min**
Max Marks: **15**

**Note: Answer any ALL questions. All questions carry equal marks.**

| **Answer ALL questions. All questions carry equal marks** **3 * 5 = 15 Marks** | | | | | |
|---|---|---|---|---|---|
| **Q.No** | **Questions** | **Marks** | **CO** | **BL** | **PI** |
| **1.** | **(a)** Derive the expression for Trigonometric Fourier series equation and coefficients | **[5M ]** | **CO1** | **BL3** | **2.1.1** |
| **OR** | | | | | |
| **2.** | **a)** Find the Fourier series expansion of the rectified Sine wave shown in below figure   | **[3M ]** | **CO1** | **BL1** | **2.1.3** |
| | **(b)** State the Dirichlet's conditions for existence of Fourier series | **[ 2M]** | **CO1** | **BL2** | **2.1.1** |
| **3.** | **(a)** Derive the expression for Fourier transform of non periodic signal | **[3M ]** | **CO1** | **BL2** | **2.1.2** |
| | **(b)** Find the Fourier transform of $x(t) = e^{-t}\, sin5tu(t)$ | **[ 2M]** | **CO1** | **BL1** | **2.1.3** |
| **OR** | | | | | |
| **4.** | (a) Briefly explain about Hilbert transform | **[3M ]** | **CO1** | **BL6** | **2.1.1** |
| | **(b)** State the Parseval's property or Parsavel's energy | **[2M ]** | **CO1** | **BL2** | **2.1.2** |

| | | | | | |
|---|---|---|---|---|---|
| | theorem of Fourier transform. | | | | |
| 5. | **(a) (a)** Determine the load resistance to receive maximum power from the source; also find the maximum power delivered to the load in the circuit shown in below figure    | [3M ] | CO2 | BL2 | 2.1.1 |
| | **(b)** State compensation theorem | [ 2M] | CO2 | BL3 | 2.1.2 |
| | **OR** | | | | |
| 6. | (a) Evaluate time domain analysis of first order RC circuit | [3M ] | CO2 | BL4 | 2.1.1 |
| | *A series RC circuit consists of a resistor of 10 Ω and a capacitor of 0.1 F as shown in Fig. 1.85. A constant voltage of 20 V is applied to the circuit at t = 0. Obtain the current equation. Determine the voltages across the resistor and the capacitor.* **Solution** By applying Kirchhoff's law, we get $10i + \frac{1}{0.1}\int i\,dt = 20$   Fig. 1.85 | [2M ] | CO2 | BL1 | 2.1.3 |

## GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
## (Autonomous)
## Department of Electrical and Electronics Engineering

| Academic Year: **2022-23**<br>Year:**II**<br>Semester:**I** | **MID Exam – I (Objective)**<br>**Electric Circuit analysis**<br>**Subject Code: GR20A2023** | Date: 09/12/2022<br>Duration: **10 min**<br>Max Marks:**5M** |
|---|---|---|

**Roll No:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**Note: Answer ALL questions. All questions carry equal marks.**

| **Answer all Objective Questions. All questions carry equal marks** | | | | | |
|---|---|---|---|---|---|
| **Q.No** | **Questions** | **Option** | **CO** | **BL** | **PI** |
| **1** | What are the methods of fourier series<br>A. trigonometric form $B. cosine\ form$<br>C. Exponential form D. All | **[ ]** | **CO-1** | **BL-2** | **2.1.2** |
| **2** | Any waveform can be expressed in Fourier series if<br>A. Sampling conditions are satisfied<br>B. Dirichlet conditions are satisfied<br>C. Maxwell's conditions are satisfied<br>D. None of the above conditions is required to be satisfied | **[ ]** | **CO-1** | **BL-1** | **2.1.1** |
| **3** | Fourier Series applies to<br>A. Only periodic signals B. Only periodic signals<br>C. Both periodic and aperiodic signals D. Only random signals | **[ ]** | **CO-1** | **BL-1** | **2.1.1** |
| **4** | The fourier transform of a unit impulse function δ(t) is<br>$\boldsymbol{A.\frac{1}{\omega}}$ B. 1 C. ω D. $\frac{1}{j\omega}$ | **[ ]** | **CO-1** | **BL-2** | **2.1.2** |
| **5** | Fourier Transform applies to<br>A. Only periodic signals B. Only periodic signals<br>C. Both periodic and aperiodic signals D. Only random signals | **[ ]** | **CO-1** | **BL-1** | **2.1.1** |
| **6** | A trigonometric Fourier series has<br>A. a one-sided spectrum B. a two-sided spectrum<br>C. both one-side and two-sided spectrum D. none | **[ ]** | **CO-1** | **BL-1** | **2.1.1** |
| **7** | Maximum power is transferred when load resistance is<br>A. equal to Zero<br>B. equal to half of the source resistane<br>C. equal to source resistance<br>D. none of the above | **[ ]** | **CO-2** | **BL-1** | **2.1.1** |
| **8** | The reciprocity theorem is applicable to<br>A. Single-source networks<br>B. Multi-source networks | **[ ]** | **CO-2** | **BL-1** | **2.1.1** |

| | | | | | |
|---|---|---|---|---|---|
| | C. Both Single and Multi-source networks<br>D. Neither Single nor Multi-source networks | | | | |
| **9** | According to Millman's Theorem, if there are n voltage sources with n internal resistances respectively, are in parallel, then these sources are replaced by?<br>A. single current source I' in series with R'<br>B. single voltage source V' in series with R'<br>C. single current source I' in parallel to R'<br>D. single voltage source V' in parallel to R' | **[ ]** | **CO-2** | **BL-1** | **2.1.2** |
| **10** | The exponential fourier series coefficients Cn in terms of trigonometric fourier series coefficients is<br>A. $Cn = \frac{1}{2}(a_n - jb_n)$ B. $Cn = \frac{1}{2}(a_n + jb_n)$<br>C. $Cn = (a_n - jb_n)$ D. $Cn = (a_n + jb_n)$ | **[ ]** | **CO-1** | **BL-2** | **2.1.3** |

BL – Bloom's Taxonomy Levels
CO – Course Outcomes
PI – Performance Indicator Code3

**GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**(Autonomous)**
**Department of Electrical and Electronics Engineering**

Academic Year: **2022-23**
Year:**II**
Semester:**I**

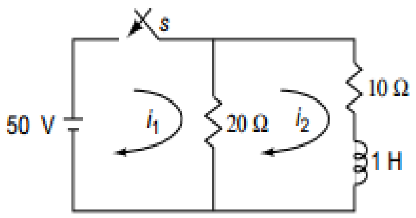
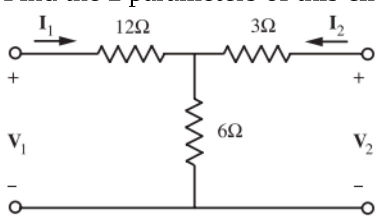
**MID Exam – I (Descriptive)**
**Electrical Circuit Analysis**
**(GR20A2023)**

Date:09/02/2023
Duration:**90 min**
Max Marks: **15**

**Note: Answer any ALL questions. All questions carry equal marks.**

**Answer ALL questions. All questions carry equal marks**

**3 * 5 = 15 Marks**

| Q.No | Questions | Marks | CO | BL | PI |
|---|---|---|---|---|---|
| **1.** | **(a)** A balanced delta connected load of (8+j6) ohms per phase is connected to a 3-phase, 50Hz, 230V supply. Calculate a. line current b. Power factor c. Reactive volt-ampere and d. Total volt-ampere | [ 3M] | CO3 | BL2 | 1.3.1 |
| | **(b)** Derive the relationship between line and phase quantities in a 3-phase delta connected | [ 2M] | CO3 | BL2 | 1.1.1 |
| | **OR** | | | | |
| **2.** | Briefly explain two wattmeter method | [ 5M] | CO3 | BL4 | 2.4.1 |
| **3.** | Derive convolution Integral of Laplace transform | [ 5M] | CO4 | BL2 | 1.1.1 |
| | **OR** | | | | |
| **4.** | In the circuit shown in Figure, obtain the equations for $i_1(t)$ and $i_2(t)$ when the switch is closed at t = 0.<br><br> | [ 5M] | CO4 | BL3 | 2.3.1 |
| **5.** | Derive the condition for symmetry and reciprocity of Z parameters | [ 5M] | CO5 | BL2 | 1.1.1 |
| | **OR** | | | | |
| **6.** | **(a)** Find the **z** parameters of this circuit shown below Figure.<br><br> | [ 5M] | CO5 | BL3 | 2.1.2 |

**GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**(Autonomous)**
**Department of Electrical and Electronics Engineering**

| | | |
|---|---|---|
| Academic Year: **2022-23** | **MID Exam – I (Objective)** | Date: 09/02/2023 |
| Year: **II** | **Electrical Circuit Analysis (GR20A2023)** | Duration: **10 min** |
| Semester: **I** | | Max Marks:**5M** |

**Roll No:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**Note: Answer ALL questions. All questions carry equal marks.**

**Answer all Objective Questions. All questions carry equal marks**

| Q.No | Questions | Option | CO | BL | PI |
|---|---|---|---|---|---|
| **1** | In a three-phase balanced star connected system, the phase relation between the line voltages and their respective phase voltage is given as under<br>A. the line voltages lead their respective phase voltages by 30°.<br>B. the phase voltages lead their respective line voltage by 30°.<br>C. the line voltages and their respective phase voltages are in phase.<br>D. the phase voltages lead their respective line voltage by 120°. | [ ] | **CO3** | **BL2** | **2.4.1** |
| **2** | Two wattmeter method of power measurement can be used to measure power in<br>A. balanced circuits B. unbalanced circuits<br>C. both balanced and unbalanced circuits D. none of the above | [ ] | **CO3** | **BL1** | **2.1.1** |
| **3** | In two wattmeter methods of power measurements, when the pf is 0.5<br>A.The readings of the two wattmeter's are equal and positive<br>B.The readings of the two wattmeter's are equal and opposite<br>C.The total power is measured by only one wattmeter<br>D. none of the above | [ ] | **CO3** | **BL1** | **2.1.1** |
| **4** | The Laplace transform of a unit step function is<br>A. $\frac{1}{s}$ B.1 C. $\frac{1}{s^2}$ D. $\frac{1}{s+a}$ | [ ] | **CO4** | **BL2** | **2.1.1** |
| **5** | The Laplace transform of the first derivative of a function f(t) is<br>A. F(s)/s B. sF(s) – f(0) C. F(s) – f(0) D. f(0) | [ ] | **CO4** | **BL3** | **1.1.1** |
| **6** | The inverse transform of $\frac{6}{s^4}$ is<br>A.3 B. $t^2$ C. $t^3$ D. $3t$ | [ ] | **CO4** | **BL3** | **2.1.1** |
| **7** | The h parameters $h_{11}$and $h_{12}$ are obtained<br>A. By shorting output terminals B. By opening input terminals<br>C. By shorting input terminals D. By opening output terminals | [ ] | **CO5** | **BL1** | **2.1.2** |
| **8** | Which parameters are widely used in transmission line theory<br>A. Z parameters B. Y parameters C. ABCD parameters D. H parameters | [ ] | **CO5** | **BL2** | **2.1.2** |
| **9** | In parallel connection the _____ parameters are added<br>A. Z parameters B. Y parameters C. ABCD parameters D. H parameters | [ ] | **CO5** | **BL2** | **2.1.2** |
| **10** | Transfer function of a system is defined as the ratio of output to input in<br>A. Z-transformer B. Fourier transform<br>C. Laplace transform D. All of these | [ ] | **CO3** | **BL1** | **2.1.1** |

**Gokaraju Rangaraju Institute of Engineering and Technology**

**(Autonomous)**

**Bachupally, Kukatpally, Hyderabad – 500 090**

**Direct Internal CO Attainments**

| | | | | | |
|---|---|---|---|---|---|
| Academic Year | 22-23 | Department | EEE | Name of the Programme | Btech |
| Year - Semester | II-I | Course Name : | ECA | Course Code | GR20A2023 |
| Section | A | | | | |

| | Mid -I | | | | | | | | | | | | Mid -II | | | | | | | | Assignment Marks | | | | | Assessment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1a | 2a | 2b | 3a | 3b | 4a | 4b | 5a | 5b | 6a | 6b | obj | 1a | 1b | 2 | 3 | 4 | 5 | 6 | obj | I | II | III | IV | V | Marks |
| Enter CO Number → 1,2,3,4,5,6,7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1,2 | 3 | 3 | 3 | 4 | 4 | 5 | 5 | 3,4,5 | 1 | 2 | 3 | 4 | 5 | 1,2,3,4,5 |
| Marks → | 5 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 5 | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| S.No/Roll No. | *Note :* Enter Marks Between Two Green rows. *Another Note :* Additional Columns if Required should be inserted after column H and appropriately rename the Q. Nos. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21241A0201 | 1.5 | | | 1 | | | | 3 | | | | 3.5 | | | 1 | 3 | | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0202 | 1.5 | | 2 | 1 | | | | | | | | 1.5 | | 2 | | 5 | | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0203 | 4 | | | 1 | 2 | | | 0.5 | | | | 2.5 | 1 | 2 | | 1 | | | 5 | 4 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0204 | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0205 | 5 | | | | | | | 2 | 1 | | | 4.5 | | | 3 | | | 2 | | 1 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0206 | 4 | | | 2 | | | | 2 | | | | 3.5 | | 2 | | 1 | | 1 | | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0207 | 5 | | | | | 1 | 1 | 2 | | 3 | 2 | 3.5 | | | 5 | 1 | | | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| 21241A0208 | 5 | | | | 1 | | | 1.5 | | | | 4 | | 2 | | | | | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0209 | 0 | | | | | | | | | | | 3 | | | | 1 | | | 2 | 4 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0210 | 5 | | | | | | | 2.5 | | | | | 1 | 2 | | | | | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 5 |
| 21241A0211 | | | | | | | | | | | | | | | 3 | | | 1 | | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0212 | 5 | | | | | | | 2 | | | | 2.5 | 1 | 2 | | | | | 4 | 3 | 1 | 1 | 1 | 1 | 1 | 5 |
| 21241A0213 | 2 | | | | | | | 3 | 1 | | | 2.5 | 1 | | | 5 | | | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0214 | 2 | | | | | 1 | | 1 | | | | 2.5 | | 1 | | | | | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0215 | 5 | | | 1 | | | | | | | | 3 | 1 | | | 2 | | | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0216 | | | | | | | | | | | | 2 | | | | 1 | | | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0217 | 5 | | | 3 | | | | 2 | 1 | | | 3 | | | 5 | 5 | | 1 | | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0218 | 3 | | | | | | | 1 | | 1 | | 2 | | 1 | | | | | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0219 | 5 | | | 3 | 2 | | | 3 | | | | 4 | | 2 | | 5 | | | 5 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0220 | 5 | | | 2 | | | | 1 | | | | 3.5 | | | | 4 | | 2 | | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0221 | 5 | | | | | 1 | | 1 | | | | 3 | | 2 | | 1 | | | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0222 | 3 | | 1 | | 2 | | | 1 | | | | 3 | | | 4 | 2 | | | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0223 | | | | 1 | | | | | | | | 2 | | | | | | | 1 | 3 | 5 | 5 | 5 | 5 | 5 | 4 |
| 21241A0224 | 4 | | | 1 | 1 | | | 2 | | | | 5 | | | 2 | 1 | | | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 5 |
| 21241A0225 | 5 | | | | 1 | | | 1 | 1 | | | 4 | 2 | 2 | | 3 | | | 4 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| 21241A0226 | 1 | | | | | | | | | | | 2.5 | | | | | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0227 | 5 | | | | 2 | | | 3 | 1 | | | 3.5 | | | 4 | 1 | | 2 | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0228 | 4 | | | 2 | | | | 1 | 1 | | | 4 | | | 5 | 4 | | | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0229 | 5 | | | 1 | | | | 3 | | | | 4 | | 1 | | 4 | | | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0230 | 5 | | | 1 | | | 2 | 1 | 1 | | | 4 | | 2 | | 5 | | 2 | | 2 | 1 | 1 | 1 | 1 | 1 | 5 |
| 21241A0231 | | 1 | | | | 1 | 1 | 2 | | | | 4 | 1 | | | | 1 | 2 | | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0232 | | 1 | 1 | | | | | 1 | 1 | | | 4 | | 1 | | | 2 | 1 | | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0233 | | | | | | | | | | | | 4 | | | | | | | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0234 | 2 | | | 1 | | | | 1 | | | | 3 | | | | 5 | | | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 5 |
| 21241A0235 | 5 | | | 3 | 2 | | | 2 | 2 | | | 4 | | | 4 | 3 | | 1 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0236 | 5 | | | 1.5 | | | | 1 | 1.5 | | | 4 | | | 5 | 4 | | | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0237 | 5 | | | | | | | 3 | | | | 2 | | | 4 | 5 | | | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21241A0238 | | | | | | | | 2 | | | | 3 | | | | 3 | | | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0239 | 5 | | | | | 1 | 1 | 1 | | | | 3 | 1 | 2 | | 4 | | | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0240 | 5 | | | | 2 | | | 2 | | | | 3 | | 2 | 3 | | | | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0241 | 4 | | | | | | | | | | | 2 | | | | | | | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0242 | 5 | | | | | 1 | 1 | 3 | | 2 | 1 | 3 | | | 3 | 3 | | | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 4 |
| 21241A0243 | 5 | | | | | | 1 | | | 2 | 1.5 | 3.5 | | | 4 | 4 | | | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| 21241A0244 | 5 | | | | | | 1.5 | 2.5 | 1 | | | 4 | | 1 | | 4 | | | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| 21241A0245 | 5 | | | 3 | | | 3 | 1 | 3 | 1.5 | | 3 | 2 | 2 | 4 | 5 | | | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| 21241A0246 | 5 | | | | | | 1 | | 3 | | | 4 | | | 2 | | | | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21241A0247** | 2 | | | | | | 1 | 1 | 1 | | | 2 | | | | | | | | | 5 | 5 | 5 | 5 | 5 | 4 |
| **21241A0248** | 5 | | | 2 | 1 | | | | 3 | | | 4 | | | 3 | 4 | | | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |
| **21241A0249** | | 1.5 | 2 | | | | 1 | | | | | 3 | | | | 4 | | 3 | | 3 | 1 | 1 | 1 | 1 | 1 | 4 |
| **21241A0250** | | | | | | | | 2 | | | | 3 | | | | | | | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| **21241A0251** | 2 | | | | | 1 | 1 | | | | | 2 | | | 2 | 1 | | 1 | | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| **21241A0252** | 5 | | | | | 2 | 1 | 2 | 2 | | | 5 | | | 4 | 5 | | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| **21241A0253** | 0 | | | | | | | | | | | 2 | | | | | | | 1 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |
| **21241A0254** | 5 | | | 1 | | | | | | | | 3 | | | | 5 | | | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| **21241A0255** | 5 | | 2 | 3 | | | | | | | | 4 | 2 | 2 | | 4 | | | | 2 | 4 | 4 | 4 | 4 | 4 | 5 |
| **21241A0256** | 1 | | | | | | | 1 | | | | 3 | | | | | 1 | | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| **21241A0257** | 5 | | | 3 | 2 | | | 3 | 1.5 | | | 4 | 3 | 2 | | 5 | | | 5 | 2 | 5 | 5 | 5 | 5 | 5 | 5 |
| **21241A0258** | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 4 |
| **21241A0259** | 2 | 1 | | | | 1 | | 2 | 1 | | | 4 | | 1 | 1 | 3 | | | 2 | 4 | 1 | 1 | 1 | 1 | 1 | 4 |
| **21241A0260** | 5 | | | | | | | 1 | | | | 4 | | 2 | | | | | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |
| **21241A0261** | 5 | | | | | | | 3 | 1 | | | 5 | | 2 | | 2 | | | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 |
| **21241A0262** | 1 | 1 | | | | | | | | | | 2 | | 2 | 4 | | | | | 2 | 4 | 4 | 4 | 4 | 4 | 5 |
| **21241A0263** | 2 | | | | | | | | | | | 2 | | 1 | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 |
| **22245A0201** | | | 2 | | | 1 | 2 | 3 | 1 | | | 4 | 2 | 1 | | | | | | 4 | 1 | 1 | 1 | 1 | 1 | 4 |
| **22245A0202** | | 2 | 2 | 1 | 1 | | | 2 | 1 | | | 5 | | | 4 | 2 | | | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **22245A0203** | 5 | | | | | 1 | 1 | 3 | | | | 5 | | | 5 | 5 | | | 4 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| **22245A0204** | 4 | | | 1 | | | | | | 2 | 1 | 3 | | | 3 | | | | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **22245A0205** | 5 | | | | | | | 1.5 | | | | 5 | | | 5 | 3 | | | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| **22245A0206** | 5 | | | | | 1 | 1 | 1 | | | | 5 | | | 4 | | 3 | | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| **if your class strength is > 60 then *insert rows above the green row(Last Record)* , Similarly *delete the empty rows above green row* if the class strenght is < 60)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total number of students appeared for the examination (NST) | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 | 69 |
| Total number of students attempted the question (NSA) | 56 | 6 | 7 | 23 | 12 | 12 | 16 | 47 | 21 | 6 | 4 | 65 | 12 | 26 | 27 | 42 | 5 | 12 | 51 | 66 | 69 | 69 | 69 | 69 | 69 | 69 |
| Attempt % (TAP) = (NSA/NST)*100 | 81 | 9 | 10 | 33 | 17 | 17 | 23 | 68 | 30 | 9 | 6 | 94 | 17 | 38 | 39 | 61 | 7 | 17 | 74 | 96 | 100 | 100 | 100 | 100 | 100 | 100 |
| Total number of Students who got more than 60% marks (NSM) | 42 | 1 | 5 | 10 | 7 | 1 | 4 | 27 | 7 | 4 | 2 | 49 | 5 | 18 | 22 | 29 | 1 | 1 | 30 | 38 | 40 | 40 | 40 | 40 | 40 | 69 |
| Attainment % (TMP) = (NSM/NSA)*100 | 75 | 17 | 71 | 43 | 58 | 8 | 25 | 57 | 33 | 67 | 50 | 75 | 42 | 69 | 81 | 69 | 20 | 8 | 59 | 58 | 58 | 58 | 58 | 58 | 58 | 100 |
| Score(S) | 3 | 0 | 3 | 1 | 2 | 0 | 0 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 0 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| **Note : CO attainment is considered to be zero if the attempt % is less than 30%** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **CO Validation** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **2** | **2** | **2** | **1,2** | **3** | **3** | **3** | **4** | **4** | **5** | **5** | **3,4,5** | **1** | **2** | **3** | **4** | **5** | **1,2,3,4,5** |
| **Course Outcome** | **CO1** | **CO1** | **CO1** | **CO1** | **CO1** | **CO1** | **CO1** | **CO2** | **CO2** | **CO2** | **CO2** | **O1,CO** | **CO3** | **CO3** | **CO3** | **CO4** | **CO4** | **CO5** | **CO5** | **3,CO4,C** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** | **CO1,CO2,CO3,CO4,CO5** |
| **Marks (Y)** | **5** | **3** | **2** | **3** | **2** | **3** | **2** | **3** | **2** | **3** | **2** | **5** | **3** | **2** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** | **5** |
| **No. of COs Shared (Z)** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **3** | **1** | **1** | **1** | **1** | **1** | **5** |
| **Y/Z** | **5** | **3** | **2** | **3** | **2** | **3** | **2** | **3** | **2** | **3** | **2** | **2.5** | **3** | **2** | **5** | **5** | **5** | **5** | **5** | **1.667** | **5** | **5** | **5** | **5** | **5** | **1** |
| **S*Y/Z** | **15** | **0** | **6** | **3** | **4** | **0** | **0** | **6** | **2** | **9** | **4** | **7.5** | **3** | **6** | **15** | **15** | **0** | **0** | **10** | **3.333** | **10** | **10** | **10** | **10** | **10** | **3** |
| **CO1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **1** |
| **CO2** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **1** |
| **CO3** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **0** | **0** | **1** | **0** | **0** | **1** |
| **CO4** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** | **0** | **0** | **1** | **0** | **1** |
| **CO5** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1** | **1** | **1** | **0** | **0** | **0** | **0** | **1** | **1** |
| **CO6** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **CO7** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

| Weighted Average for Attainment relevance (Internal CODn) | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| | 1.70 | 2.24 | 2.28 | 1.77 | 1.49 |

**!! Caution !! For CO Values < 2.25 should be justified with Remidial Action Report.**

## Gokaraju Rangaraju Institute of Engineering and Technology

**(Autonomous)**

**Bachupally, Kukatpally, Hyderabad – 500 090**

**Indirect CO Attainments**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Academic Year | 22-23 | Department | EEE | Name of the Programme | Btech | | |
| Year - Semester | II-I | Course Name : | ECA | Course Code | | Section | A |

**Course Outcomes survey on Scale 1 (Low) to 5 (High)**

| Enter Course Outcomes → | Explain the differences between linear and non-linear magnetic circuits | The concepts of generators and motors | Select the appropriate DC generator or DC motor for the given application | Able to test ant given DC Generator or DC motor. | Explain the different types of materials used in transformers. | | |
|---|---|---|---|---|---|---|---|
| CO Number 1,2,3,4,5,6,7 | 1 | 2 | 3 | 4 | 5 | | |
| Marks | 5 | 5 | 5 | 5 | 5 | | |
| S.No/Roll No. | Note : Enter Marks Between Two Green rows. | | | | | | |
| First Record / 1 | 5 | 4 | 5 | 4 | 4 | | |
| 2 | 5 | 5 | 5 | 5 | 5 | | |
| 3 | 5 | 5 | 5 | 5 | 5 | | |
| 4 | 5 | 5 | 5 | 5 | 5 | | |
| 5 | 5 | 5 | 5 | 5 | 5 | | |
| 6 | 5 | 5 | 5 | 5 | 5 | | |
| 7 | 5 | 2 | 3 | 2 | 2 | | |
| 8 | 5 | 5 | 5 | 2 | 2 | | |
| 9 | 5 | 5 | 5 | 2 | 2 | | |
| 10 | 5 | 5 | 5 | 2 | 2 | | |
| 11 | 5 | 5 | 5 | 5 | 5 | | |
| 12 | 5 | 5 | 5 | 5 | 5 | | |
| 13 | 5 | 5 | 5 | 5 | 5 | | |
| 14 | 5 | 5 | 5 | 5 | 5 | | |
| 15 | 5 | 5 | 5 | 5 | 5 | | |
| 16 | 5 | 2 | 3 | 2 | 2 | | |
| 17 | 5 | 5 | 5 | 2 | 2 | | |
| 18 | 5 | 5 | 5 | 2 | 2 | | |
| 19 | 5 | 5 | 5 | 2 | 2 | | |
| 20 | 5 | 5 | 5 | 5 | 5 | | |
| 21 | 5 | 5 | 5 | 5 | 5 | | |
| 22 | 5 | 5 | 5 | 5 | 5 | | |
| 23 | 5 | 5 | 5 | 5 | 5 | | |
| 24 | 5 | 5 | 5 | 5 | 5 | | |
| 25 | 5 | 2 | 3 | 2 | 2 | | |
| 26 | 5 | 5 | 5 | 2 | 2 | | |
| 27 | 5 | 5 | 5 | 2 | 2 | | |
| 28 | 5 | 5 | 5 | 2 | 2 | | |
| 29 | 5 | 5 | 5 | 5 | 5 | | |
| 30 | 5 | 5 | 5 | 5 | 5 | | |
| 31 | 5 | 5 | 5 | 5 | 5 | | |
| 32 | 5 | 5 | 5 | 5 | 5 | | |
| 33 | 5 | 5 | 5 | 5 | 5 | | |
| 34 | 5 | 2 | 3 | 2 | 3 | | |
| 35 | 5 | 5 | 5 | 2 | 3 | | |
| 36 | 5 | 5 | 5 | 2 | 3 | | |
| 37 | 5 | 5 | 5 | 2 | 3 | | |
| 38 | 5 | 5 | 5 | 5 | 5 | | |
| 39 | 5 | 5 | 5 | 5 | 5 | | |
| 40 | 5 | 5 | 5 | 5 | 5 | | |
| 41 | 5 | 5 | 5 | 5 | 5 | | |
| 42 | 5 | 5 | 5 | 5 | 5 | | |
| 43 | 5 | 2 | 3 | 2 | 3 | | |
| 44 | 5 | 5 | 5 | 2 | 3 | | |
| 45 | 5 | 5 | 5 | 2 | 3 | | |
| 46 | 5 | 5 | 5 | 2 | 3 | | |
| 47 | 5 | 5 | 5 | 5 | 5 | | |
| 48 | 5 | 5 | 5 | 5 | 5 | | |
| 49 | 5 | 5 | 5 | 5 | 5 | | |
| 50 | 5 | 5 | 5 | 5 | 5 | | |
| 51 | 5 | 5 | 5 | 3 | 5 | | |
| 52 | 5 | 2 | 3 | 3 | 3 | | |
| 53 | 5 | 5 | 5 | 3 | 2 | | |
| 54 | 5 | 5 | 5 | 3 | 2 | | |
| 55 | 5 | 5 | 5 | 3 | 2 | | |
| 56 | 5 | 5 | 5 | 3 | 2 | | |
| 57 | 5 | 5 | 5 | 3 | 2 | | |
| 58 | 5 | 5 | 5 | 3 | 3 | | |
| 59 | 5 | 5 | 5 | 3 | 3 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 60 | 5 | 5 | 5 | 3 | 3 | | |
| 61 | 5 | 5 | 5 | 3 | 3 | | |
| 62 | 5 | 5 | 5 | 3 | 3 | | |
| 63 | 5 | 5 | 5 | 3 | 3 | | |
| 64 | 5 | 5 | 5 | 3 | 3 | | |
| 65 | 5 | 5 | 5 | 3 | 3 | | |
| 66 | 5 | 5 | 5 | 3 | 3 | | |
| 67 | 5 | 5 | 5 | 3 | 3 | | |
| 68 | 5 | 5 | 5 | 2 | 2 | | |
| **Last Record 69** | 5 | 4 | 5 | 4 | 4 | | |
| **if your class strength is > 60 then *insert rows* *above the green row (Last Record)* , Similarly *delete the* *empty rows above green row* if the class strenght is < 60)** | | | | | | | |
| Total number of students appeared for the examination (NST) | 69 | 69 | 69 | 69 | 69 | | |
| Total number of students attempted the question (NSA) | 69 | 69 | 69 | 69 | 69 | | |
| Attempt % (TAP) = (NSA/NST)*100 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | | |
| Total number of Students who got more than 60% marks (NSM) | 69 | 63 | 69 | 48 | 51 | | |
| Attainment % (TMP) = (NSM/NSA)*100 | 100.00 | 91.30 | 100.00 | 69.57 | 73.91 | | |
| Score(S) | 3 | 3 | 3 | 3 | 3 | | |

**CO attainment is considered zero if the attempt % is less than 30%**

| Indirect CO (COIn) | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 | CO7 |
|---|---|---|---|---|---|---|---|
| | 3 | 3 | 3 | 3 | 3 | | |

**!! Caution !! For CO Values < 2.25 should be justified with Remidial Action Report.**

Gokaraju Rangaraju Institute of Engineering and Technology
(Autonomous)
Bachupally, Kukatpally, Hyderabad – 500 090
External CO Attainments

| | | | | | |
|---|---|---|---|---|---|
| Academic Year | 22-23 | Department | EEE | Name of the Programme | Btech |
| Year - Semester | II-I | Course Name : | ECA | Course Code | GR20A2023 |

Section: A

| | Q.No 1 (a) Marks | Q.No 1 (b) Marks | Q.No 1 (c) Marks | Q.No 1 (d) Marks | Q.No 1 (e) Marks | Q.No 1 (f) Marks | Q.No 1 (g) Marks | Q.No 1 (h) Marks | Q.No 1 (i) Marks | Q.No 1 (j) Marks | Q.No 2a Marks | Q.No 2b Marks | Q.No 3a Marks | Q.No 3b Marks | Q.No 4a Marks | Q.No 4b Marks | Q.No 5a Marks | Q.No 5b Marks | Q.No 6a Marks | Q.No 6b Marks | Q.No 7a Marks | Q.No 7b Marks | Q.No 8a Marks | Q.No 8b Marks | Q.No 9a Marks | Q.No 9b Marks | Q.No 10a Marks | Q.No 11a Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enter CO Number → 1,2,3,4,5,6,7 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | | 4 | 4 | 5 | 5 |
| Marks → | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 | 5 |
| S.No/Roll No. | *Note :* Enter Marks Between Two Green rows. *Another Note :* Additional Columns if Required should be inserted after column H and appropriately rename the Q. Nos. For Calculations consult Departments CO-PO Incharge | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| First Record / 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |
| 2 | 0 | 0 | 0 | | 1 | | | | | | | | 0 | | | | | | | 0 | | | | | | | | |
| 3 | 1 | 1 | 1 | 0 | 1 | 0 | | 0 | 1 | 1 | | | 3 | | | | 3 | 4 | | | 4 | 3 | | | 2 | | | 4 |
| 4 | 1 | 1 | 0 | 0 | | | | 0 | | 0 | | | 3 | | | | 0 | 0 | | | 3 | | | | 0 | | 1 | |
| 5 | 2 | 1 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | | | 8 | | | | 1 | | 1 | 4 | | | | | | | 7 | |
| 6 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 6 | | 4 | 4 | | | | | 4 | 4 | | | 1 | 2 | 3 | 2 |
| 7 | 2 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | | | 8 | | 0 | 0 | | | | | 4 | 0 | 0 | | 0 | | | 8 |
| 8 | 2 | 2 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | | | | | | 4 | 4 | | | | 3 | 4 | | | | | | 5 | |
| 9 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 2 | 1 | | | 8 | | 4 | 3 | | | | | 4 | 3 | | | 2 | 1 | 3 | |
| 10 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 7 | | 0 | | 4 | 4 | | | 1 | 4 | 4 | 2 | | | | | 8 | |
| 11 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 1 | 2 | | 4 | | | | 3 | 3 | | 3 | | | 4 | 2 | | | | | 1 | 6 |
| 12 | | 1 | 1 | | 1 | 1 | | 2 | 1 | | | | | | 2 | 0 | 3 | 4 | | 4 | 4 | 1 | 1 | | | | 8 | 4 |
| 13 | 2 | 1 | 0 | 2 | 1 | 0 | 1 | 2 | 2 | 2 | | | 8 | | 4 | 4 | | | | | 0 | 1 | 1 | | 1 | | 5 | 4 |
| 14 | 2 | 2 | 2 | 1 | 1 | 1 | | 1 | 1 | 1 | | | 6 | | 4 | 4 | | | | | 4 | 3 | 2 | | 2 | | | 7 |
| 15 | 2 | 2 | 0 | 1 | 1 | 1 | 1 | | | | | | 6 | 0 | 3 | | | 2 | | | 4 | 2 | | | 2 | | | 6 |
| 16 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | | | 4 | | | | 4 | 4 | | | 4 | 2 | 1 | 2 | | | 4 | |
| 17 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | | | 7 | | 4 | 4 | | 2 | | 3 | 4 | | 1 | | | | 3 | |
| 18 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | 2 | | | | 2 | 1 | 1 | 0 | | | | | 1 | 1 | | 2 |
| 19 | 2 | 2 | 0 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 7 | | | | 4 | 4 | | | | | 4 | 4 | 3 | 2 | | | | 8 |
| 20 | 2 | 2 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | | | 3 | | 2 | 1 | | | | | 4 | 2 | | | 0 | | 1 | 5 |
| 21 | 1 | 1 | 1 | | 1 | 0 | 1 | 1 | 1 | 2 | | | 6 | | 4 | 3 | | | | 3 | 4 | 3 | 2 | 2 | 2 | | 5 | |
| 22 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 2 | 2 | 1 | 6 | | | | 2 | 1 | | | | | 4 | 2 | | | 1 | 1 | 4 | |
| 23 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | | | 6 | | 4 | 4 | | | | | 4 | 2 | | | 2 | 1 | 3 | |
| 24 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | | | | 4 | 5 | | | | 3 | 4 | 3 | 1 | | | | 6 | 7 |
| 25 | 2 | 2 | 0 | 1 | 1 | | 0 | 0 | 1 | 0 | | | 5 | | 3 | 3 | | | 2 | 4 | | | | | 1 | 1 | 3 | |
| 26 | 2 | 2 | 1 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | | | 7 | | 4 | 4 | | | 3 | 3 | | | 2 | 2 | | | 7 | |
| 27 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | | | 1 | | 0 | 0 | | | 1 | 1 | | | | | 1 | 0 | | 1 |
| 28 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 3 | | | | | | 1 | 2 | 3 | 4 | | | | | 1 | 0 | | 6 |
| 29 | 2 | 1 | 1 | 2 | 1 | | | | 1 | 0 | | | 1 | | 4 | 4 | | | | | 2 | 2 | 1 | 3 | | | 4 | 3 |
| 30 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | | | | | 2 | 2 | | | 0 | | | | | | 1 | | | |
| 31 | 2 | 2 | | 1 | 1 | 2 | 1 | 0 | 0 | 1 | | | 7 | | 4 | 4 | | | | | 4 | 3 | 1 | 3 | | | 7 | |
| 32 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 0 | | | 5 | | 4 | 4 | | | | | 5 | 2 | 1 | 2 | | | 4 | |
| 33 | 1 | 2 | 0 | 2 | 1 | 1 | 0 | 1 | 2 | 2 | | | 2 | | 4 | 1 | 1 | 2 | | 4 | 3 | 2 | | | | | | 8 |
| 34 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | | | 8 | | 4 | 4 | | | | | 4 | 2 | | | 2 | 2 | 8 | |
| 35 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | | | 1 | | 1 | 0 | 0 | | 0 | | 3 | 2 | | | 1 | 1 | 2 | |
| 36 | 2 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | | | 7 | | 4 | 4 | | | | 0 | 4 | 1 | | | 1 | 1 | 8 | |
| 6 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | | | 6 | | 4 | 4 | | | | | 4 | 1 | 2 | 1 | | | | 7 |
| 38 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | | | 6 | | 2 | 2 | | | | | 4 | 3 | | | 2 | 2 | | 5 |
| 39 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | | | 9 | | | | 3 | 4 | | | 5 | 4 | 3 | | | | 5 | |
| 40 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 2 | | | | 4 | 3 | | | 1 | 1 | | | | | 2 | | 1 | |
| 41 | 0 | 0 | 0 | 0 | 0 | | | | | | | | 1 | | 0 | 0 | 2 | 0 | 2 | 3 | | | | | | | | 2 |
| 42 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| 43 | | | | | | | | | | | | | | | | | 3 | 1 | | | | | | | | | | 4 |
| 44 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | | 0 | | 0 | 0 | | | | | 1 | | 1 | | | | | 1 |
| 45 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | | | 8 | | 4 | 4 | | | 4 | 4 | | | 3 | 3 | | | 8 | |
| 46 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | | | 3 | | 4 | 5 | | | | 4 | 5 | 4 | | | | | 8 | |
| 47 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | | | 7 | | | | | | | | 5 | 2 | | | 3 | 2 | 7 | |
| 48 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | | | 6 | | 5 | 5 | | | | | 4 | 4 | 1 | 2 | | | 6 | |
| 49 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 0 | | | 6 | | 4 | 4 | | | | | 5 | 4 | | | | | 6 | 7 |
| 50 | 2 | 2 | 2 | 1 | 2 | | 1 | 1 | 2 | 2 | | | 3 | | 4 | 4 | | | | | | | 1 | 2 | | | 6 | |
| 51 | | 1 | 1 | 2 | 1 | 2 | 0 | 0 | 2 | 1 | | | 2 | | 5 | 4 | | | 3 | 4 | | | 1 | 0 | | | 7 | |
| 52 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 0 | | | 6 | | 4 | 0 | | | 0 | 4 | | | | | 2 | 1 | 7 | |
| 53 | 2 | 1 | | 1 | 1 | 0 | 1 | 0 | 2 | | | | 7 | | 5 | 5 | | | | | 4 | 3 | 2 | 4 | 2 | 2 | 8 | |
| 54 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | | | 7 | | 5 | 4 | | | | | 5 | 4 | 2 | 4 | | | 7 | |
| 55 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | | | 3 | | 3 | 3 | | | | | 4 | | 3 | 0 | | | 3 | |
| 56 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 2 | | | 6 | | 4 | 3 | | | 2 | 4 | 4 | 3 | | | 1 | 2 | 5 | |
| 57 | 2 | 1 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 9 | | | | | | | | | 4 | 3 | | | | 2 | | | 6 |
| 58 | | | | 0 | 1 | 2 | 1 | | | | 7 | | | | | | 1 | 4 | 3 | 2 | | | 8 | 8 | | | | 4 |
| 59 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | | | 9 | | 5 | 5 | | | | | 5 | 4 | | | 1 | 3 | 8 | |
| 60 | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | | | 3 | | 4 | 4 | | | | | 4 | 2 | | | | 1 | 0 | 7 |
| 61 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | | | 6 | | 4 | 4 | | | 1 | 3 | 4 | 1 | | | 3 | 3 | | 8 |
| 62 | 1 | 1 | 0 | 0 | | | | | 1 | 1 | | | 3 | 1 | | | | | | 3 | 3 | | | | | | | 3 |
| 63 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 5 | | 8 | | 5 | 4 | | | | | 5 | 4 | | | 3 | 2 | 9 | |
| 64 | 2 | 2 | 0 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | | | 4 | | 4 | 4 | | | | | 4 | 1 | | | 1 | 0 | | 7 |
| 65 | 1 | 1 | 0 | 1 | 1 | 0 | | | 1 | 0 | | | 1 | | | | 1 | 2 | | | 3 | 0 | | | 2 | 1 | 4 | |
| 66 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 8 | | | | 4 | 3 | | 4 | | | 4 | 3 | 2 | | 1 | | 4 | 4 |
| 67 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | | | 3 | | 0 | 0 | 1 | 1 | 1 | | 4 | 1 | | | 1 | 0 | 1 | 0 |
| 68 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | | | 3 | | 0 | 1 | | | | | 3 | | | | | | 4 | |
| 69 | 1 | 2 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | | | 5 | | 2 | 0 | | | 3 | 4 | | | | | 1 | 2 | 5 | |
| 70 | 1 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 3 | | | | | | 2 | 0 | 2 | 2 | | | | | 1 | 0 | 0 | 0 |
| last record 71 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | | | | | | | 4 | | | 5 | 4 | 2 | | | | 5 | |
| if your class strength is > 60 then ***insert rows above the green row***, Similarly ***delete the empty rows above green row*** if the class strenght is < 60) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total number of students appeared for the examination (NST) | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | | 71 | 71 | 71 | 71 |
| Total number of students attempted the question (NSA) | 66 | 68 | 65 | 66 | 67 | 62 | 60 | 62 | 64 | 61 | 15 | 1 | 55 | 3 | 54 | 53 | 17 | 20 | 21 | 29 | 51 | 43 | 26 | | 36 | 25 | 48 | 31 |
| Attempt % (TAP) = (NSA/NST)*100 | 92.96 | 95.77 | 91.55 | 92.96 | 94.37 | 87.32 | 84.51 | 87.32 | 90.14 | 85.92 | 21.13 | 1.41 | 77.46 | 4.23 | 76.06 | 74.65 | 23.94 | 28.17 | 29.58 | 40.85 | 71.83 | 60.56 | 36.62 | | 50.70 | 35.21 | 67.61 | 43.66 |
| Total number of Students who got more than 60% marks (NSM) | 40 | 36 | 13 | 24 | 8 | 16 | 3 | 24 | 26 | 15 | 10 | 0 | 43 | 0 | 40 | 37 | 5 | 8 | 6 | 21 | 48 | 20 | 5 | | 3 | 2 | 40 | 24 |
| Attainment % (TMP) = (NSM/NSA)*100 | 60.61 | 52.94 | 20.00 | 36.36 | 11.94 | 25.81 | 5.00 | 38.71 | 40.63 | 24.59 | 66.67 | 0.00 | 78.18 | 0.00 | 74.07 | 69.81 | 29.41 | 40.00 | 28.57 | 72.41 | 94.12 | 46.51 | 19.23 | | 8.33 | 8.00 | 83.33 | 77.42 |
| Score(S) | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | 0 | 3 | 0 | 3 | 3 | 0 | 1 | 0 | 3 | 3 | 1 | 0 | | 0 | 0 | 3 | 3 |
| CO attainment is considered zero if the attempt % is less than 30% | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **CO Validation** | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | | 4 | 4 | 5 | 5 |
| **Course Outcome** | CO1 | CO1 | CO2 | CO2 | CO3 | CO3 | CO4 | CO4 | CO5 | CO5 | CO1 | CO1 | CO1 | CO1 | CO2 | CO2 | CO2 | CO2 | CO3 | CO3 | CO3 | CO3 | CO4 | | CO4 | CO4 | CO5 | CO5 |
| **Marks (Y)** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 | 5 |
| **No. of COs Shared (Z)** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| **Y/Z** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | | 5 | 5 | 5 | 5 |
| **S*Y/Z** | 6 | 4 | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 15 | 0 | 15 | 0 | 15 | 15 | 0 | 5 | 0 | 15 | 15 | 5 | 0 | | 0 | 0 | 15 | 15 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **CO1** | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| **CO2** | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| **CO3** | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | | 0 | 0 | 0 | 0 |
| **CO4** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 1 | 1 | 0 | 0 |
| **CO5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 1 | 1 |
| **CO6** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| **CO7** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |

| Weighted Average for Attainment relevance | CO1 | CO2 | CO3 | CO4 | CO5 | | |
|---|---|---|---|---|---|---|---|
| | 1.67 | 1.54 | 1.46 | 0.11 | 0.50 | | |

**!! Caution !! For CO Values < 2.25 should be justified with Remidial Action Report.**

Gokaraju Rangaraju Institute of Engineering and Technology

(Autonomous)

Bachupally, Kukatpally, Hyderabad – 500 090

## Summary Sheet CO Attainments

| | |
|---|---|
| Academic Year: | 22-23 |
| Course/Subject: | ECA |
| Department: | EEE |
| Section | A |

| | |
|---|---|
| Name of the Program: | Btech |
| Course Code: | GR20A2023 |
| Year - Semester : | II-I |

| **Attainment/CO** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** | | |
|---|---|---|---|---|---|---|---|
| Attainment for Direct Internal CO (Mid I & II, Assignments, Tutorials, Assessments, etc.) | 1.70 | 2.24 | 2.28 | 1.77 | 1.49 | | |
| Attainment for Direct External CO (End Semester Exam) | 1.67 | 1.54 | 1.46 | 0.11 | 0.50 | | |
| Direct CO (0.3*Internal + 0.7*External) | 1.68 | 1.75 | 1.71 | 0.61 | 0.80 | | |
| Indirect CO | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | | |
| Final CO (COFn) = (0.9 x Direct CO + 0.1 x Indirect CO) | **1.81** | **1.88** | **1.84** | **0.85** | **1.02** | | |

| **CO** | **Course Outcome** | **Remedial Action for COs Less than 75% (2.25)** |
|---|---|---|
| CO1 | Explain the differences between linear and non-linear magnetic circuits | Need to conduct more assignments |
| CO2 | The concepts of generators and motors | Seminars to be conducted |
| CO3 | Select the appropriate DC generator or DC motor for the given application | Need to conduct more assignments |
| CO4 | Able to test ant given DC Generator or DC motor. | Revision should be done more |
| CO5 | Explain the different types of materials used in transformers. | Revision should be done more |

| ID No. | Name of the Faculty | Department | Signature |
|---|---|---|---|
| 888 | G Sandhyarani | EEE | |
| | | | |

**HOD** **DAA**

**Copy to: IQAC**

# Gokaraju Rangaraju Institute of Engineering and Technology

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**Bachupally, Kukatpally, Hyderabad – 500 090**

**Direct Internal CO Attainments**

| | |
|---|---|
| **Academic Year** | 22-23 |
| **Year - Semester** | II-I |

| | |
|---|---|
| **Department** | EEE |
| **Course Name :** | ECA |

| | |
|---|---|
| **Name of the Programme** | Btech |
| **Course Code** | GR20A02023 |

| P-Outcomes / C-Outcomes | A | B | C | D | E | F | G | H | I | J | K | L | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | H | H | M | | H | | | H | M | | M | H | M | M |
| 2 | H | M | | M | M | M | M | H | M | M | M | M | M | |
| 3 | H | H | M | M | M | | | M | M | | H | M | | M |
| 4 | H | H | M | M | M | | M | M | M | | H | M | M | |
| 5 | H | M | M | | H | M | | H | M | M | H | H | | M |

**Enter H,M, L values of CO-PO Mapping Matrix in blue shaded rows 12 - 18 for seven CO s automatically PO Attainments are Calculated**

Convert above mappings to scale 1-3

| P-Outcomes / C-Outcomes | A | B | C | D | E | F | G | H | I | J | K | L | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | 3 | | | 3 | 2 | | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | 2 | 2 | | 3 | 2 | | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | | 2 | 2 | 2 | | 3 | 2 | 2 | |
| CO5 | 3 | 2 | 2 | | 3 | 2 | | 3 | 2 | 2 | 3 | 3 | | 2 |
| Expected Attainment | 3.00 | 2.60 | 2.00 | 2.00 | 2.40 | 2.00 | 2.00 | 2.60 | 2.00 | 2.00 | 2.60 | 2.40 | 2.00 | 2.00 |

Fill the below table with obtained attainments in mids, external and Tutorial/Attendence

| | CO1 | CO2 | CO3 | CO4 | CO5 | | |
|---|---|---|---|---|---|---|---|
| Final Cos CoF | 1.81 | 1.88 | 1.84 | 0.85 | 1.02 | | |

| | Attained PO A | Attained PO B | Attained PO C | Attained PO D | Attained PO E | Attained PO F | Attained PO G | Attained PO H | Attained PO I | Attained PO J | Attained PO K | Attained PO L | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1.81 | 1.81 | 1.21 | | 1.81 | | | 1.81 | 1.21 | | 1.21 | 1.81 | 1.21 | 1.21 |
| CO2 | 1.88 | 1.25 | | 1.25 | 1.25 | 1.25 | 1.25 | 1.88 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | |
| CO3 | 1.84 | 1.84 | 1.22 | 1.22 | 1.22 | | | 1.22 | 1.22 | | 1.84 | 1.22 | | 1.22 |
| CO4 | 0.85 | 0.85 | 0.56 | 0.56 | 0.56 | | 0.56 | 0.56 | 0.56 | | 0.85 | 0.56 | 0.56 | |
| CO5 | 1.02 | 0.68 | 0.68 | | 1.02 | 0.68 | | 1.02 | 0.68 | 0.68 | 1.02 | 1.02 | | 0.68 |
| CO6 | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO7 | | | | | | | | | | | | | | |
| Attained | 1.48 | 1.28 | 0.92 | 1.01 | 1.17 | 0.96 | 0.91 | 1.30 | 0.98 | 0.96 | 1.23 | 1.17 | 1.01 | 1.04 |

Note : If Average Attainment of a PO is #Div/0! Relace the corresponding PO with blank.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO1** | **PSO2** |
| **Expected** | 3.00 | 2.60 | 2.00 | 2.00 | 2.40 | 2.00 | 2.00 | 2.60 | 2.00 | 2.00 | 2.60 | 2.40 | 2.00 | 2.00 |
| **Attained** | 1.48 | 1.28 | 0.92 | 1.01 | 1.17 | 0.96 | 0.91 | 1.30 | 0.98 | 0.96 | 1.23 | 1.17 | 1.01 | 1.04 |
| | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** | **U** |

**Note : PO is Satisfied if attained PO > 75, U indicates PO Unsatisfied**

**Faculty Co-Ordinator** **HOD**