Electronics & Communication Engineering

4.1 NETWORK FILTERS AND TRANSMISSION LINES

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RATIONALE

The Study of networks, filters and transmission lines leads to understanding of line communication, audio and video communication, and microwave communication. Particularly the study of networks takes off from principles of a.c. theory and introduces the student to parameters and characteristics of various networks, including filters. Also the study of transmission lines becomes important as its analogy is used in study of transmission of plane electromagnetic waves in bounded media.

DETAILED CONTENTS

1. Networks (14 hrs)

   a) Two port (four terminals) network: Basic concepts of the following terms:

      - Symmetrical and asymmetrical networks: Balanced and unbalanced network; T-network, Л network, Ladder network; Lattice network; L-network and Bridge T-network

   b) Symmetrical Network:

      - Concept and significance of the terms characteristic impedance, propagation constant, attenuation constant, phase shift constant and insertion loss.
      - T-network and Л Network

   c) Asymmetrical Network

      - Concept and significance of iterative impedance, image impedance, image transfer constant and insertion loss.
      - The half section (L-section); symmetrical T and Л sections into half sections

2. Attenuators (05 hrs)

   a) Units of attenuation (Decibels and Nepers): General characteristics of attenuators

   b) Analysis and design of simple attenuator of following types; Symmetrical T and Л type, L type.

3. Filters (13 hrs)

   a) Brief idea of the use of filter networks in different communication systems, concept of low pass, high pass, band pass and band stop filters. Basic ideas of Butterworth, Chebychev filters

   b) Prototype Filter Section:

      - Impedance characteristics vs frequency characteristics of a low and high pass filter and their significance
      - Attenuation Vs frequency; Phase shift Vs frequency, characteristics impedance vs frequency of T and Л filters and their significance

- Simple design problems of prototype low pass section.

c) M-Derived Filter Sections
Limitation of prototype filters, need of m-derived filters

d) Crystal Filters
Crystal and its equivalent circuits, special properties of piezoelectric filters and their use

e) Active Filters
Basic concept of active filters and their comparison with passive filters.

4. Transmission Lines (16 hrs)

a) Transmission Lines, their types and applications.

b) Distributed constants, T and Л representation of transmission line section.

c) Definition of characteristic impedance, propagation constant, attenuation constant and phase shift constant.

d) Concept of infinite line

e) Condition for minimum distortion and minimum attenuation of signal on-the-line and introduction to loading methods.

f) Concept of reflection and standing waves, definition of reflection coefficient, SWR & VSWR and their relation (no derivation).

g) Transmission line equation, expression for voltage, current and impedance at a point on the line.

h) Concept of transmission lines at high frequencies.

i) Introduction to stubs. (single, open and short stubs).

LIST OF PRACTICALS

1. To measure the characteristic impedance of symmetrical T and Л networks
2. To measure the image impedance of a given asymmetrical T and Л networks
3. For a prototype low pass filter:
   a) Determine the characteristic impedance experimentally
   b) Plot the attenuation characteristic
4. To design and measure the attenuation of a symmetrical T/ Л type attenuator
5. For a prototype high pass filter:
   a) Determine the characteristic impedance experimentally
   b) To plot the attenuation characteristic
6. a) To plot the Impedance characteristic of a prototype band-pass filter
   b) To plot the attenuation characteristic of a prototype band pass filter
7. a) To plot the impedance characteristic of m- derived low pass filter
   b) To plot the attenuation characteristics of m-derived high pass filter
8. To observe the information of standing waves on a transmission line and measurement of SWR and characteristic impedance of the line
9. Draw the attenuation characteristics of a crystal filter

INSTRUCTIONAL STRATEGY

Stress should be laid on problems in networks/ filler and transmission lines. Practical must be carried out after completion of topic to gain a good know how on the subject students should be given home assignments on various topics, stress on making own circuit models to calculate input/output impedance, characteristic impedance, losses etc. should be carried out by the students.

RECOMMENDED BOOKS

1. Network Lines and Fields by John D Ryder; Prentice Hall of India, New Delhi
2. Network Filters and Transmission Lines by AK Chakarvorty; Dhanpat Rai and Co. Publication, New Delhi
3. Network Analysis by Van Valkenburg: Prentice Hall of India, New Delhi
4. Network Analysis by Soni and Gupta; Dhanpat Rai and Co. Publication, New Delhi
5. Network Theory and Filter Design by Vasudev K. Aatre
6. Network Filters and Transmission line by Umesh Sinha
7. Electrical and Electronics Measuring instrumentation , A.K Sawhney, Dhanpat Rai and Co. Publication, New Delhi
8. Network Analysis by G.K. Mithal
9. Network Filters and Transmission line by Nardeep Goyal, Rajneesh Kumari, Tech. Max Publication, Pune.

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (hrs)	Marks Allocation%
1	Networks	14	25
2	Attenuators	5	10
3	Filters	13	30
4	Transmission Lines	16	35
Total		**48**	**100**

4.2 COMMUNICATION SYSTEMS-1

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RATIONALE

This course provides the basics of electronic communication systems including transmitters, receivers, antennas and various modes of propagation of signals. In addition to components and systems of fiber optic communication, the students will learn the basics of satellite communication. This course will provide the students with perspectives of different communication systems.

DETAILED CONTENTS

1. AM/FM Transmitters (08 hrs)

   a) Classification of transmitters on the basis of modulation, service, frequency and power
   b) Block diagram of AM transmitters and working of each stage
   c) Block diagram and working principles of reactance FET and armstrong FM transmitters

2. AM/FM Radio Receivers (14 hrs)
   a) Principle and working with block diagram of super heterodyne AM receiver. Function of each block and typical waveforms at input and output of each block
   b) Performance characteristics of a radio receiver: sensitivity, selectivity, fidelity, S/N ratio, image rejection ratio and their measurement procedure. ISI standards on radio receivers (brief Idea)
   c) Selection criteria for intermediate frequency (IF). Concepts of simple and delayed AGC
   d) Block diagram of an FM receiver, function of each block and waveforms at input and output of different blocks. Need for limiting and de-emphasis in FM reception
   e) Block diagram of communication receivers, differences with respect to broadcast receivers.
3. Antennas: (14 hrs)

   a) Electromagnetic spectrum and its various ranges: VLF, LF, MF, HF, VHF, UHF, Microwave.
   b) Physical concept of radiation of electromagnetic energy from a dipole. Concept of polarization of EM Waves.
   c) Definition and physical concepts of the terms used with antennas like point source, gain directivity, aperture, effective area, radiation pattern, beam width and radiation resistance, loss resistance.
   d) Types of antennas-brief description, characteristics and typical applications of half wave dipole, medium wave (mast) antenna, folded dipole, turns tile, loop antenna, yagi and ferrite rod antenna (used in transistor receivers)
   e) Brief description of broad-side and end fire arrays, their radiation pattern and applications (without analysis); brief idea about Rhombic antenna and dish antenna

4. Propagation: (10 hrs)

a) Basic idea about different modes of wave propagation and typical areas of application. Ground wave propagation and its characteristics, summer field equation for field strength.
b) Space wave communication – line of sight propagation, standard atmosphere, concept of effective earth radius range of space wave propagation standard atmosphere
c) Duct propagation : sky wave propagation - ionosphere and its layers. Explanation of terms - virtual height, critical frequency, skip distance, maximum usable frequency, multiple hop propagation.

5. Fibre Optic Communications*:* (12 hrs)

- Advantages of Fibre Optic Communication
- Block Principle of Light Penetration and Propagation, NA.
- Types of optical fibres and cables.
- Brief idea of Losses in Optical Fibres and Dispersion
- Working principles and characteristics of optical light sources and light detectors.
- Block diagram of fibre optic communication link.
- Basic idea of fibre connection techniques - splicing and lensing

6. Satellite Communications*:* (06 hrs)

- Basic idea, passive and active satellites, Meaning of the terms; orbit, apogee, perigee
- Geo-stationary satellite and its need. Block diagram and explanation of a satellite communication link.

LIST OF PRACTICALS

1. To observe the waveforms at different stages of a AM transmitter
2. To observe the waveforms at different stages of a Radio Receiver
3. To align AM broadcast radio receiver
4. To identify and study the various types of antennas used in different frequency ranges.
5. To plot the radiation pattern of a directional and omni directional antenna
6. To plot the variation of field strength of a radiated wave, with distance from a transmitting antenna
7. Familiarisation and identification of fibre optic components such as fibre optic light source, detector, connector assembly etc
8. To assemble the fibre optic communication set up (using teaching module) and compare the transmitted signal with the output of the receiver
9. To measure the light attenuation of the optic fibres

NOTE: Visits to appropriate sites of digital/data communication networks, satellite communication, telemetry centres (like remote sensing) and fibre optic communication installations should be made with a view to understand their working. A comprehensive report must be

prepared by all students on these visits, especially indicating the dates and locations of their visits.

INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various areas. Visits to instrumentation and communications industries must be carried out, so as to make the students can understand where and how the various instruments are used in the industry.

RECOMMENDED BOOKS

1. Communication Systems by George Kennedy, Tata McGraw Hill Education Pvt Ltd, New Delhi.
2. Communication Systems by A.K. Gautam, SK Kataria and Sons, New Delhi.
3. Fundamentals of Communication System by Fitz, Tata McGraw Hill Education Pvt Ltd, New Delhi
4. Electronic Communication Sytesms by K.S. Jamwal, Dhanpat Rai and Sons, New Delhi.
5. Electronic Communication System by Roddy and Coolen, Prentice Hall of India, New Delhi.
6. Handbook of Experiments in Electronics and Communication Engineering by S. Poornachandra Rao, and B Sasikala, Vikas Publishing House Pvt Ltd, Jangpura, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted%
1	AM/FM Transmitters	08	10
2	AM/FM Radio Receivers	14	25
3	Antennas	14	25
4	Propagation	10	15
5	Fibre Optic Communications	12	20
6	Satellite Communications	06	5
	Total	**64**	**100**

4.3 POWER ELECTRONICS

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RATIONALE

Diploma holders in Electronics and related fields are required to handle a wide variety of power electronic equipment used in process control Industry. This subject will provide the student basic understanding of the principles of their working. The practical training will further re-inforce the knowledge and skill of the students.

DETAILED CONTENTS

1. Introduction to thyristors and other Power Electronics Devices (18 hrs)

   a) Construction, Working principles of SCR, two transistor analogy of SCR, V-I characteristics of SCR.
   b) SCR specifications & ratings.
   c) Different methods of SCR triggering.
   d) Different commutation circuits for SCR.
   e) Series & parallel operation of SCR.
   f) Construction & working principle of DIAC, TRIAC & their V-I characteristics.
   g) Construction, working principle of UJT, V-I characteristics of UJT. UJT as relaxation oscillator.
   h) Brief introduction to Gate Turn off thyristor (GTO), Programmable uni-junction transistor (PUT), MOSFET.
   i) Basic idea about the selection of Heat sink for thyristors.
   j) Application such as light intensity control, speed control of universal motors, fan regulator, battery charger.

2. Controlled Rectifiers (08 hrs)
   a) Single phase half wave controlled rectifier with load (R, R-L)
   b) Single phase half controlled full wave rectifier (R, R-L)
   c) Fully controlled full wave bridge rectifier.
   d) Single phase full wave centre tap rectifier.

3. Inverters, Choppers, Dual Converters and Cyclo converters. (16 hrs)

   i) Principle of operation of basic inverter circuits, concepts of duty cycle, series & parallel. Inverters & their applications.
   ii) Choppers: Introduction, types of choppers (Class A, Class B, Class C and Class D). Step up and step down choppers.
   iii) Dual Converters and cyclo converters: Introduction, types & basic working principle of dual converters and cyclo converters & their applications.

4. Thyristorised Control of Electric drives (14 hrs)

   a) DC drive control
      i) Half wave drives.

ii) Full wave drives
iii) Chopper drives (Speed control of DC motor using choppers)

b) AC drive control
i) Phase control
ii) Constant V/F operation
iii) Cycloconverter/Inverter drives.

5. Uninterrupted Power supplies (08 hrs)
i) UPS, on-line, off line & its specifications
ii) Concept of high voltage DC transmission
iii) Concept of SMPS

LIST OF PRACTICALS

1) To plot VI characteristic of an SCR.
2) To plot VI characteristics of TRIAC.
3) To plot VI characteristics of UJT.
4) To plot VI characteristics of DIAC.
5) Study of UJT relaxation oscillator. And observe I/P and O/P wave forms
6) Observation of wave shape of voltage at relevant point of single-phase half wave controlled rectifier and effect of change of firing angle.
7) Observation of wave shapes of voltage at relevant point of single phase full wave controlled rectifier and effect of change of firing angle.
8) Observation of wave shapes and measurement of voltage at relevant points in TRIAC based AC phase control circuit for .
9) Varying lamp intensity and AC fan speed control.
10) Installation of UPS system and routine maintenance of batteries.
11) Speed control of motor using SCRs

INSTRUCTIONAL STRATEGY

Power Electronics being very important for industrial controls requires a thorough know how about industrial devices. Teacher should take to the class various SCRs and other semiconductor devices to demonstrate these to the students. The teacher may encourage students to perform practical simultaneously for better understanding of the subject and verification of theoretical concepts. So industrial visit in between the course is a must.

RECOMMENDED BOOKS

1) Power Electronics by P.C. Sen, Tata Mc Graw Hill Education Pvt Ltd. New Delhi
2) Power Electronics by P.S. Bhimbhra, Khanna Publishers, New Delhi
3) Power Electronics – Pricilpes and Applications by Vithayathi, Tata Mc Graw Hill Education Pvt Ltd. New Delhi
4) Power Electronics by M.S. Berde, Khanna Publishers, New Delhi.
5) Power Electronics by MH Rashid

6) Industrial Electronics and Control by SK Bhattacharya and S. Chatterji, New Age Publications. New Delhi
7) Power Electronics by S Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi
8) Power Electronics by Sugandhi and Sugandhi
9) Power Electronics – Principles and Applications by J Michael Jacob, Vikas Publishing House, New Delhi

SUGGESTED DISTRIBUTION OF MARKS FOR FACILITATING PAPER SETTER

Sr No	Topic	Time Allotted (Hrs)	Marks Allotted%
1	Introduction to thyristors and other power electronics devices	18	30
2	Controlled Rectifiers	08	15
3	Inverters, Choppers, Dual Converters and Cyclo converters.	16	25
4	Thyristorised Control of Electric drives	14	20
5	Uninterrupted Power supplies	08	10
	Total	**64**	**100**

4.5 ELECTRONICS DESIGN AND FABRICATION TECHNIQUES

[Common with Electronics (μP)]

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RATIONALE

The purpose of this subject is to give practice to the students in elementary design and fabrication of the PCB. The topics of assembly, soldering, testing, and documentation have been included to give overall picture of the process of manufacturing of electronic devices.

Minor project work aims at developing interest of the students about the, what is inside the electronics devices, what is happening and how it happens. The project may be small in size but should include only those components which he has studied in earlier classes, with a clear idea of signals processing. It would enable first hand experience of components, their purchase, assembly, testing and trouble shooting. It would boost up confidence of the students to repair and preparation of electronics gadgets. There should not be more than 2-3 students for each project. A report must be prepared with a hard and soft copy. The following contents will be discussed in lab classes.

DETAILED CONTENTS

1. Electronic Design (22 hrs)

   1.1 Selection and use of commonly used active and passive components
   1.2 Testing of active and passive components
   1.3 Develop skills in assembly of components, soldering, and soldering techniques
   1.4 Procedure for Cabinet Making

2. Fabrication Techniques (20 hrs)

   2.1 Printed Circuit Boards (PCBs):

   a) PCB board materials, their characteristics and plating, corrosion and its prevention.
   b) Photo processing, screen printing, etching, high speed drilling, buffing, surface treatment and protection from harsh environments, plated through holes, double sided and multilayer PCBs.
   c) Standards of board sizes. Modular assemblies edge connectors, multi board racks, flexible boards.
   d) Assembly of circuits on PCB, soldering techniques, role of tinning, flow and wave soldering, solderability, composition of solder. Edge connector. Elements of wire shaping.

   2.2 Production

   Storage and supply of components for assembly, role of incoming inspection of components, assembly line reduction, tools and jigs for lead bending. Manual and automatic insertion techniques. Closed loop assembly of modules and/or complete instruments. Specific examples of small scale and large-scale production be given to illustrate above mentioned methods.

2.3 Testing

Jigs and fixtures for operational testing of modules / sub- assemblies. Sequence testing for failure analysis. Environmental testing at elevated temperature and humidity. Vibration and mechanical endurance testing. Packing for transportation.

2.4 Documentation

Statement of brief specifications, detailed specifications and limitations. Block diagram detailed diagrams. Testing and checking points. Warning relative to high voltage for handling during repair. Fault location guide. Simple solutions for fault removal

2.5 Introduction to log books and history sheets

3. Every student must design and prepare a PCB, mount the components and assemble in a cabinet (32 hrs)
4. Computer Aided Design (CAD) (6 hrs)
   Computer aided design of electric circuit using software ORCAD P Spice etc.
5. Production Planning (3 hrs)
6. CNC drilling, photo plating, concept of SMDs (Surface Mount Devices) (10 hrs)

Some of the projects are listed below which is just a guideline for selecting the minor project. Students can also select any other project with the advice of his teacher.

LIST OF PROJECTS:

1. Regulated power supply
2. Timers using 555 and other oscillators
3. Touch plate switches – transistorized or 555 based
4. Door bell/cordless bell
5. Clapping switch and IR switch
6. Blinkers
7. Sirens and hooters
8. Single hand AM or FM
9. Electronic toy gun, walker, blinkers
10. Electronic dice
11. Cell charger, battery charger, mobile charger
12. Fire/smoke/intruder alarm
13. Liquid level controller
14. Counters
15. Combination locks
16. Electronics musical instruments
17. Telephone handset
18. Electronic Ballasts
19. Audio amplifiers
20. Tape recorders
21. Automatic stabilizer/CVT
22. Emergency light
23. Design and manufacture of transformer
24. Fan regulator
25. Dish Antenna

INSTRUCTIONAL STRATEGY

More emphasis may be laid on practical Project. Small industrial problems may be taken as assignments. Practical training regarding fabrication techniques using CAD may be carried out.

LIST OF RECOMMENDED BOOKS

1. Printed Circuit Board by Bosshart

2. Printed Circuit Board by RS Khandpur, Tata McGraw Hill Education Pvt Ltd., New Delhi

3. Electronics Techniques by Rajesh Kumar, NITTTR, Chandigarh

4. Modular CAD for PCBs using EAGLE Software by Rajesh Kumar, NITTTR, Chandigarh

5. Electronic Manufacturing Technology by KS Jamwal, Dhanpat Rai and Sons, New Delhi