Program Name : **Diploma in Digital Electronics**

Program Code : **DE**

Semester : **Fourth**

Course Title : **Analog and Digital communication**

Course Code : **22424**

1. RATIONALE

Analog and Digital communication plays vital role in every aspect of humen life. Diploma passout electronic engineers have to deal with the various Analog and Digital communication circuits while maintaining electronics communication systems in industry. Analog communication is a foundation for all advanced subjects in communication engineering. Digital communication offers data processing option and flexibility which is not available with analog communication. This course is developed in such a way that understanding of the limitations of analog communication is developed to overcome it by digital communication techniques.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Maintain basic Electronics Communication Systems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Use analog communication principles in electronics communication systems.
b. Maintain analog modulation equipment.
c. Maintain AM and FM receiver circuits.
d. Maintain digital modulators using sampling techniques.
e. Use PCM technique in digital communication.
f. Troublehsoot digital modulation equipment .

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical				
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	4	8	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credits*
***ESE** - End Semester Examination; **PA** - Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs.UOs.ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

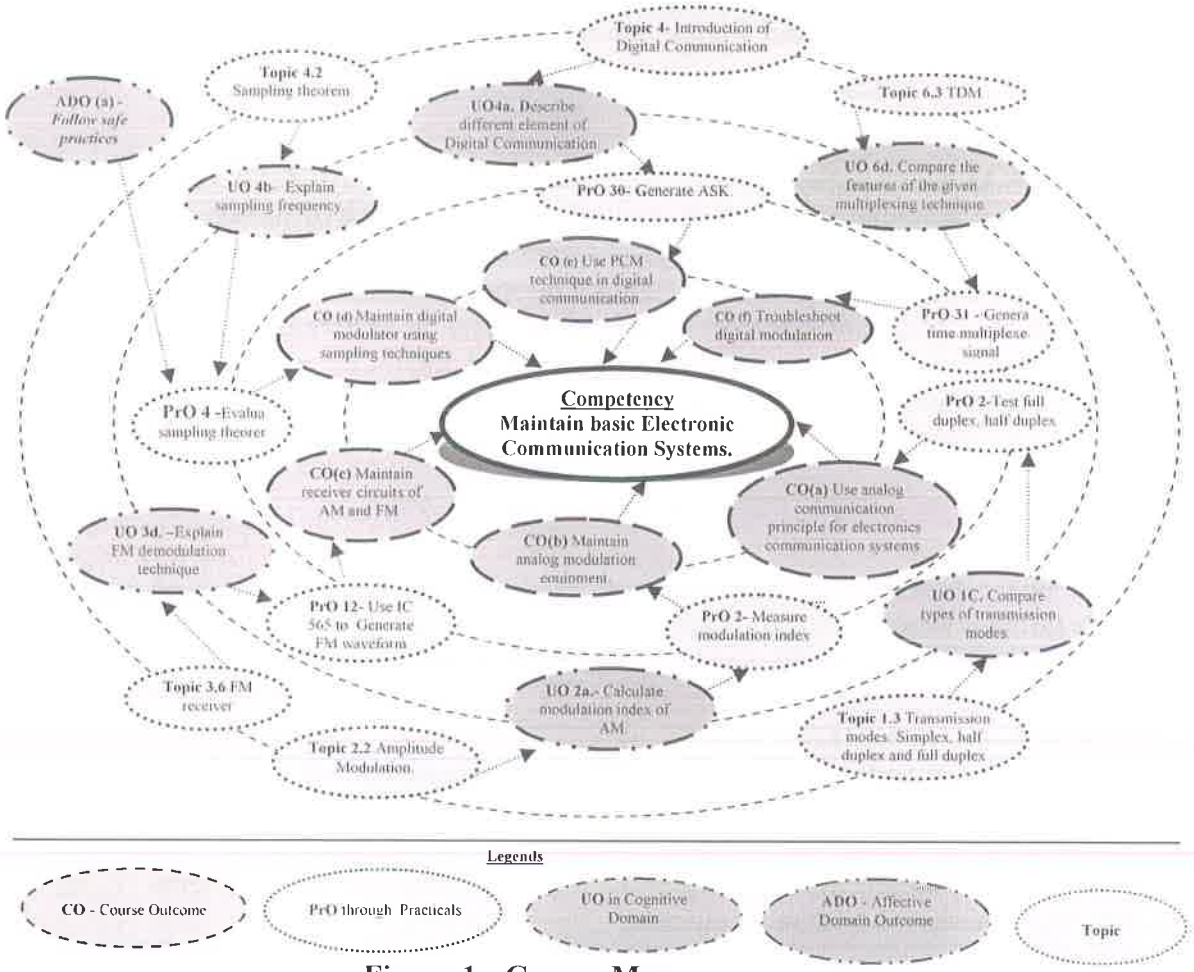

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Check the functioning of the Simplex, half duplex , full duplex communication by using RS232.	I	02
2	Use CRO to measure modulation index of AM waveform.	II	02*
3	Use Filter method, phase shift method and its detection to draw wavform of SSB modulator.		
4	Use the relevant equipment to find the the modulation index to draw wavform of AM Generation (DSB-SC) .	II	02
5	Use diode detector to draw the waveform of AM signal.	II	02
6	Troubleshoot voltage controlled oscillator to generate FM waveform and measure the frequency deviation for different modulating signals.	II	02*
7	Use DSO to measure modulation index of FM waveform .	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
8	Use NE 566 VCO IC and varactor diode to generate FM signal and calculate modulation index.	II	02
9	Use the relevant equipment to determione the gain of pre-emphasis and de-emphasis circuit to plot the corresponding frequency response curve.	II	02
10	Troubleshoot different blocks in AM, FM generation .	II	02*
11	Use any simulation software to generate AM wave.	II	02
12	Use any simulation software to generate FM wave.	II	02*
13	Use any simulation software to generate SSB-SC wave.	II	02
14	Use any simulation software to generate DSB-SC wave.	II	02*
15	Use any simulation to Envelope Detector.	III	02
16	Troubleshoot Radio Receiver to plot the graph of RF Characteristics of: Selectivity, Sensitivity, Fidelity Observe.	III	02*
17	Use IC 564 / IC 565/ IC8038 for FM demodulation to trace it's input and output waveforms.	III	02*
18	Use Spectrum Analyzer Spectrum to troubleshoot AM and FM receiver.	III	02
19	Diagnose the faults of the different blocks in AM receiver.	III	02
20	Check the functioning of the Use IC DG211using sampling theorem.	IV	02*
21	Use open source software to evaluate Sampling theorem.	IV	02
22	Use the relevant equipment to plot waveforms of PCM modulation and demodulation and sampling frequency	V*	02
23	Use the relevant equipment to plot waveforms of DM, ADM modulation and demodulation	V	02
24	Use open source software to generate ASK.	V	02
25	Use open source software to generate FSK.	V	02
26	Use open source software to generate PSK.	V	02
27	Troubleshoot relevant equipment to check the ASK modulation and demodulation to interpret the recovered data from the amplitude variations in the carrier signal.	VI	02*
28	Use the relevant equipment to check the FSK modulation and demodulation and interpret the recovered data .	VI	02
29	Use the relevant equipment to check the PSK modulation and demodulation.	VI	02
30	Use the relevant equipment to check the interpret QAM modulation and demodulation and observe a) Variations in amplitude and phase b) The recovered data.	VI	02
31	Troubleshoot the relevant equipment to generate time multiplexed signal for two signals and demultiplex to recover the original signals.	VI	02
32	Troubleshoot the relevant equipment to generate frequency multiplexed signal for two signals and demultiplex to recover the original signals.	VI	02
33	Use the relevant equipment to generate time multiplexed signal for two signals and demultiplex to recover the original signals using any	VI	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	open source simulation software.		
34	Use the relevant equipment to generate frequency multiplexed signal for two signals and demultiplex to recover the original signals using any open source simulation software.	VI	02
	Total		**68**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices
b. Practice good housekeeping
c. Practice energy conservation
d. Demonstrate working as a leader/a team member
e. Maintain tools and equipment
f. Follow ethical practices

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Cathode Ray Oscilloscope Duel Trace 20Mhz, 1MegaΩ Input Impedance	1 to 23
2	RF signal generator with Wide frequency range 100 KHz to 150 MHz Fine frequency adjustment by calibrated dial Built in audio frequency generator	1 to 23
3	DSO with Bandwidth : 50/100MHz TFT Colour LCD Dual Channel Real Time Sampling: 1GSa/s Equivalent Sampling 25GSa/s Memory 1M pts 10 Waveforms and 10 Setups can be stored	1 to 23
4	Regulated power supply: DC Supply Voltages Dual DC : 2 x 0 - 30V;0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation	1 to 23
5	AM trainer kit for DSB/SSB AM modulation and demodulation	2 to 4
6	Digital Multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 - 100 MΩ) , Capacitance and Temperature measurement	1 to 23
7	FM trainer kit for FM modulation and demodulation	5 and 7
8	Trainer kit for FM modulator using IC566: AC Source: 600Hz to 2.5 KHz. FM Modulator : VCO Test Points , circuit diagram engraved on front panel with transparent rear panel	8
9	FM demodulator experiment kit using such as IC 564/565 (PLL based).	12
10	PCM Mod and Demod kit with Test Points , circuit diagram engraved on front panel with transparent rear panel	16
11	DM and ADM kit with Test Points , circuit diagram engraved on front panel with transparent rear panel	17
12	ASK,FSK, and PSK kit with Test Points , circuit diagram engraved on front panel with transparent rear panel	18 to 20
13	QAM MOD and DMOD trainer kit.	21
14	FDM and TDM kit with Test Points , circuit diagram engraved on front panel with transparent rear panel	22 to 23
15	Spectrum analyser .	15
16	Any Simulation Software like Simulink , Scicos ,Electronic Workbench any other EDA tool.	24 to 31

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Basics of electronic communication	1a. Interpret the working of the given block(s) of basic electronic communication system with sketches. 1b. Identfy the appropriate frequency band of electromagnetic spectrum for the specified application with justification.	1.1 Definition: Analog signal, digital signal and baseband signal; importance of electronic communication 1.2 Elements of basic electronic communication system. 1.3 Concept of transmission bandwidth, noise and types of noise. 1.4 Mode of electronics communication: Simplex, Half duplex, Full duplex communication.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1c. Compare the features of the given types of transmission modes. 1d. Explain with sketches the given types of modes of communication.	
Unit-II Modulation Techniques	2a. Interpret necessity of the given type of modulation technique with sketches. 2b. Explain with sketches the working of the given type of signal generation technique. 2c. Interpret the given parameters of AM signal with sketches. 2d. Calculate modulation index and power distributions of the given AM signal. 2e. Explain with sketches the given signal generation technique. 2f. Describe with sketches the procedure to maintain the given analog modulation equipment.	2.1 **Basics of Modulation**. -Need for modulation, types and definition of: AM, FM, PM 2.2 **Amplitude Modulation**- Modulation index-definition, its effect on modulated signal, mathematical equation of amplitude modulated wave and its meaning, concepts of side band (SSB,DSB), Representation of AM signal in time and frequency domain,power relations in AM wave,circuit diagram and working of BJT/FET modulator. 2.3 **Frequency Modulation**- Deviation ratio, maximum deviation ratio, mathematical representation of FM and its meaning,Representation of FM signal in time domain and frequency domain Bandwidth requirements. Concept of Pre-emphasis and De-emphasis, Generation of FM -reactance modulator, varactor diode, modulator, Armstrong method. FM signal generation using ICs 566,564. 2.4 **Pulse Modulation Techniques**- Need of pulse modulation, PAM, PWM, PPM-Block diagram, waveforms, strength and limitations and their comparison,generation of PAM transistorized circuit, generation of PWM, PPM using IC 555.
Unit– III AM and FM Radio Receivers	3a. Explain with sketches the given type of Radio receiver. 3b. Explain with sketches the given blocks of AM super heterodyne receiver. 3c. Describe with sketches the given characteristics of radio receiver. 3d. Explain with sketches the given type of FM demodulation technique.	3.1 Block diagram of tuned radio frequency receiver and its working with waveforms. 3.2 Block diagram of super heterodyne receiver. 3.3 RF Section and characteristics of AM radio receiver sensitivity, selectivity, fidelity. 3.4 Image frequency and its rejection Frequency changing and tracking. 3.5 Demodulation of AM signal: diode detector, practical diode detector. Need of AGC and its types – simple, delayed.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	3e. Describe with sketches the procedure to maintain the given receiver circuits.	3.6 FM receiver : Block diagram and explanation of FM super heterodyne radio receiver circuit diagram and working of slope detector and balanced slope detector PLL as FM demodulator.
Unit– IV Introductio n of Digital Communica tion	4a. Describe with sketches the characteristics of digital communication system . 4b. Determine the sampling frequency for the given modulating frequency. 4c. Explain with sketches the sampling theorem to recover the original signal when Fs >= Fm. 4d. Explain with sketches the quantization process for the given 'q' levels of quantization. 4e. Describe with sketches the procedure to maintain the given type of digital modulator using sampling technique.	4.1 Historical perspective of digital communication, elements of digital communication system with its block diagram, communication channel types and their Characteristics (bit rate, bandwidth, repeater distance) applications, and Channel modeling, channel noise. 4.2 Sampling theorem, Nyquist rate and aliasing effect. 4.3 Quantization process , quantization error, quantization noise, Uniform, Non-uniform quantization .
Unit– V Pulse Modulation Techniques	5a. Explain with sketches the utilization of the given modulation technique. 5b. Compare the salient features of the given modulation techniques. 5c. Explain with sketches the generation and demodulation of specified modulation techniques. 5d. State the limitations of given modulation technique and the alternative to overcome it. 5e. Describe the procedure to maintain the given type of digital communication equipment using PCM technique.	5.1 Pulse code modulation (PCM) transmitter and receiver block diagram and its working, 5.2 Differential pulse code modulation (DPCM). Transmitter and receiver block diagram and its working, 5.3 Delta modulation (DM) block diagram of transmitter and receiver. 5.4 Adaptive Delta modulation (ADM) transmitter and receiver block diagram.
Unit –VI Digital Modulatio	6a. Select the given digital modulation techniques with justification for the	6.1 M-ary encoding , minimum bandwidth, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
n Technique s	given application. 6b. Choose the suitable multiplexing techniques with justification for the given application. 6c. Explain with sketches the working of the specified digital communication device. 6d. Compare with sketches the working of the given multiplexing techniques. 6e. Describe with sketches the procedure to maintain the given type of digital modulation equipment.	(PSK), Quadrature Phase Shift Keying (QPSK), transmitter and receiver block diagram and their working with waveform. 6.2 Quadrature amplitude modulation(QAM): need, transmitter and receiver block diagram and their working with waveforms, 6.3 Need of multiplexing, Time Division Multiplexing (TDM), 6.4 Frequency division multiplexing (FDM), code division multiplexing (CDM), space division multiplexing (SDM), definition, block diagram and their comparison. 6.5 Multiple Access techniques: time division multiple access (TDMA), frequency division multiple access (FDMA), code division multiple access (CDMA)

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of electronic communication	10	2	02	02	06
II	Modulation Techniques	14	4	06	06	16
III	AM and FM Radio Receivers	14	4	06	06	16
IV	Introduction of Digital Communication	04	2	02	04	08
V	Pulse Modulation Techniques	10	2	02	06	10
VI	Digital Modulation Technique	12	2	06	06	14
Total		**64**	**16**	**24**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs.. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Follow the safety precautions.

c. Use various measuring equipments to test electric/electronic equipment and component.
d. Library / Internet survey of Analog and digital communication system.
e. Prepare power point presentation or animation for understanding different circuits behavior.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Use Flash/Animations to explain various Modulation and Demodulation techniques.
g. Guide student(s) in undertaking micro-projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a) Modulation: Build a circuit for modulation using IC MC1496/8038 on general purpose PCB and prepare the report.
b) **FM transmitter:** Build a circuit on general purpose PCB for FM transmitter using IC 8038/ transistor BF549 and prepare a report.
c) **FM transmitter:** Build a circuit on general purpose PCB for FM transmitter using IC NE555 timer IC to produce audio tone and use JFET to built harltley oscillato and prepare a report
d) **Mobile jammer:** Build a circuit on general purpose PCB for mobile jammer.
e) **Tuning of IFT:** Build a circuit on general purpose PCB for tuning IFT at 455KHz.
f) **FM encoder / decoder circuit** :- Establishe the communication with high level security using RF600E and RF600D ICs this pair of encoder and decoder ICs the operating voltage of these ICs is from 2V to 6.6V DC and prepare a report..

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Communication Systems	Kennedy, George; Bernard, Davis; Prasanna, SRM	Mc-Graw Hill, , New Delhi,2011, ISBN : 9780071077828
2	Principles of Electronics Communication system	Frenzel, Louis E.	Mc-Graw Hill, New Delhi,2007, ISBN : 9780073222783
3	Electronic Communications	Roddy, Dennis; Coolen, John G.	PHI Learning, New Delhi, 1995, ISBN : 978-0133120837
4	Electronic communication system	Tomasi, W.	Pearson Education India, New Delhi, 2001, ISBN: 9780130221254
5	Digital Communications	Khanna., V.K.	S.Chand Publishing ,New Delhi, ISBN:9788121191021
6	Analog Communication	Sedha,R. S.	S. Chand Publishing,New Delhi ISBN:9789383746743
7	Introduction to Analog and Digital Communication	Haykin, Simon; Moher, Michel	Willy India Pvt.Ltd., New Delhi. ISBN:9788126536535
8	Digital and Analog Communication	Shanmugan, K. Sam	Willy India Pvt.Ltd., New Delhi. ISBN:9788126536801

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.circuitdaiagram.net/am-radio-receiver.html
b. www.wikipedia.org
c. www.ni.com/multisim
d. www.circuitstoday.com/single-chip-fm-radio-circuit
e. www.masd.k12.pa.us
f. http://www.circuitdiagram.org/am-radio-with -mk484.html
g. www.learnerstv.com/free-engineering
h. www.electronicsforu.com/category/electronics-projects
i. http://www.docsity.com/en/