Government of Karnataka

Department of Technical Education

Board of Technical Examinations, Bengaluru

Course Title :	**ANALOG COMMUNICATION**	Course Code	: **15EC33T**
Semester	: **Third**	Credits	: **4**
Teaching Scheme in Hrs (L:T:P)	: **4:0:0**	Course Group	: **Core**
Type of course	: **Lecture**	Total Contact Hours	: **52**
CIE	: **25 Marks**	SEE	: **100 Marks**

Prerequisites

Basic knowledge of semiconductor devices and basic principles of electrical and electronics

Course Objectives

1. Apply the basic knowledge of BEEE theory and analyze the network theorems
2. Understand the functioning and application of resonance, filters and attenuator circuits
3. Describe the working of analog modulation and demodulation circuits
4. Understand transmission lines and matching networks

Course Outcomes

On successful completion of the course, the students will be able to attain the following COs:

Course Outcome		CL	Linked POs	Teaching Hrs
CO1	Analyze and apply the network theorems.	***R/U/A***	1,2,3,10	10
CO2	Design the simple filters and attenuator circuits.	***R/U/A***	1,2,3,10	11
CO3	Describe the operation of transmission lines and matching networks	***R/U/A***	1,2,3,10	07
CO4	Describe and distinguish of analog modulation techniques.	***R/U/A***	1,2,3,10	07
C05	Differentiate types of antennas and wave propagation.	***R/U/A***	1,2,3,10	09
C06	Decide the appropriate modulation and demodulation technique for suitable transmitter and receiver circuit.	***R/U/A***	1,2,3,10	08
			Total	**52**

Legends: PO-Program Outcome, CO-Course Outcome, CL-Cognitive Level, R-Remember, U-Understand, A-Apply

Course-PO attainment matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Analog Communication	**3**	**3**	**3**	**--**	**--**	**--**	**--**	**--**	**--**	**3**

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course content and pattern of marks for SEE

Unit	Unit Name	Teaching Hours	Questions for SEE			Marks	Weightage (%)
			R	U	A		
1	Network Theorems	10	05	10	15	30	20
2	Resonance, Filters and attenuators	11	05	10	15	30	20
3	Transmission Lines	07	05	05	10	20	12
4	Antennas and Wave Propagation	07	05	05	10	20	12
5	Amplitude Modulation and demodulation	9	05	10	10	25	15
6	Frequency Modulation and demodulation	08	05	05	10	20	15
	Total	**52**	**30**	**45**	**70**	**145**	**100**

Legend: R- Remember, U-Understand A-Application

Course Contents

Unit 1: Network Theorems 10 Hours

Network Theorems: Superposition theorem**,** Thevenin's theorem, Maximum Power Transfer theorem and Norton's theorem, Statements and simple problems.

Unit 2: Resonance, filters and attenuators 11 Hours

Resonance: Definition, types, applications of resonance. **Series resonance and Parallel resonance:** circuit diagram, phasor diagram, resonance plot and characteristics. Condition for resonance. Derivation for frequency of resonance. Expressions for impedance, current, voltage, Q factor, power factor and bandwidth in terms of Q. Simple problems**. Passive Filters:** Definition of Filter, cut-off frequency, pass band and stop band. Classification of filters. Ideal characteristics curve of passive LPF, HPF, BPF and BRF. Circuit diagram of T and PI configurations of LPF and HPF (Only expressions, No Derivation), Simple problems. Block diagrams to realize BPF & BRF using LPF & HPF.

Attenuators: Definition, classification and applications of attenuators. Definition of Bel, Decibel and Neper. Relationship between Bel, Decibel and Neper. Express attenuation in dB. Circuit diagram of symmetrical T and Π type attenuators (Only expressions, No Derivation).

Unit 3: Transmission lines 07 Hours

Transmission Lines: Definition of transmission line, different types of transmission lines (power lines, Parallel wire, coaxial, Wave guide). Mention their applications. Electrical model of a transmission line, Definition of primary constants: R, L, G and C. Definition of secondary constants: Characteristic impedance and Propagation Constant, expressions for secondary constants in terms of primary constants. Concept of reflection and standing waves, expressions for standing wave ratio, reflection coefficient, standing wave ratio in terms of

reflection coefficient and reflection coefficient in terms of standing wave ratio. Wave patterns for Voltage & Current on Short circuited line and Open circuited line. Impedance matching techniques: Single stub matching and double stub matching

Unit 4: Antennas and wave propagation 07 Hours

Antennas: Definition of antenna and dipole. Concept of electric and magnetic fields in a dipole. Definition of Polarization, Isotropic radiator, Radiation pattern, Directive gain, Directivity, Power gain, Antenna resistance, Antenna efficiency, Beam width. **Array antenna:** Definition and types of array antenna, working of broadside, end-fire array, mention their applications. Features of yagi-uda antenna. Working of Parabolic reflector (Dish Antenna) – Feed mechanisms – Cassegrain and Horn feed. **Wave Propagation:** Fundamentals of Electromagnetic Waves, electromagnetic spectrum, modes of wave propagation: ground wave propagation, sky wave propagation and space wave propagation. Comparison of modes of wave propagation.

Unit 5: Amplitude modulation and demodulation 09 Hours

Modulation: Block diagram of electronic communication system, distinguish between analog and digital communication, define modulation, need for modulation and types of analog modulation techniques. **Amplitude modulation and demodulation:** definition, block diagram and waveform, expressions of modulating signal, Carrier signal, modulated signal, modulation index in terms of modulating voltage (Vm) and carrier voltage (Vc), modulation index in terms of maximum voltage (Vmax) and minimum voltage (Vmin), modulation index in case of simultaneous modulations, LSB and USB, Bandwidth, Power in AM wave. Solve simple problems. Amplitude Modulator circuit using diode. Demodulation of AM wave, working of AM Linear diode detector circuit. Definition with working principal of SSBSC, DSBSC, VSB and comparison between them.

Unit 6: Frequency modulation and demodulation 08 Hours

Frequency Modulation and demodulation: definition, block diagram and waveform, expressions of frequency deviation, modulation index. Relationship between frequency deviation and modulation index. Carson's rule for bandwidth. Varactor diode method of generating FM. **FM detectors:** Foster Seeley discriminator and Ratio detector. Need for pre-emphasis and de-emphasis circuits. Merits and demerits of FM over AM, Definition of Phase modulation. Definition of Selectivity, Sensitivity, Gain, Fidelity, Image Frequency and its Rejection, Double Spotting, Noise Figure.

References

1. *Electrical Engineering Fundamentals*, by Vincent Del Toro, Prentice-hall of India Pvt. Ltd. ISBN: 0132471310, 9780132471312
2. *Communication Engineering*, by Vijayachitra, McGraw Hill Education (India) Private Limited; First edition (1 May 2013), ISBN: 1259006867, 9781259006869
3. Basic Electrical Engineering, by D.P. Kothari and I.J. Nagrath, Tata McGraw-Hill Publishing Pvt. Ltd. ISBN: 0070435898, 9780070435896
4. *Electronic Communication systems* by William Schweber, Fourth Edition PHI Publications ISBN: 0130916218, 9780130916211
5. *Electronic Communication* by Dennis Roddy and John Coolen PHI Publications ISBN: 8177585584, 9788177585582

6. *Analog and Digital Communications* – T L Singal, McGraw Hill Education
7. ISBN: 1259084523, 9781259084522
8. http://nptel.ac.in/courses/117102059/
9. https://www.youtube.com/watch?v=Xw2_AWWjAn0
10. https://www.youtube.com/watch?v=UW_X2sfwA5w
11. https://www.youtube.com/watch?v=dGu2mxpTRPs
12. https://www.youtube.com/watch?v=hqhV50852jA
13. https://www.youtube.com/watch?v=ZYgFuUl9_Vs
14. https://www.youtube.com/watch?v=m9ikRi_-Iqo
15. https://www.youtube.com/watch?v=eNmh_G_v_-o
16. https://www.youtube.com/watch?v=wegmG4qHvkk
17. https://www.youtube.com/watch?v=_5JyiFWLn-w
18. https://www.youtube.com/watch?v=SmW4z76KgNQ&spfreload=10
19. https://www.youtube.com/watch?v=R04yEKqgGPc

Course Delivery

The course will be delivered through lectures, presentations and support of modern tools. Student activities are off-class.

Course Assessment and Evaluation Scheme

Master Scheme

Assessment Method	What		To Whom	Assessment mode /Frequency /timing	Max. Marks	Evidence Collected	Course Outcomes
Direct assessment	CIE	IA	Students	Three tests+	20	Blue Books	1 to 6
				Activity*	05	Activity Sheets	1 to 6
	SEE	End exam		End of the course	100	Answer Scripts at BTE	1 to 6
				Total	125		
Indirect assessment	Student feedback on course		Students	Middle of the Course	Nil	Feedback Forms	1 to 3 Delivery of course
	End of course survey			End of the Course	Nil	Question-naires	1 to 6, Effectiveness of delivery instructions & assessment methods

Legends: CIE-Continuous Internal Evaluation, SEE- Semester End-exam Evaluation

+ Every I.A. test shall be conducted for 20 marks. Average of three tests, by rounding off any fractional part thereof to next higher integer, shall be considered for IA.

***S**tudents should do activity as per the list of suggested activities/ similar activities with prior approval of the teacher. Activity process must initiated well in advance so that it can be completed well before the end of the term.

Questions for CIE and SEE will be designed to evaluate the various CLs as per the weightage shown in the following table.

Sl. No.	Cognitive Levels (CL)	Weightage (%)
1	Remembering	20
2	Understanding	30
3	Applying	50
	Total	**100**

Continuous internal evaluation (CIE) pattern

(i) Student Activity (5 marks)

The following student activities or similar activities can be assigned for assessing CIE/IA marks

Sl. No.	Activity
1	Visit any local small-scale industry and prepare work flow of any specific electronic module preparation- from discrete components to module fabrication.
2	Design, construct and demonstrate any resonant circuit
3	Prepare a document on different antennas and tabulate the specific details of each / datasheets/ application
4	Demonstrate Amplitude modulation and demodulation
5	Demonstrate / presentation / simulation how Radio works
6	Demonstrate / presentation / simulation how LED TV works
7	Prepare/collect animation video of wave propagation and fundamentals of Electromagnetic Waves and give presentation on it.
8	List different wave propagations and give presentation on it.

Execution Note:

1. Maximum of 2 students in each batch for student activity
2. Any two activities (either from the list given or any similar activities) shall be assigned among different batches; may be assigned by the teacher based on interest of the students.
3. Project activities shall be carried out throughout the semester and present the project report at the end of the semester; concerned teacher is expected to observe and record the progress of students' activities
4. Submit qualitative hand-written report not exceeding 6 pages; one report per batch
5. Each of the activity can be carried out off-class well in advance; however, demonstration/presentation should be done during laboratory sessions
6. Assessment shall be based on quality of work as prescribed by the following **rubrics** table

(ii) Model of rubrics for assessing student activity

Dimension	Scale					Marks (Example)
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	
1. Research and gathering information	Does not collect information relate to topic	Collects very limited information, some relate to topic	Collects basic information, most refer to the topic	Collects more information, most refer to the topic	Collects a great deals of information, all refer to the topic	3
2. Full-fills team roles and duties	Does not perform any duties assigned to the team role	Performs very little duties	Performs nearly all duties	Performs almost all duties	Performs all duties of assigned team roles	2
3. Shares work equality	Always relies on others to do the work	Rarely does the assigned work, often needs reminding	Usually does the assigned work, rarely needs reminding	Always does the assigned work, rarely needs reminding.	Always does the assigned work, without needing reminding	5
4. Listen to other team mates	Is always talking, never allows anyone to else to speak	Usually does most of the talking, rarely allows others to speak	Listens, but sometimes talk too much,	Listens and talks a little more than needed.	Listens and talks a fare amount	3
					Total marks	ceil(13/4)= 4

(iii) CIE/IA Tests (20 Marks)

Three tests have to be conducted, during specified schedule, in accordance with the test pattern given below and their average-marks shall be considered for CIE/IA.

(iv) Format of CIE/IA test question paper

CIE Question Paper								
Institution Name and Code								
Course Co-ordinator/Teacher								
Program Name		***Test No.***		*Units*				
Class/Sem		*Date*		*CL*				
Course Name		*Time*		*COs*				
Course Code		*Max. Marks*		*POs*				
Note to students: Answer all questions								
Question No.	**Question**			Marks	**CL**	**CO**	**PO**	
1								
2								
3								
4								

Legends: PO-Program Outcome, CO-Course outcome, CL-Cognitive Level, R-Remember, U-Understand, A-Apply

Note: Internal choice may be given in each CO at the same cognitive level (CL).

(v) Model question paper for CIE

CIE Question Paper						
Institution Name and Code						
Course Co-ordinator/Teacher						
Program Name	Electronics and Communication	***Test No.***	1	*Units*	1 & 2	
Class/Sem	3rd Sem	*Date*	1/1/2017	*CL*	R/U/A	
Course Name	**Analog Communication**	*Time*	10-11AM	*COs*	1 & 2	
Course Code	15EC33T	*Max. Marks*	20	*POs*	1, 2 & 3	
Note to students: Answer all questions						

No.	Question	Marks	CL	CO	PO
1	State and explain Thevenin's theorem with an example Or State and prove Maximum Power transfer theorem with an example	5+5	U/A	1	1,2,3
2	Define resonance, mention types and its applications	05	R/A	2	1,2
3	Derive expression for frequency of resonance for series resonance circuit	05	A	2	1,2
4		05	A	2	1,2

Semester end-exam evaluation (SEE)

(i) End-exam question-paper pattern

Unit	Unit Name	Study Duration (Hrs.)	No. Questions for end-exam		Marks
			PART – A 5 Marks	PART – B 10 Marks	
1	Network theorems	10	02	02	30
2	Resonance, filters and attenuators	11	02	02	30
3	Transmission lines	07	02	01	20
4	Antenna and wave propagation	07	02	01	20
5	Amplitude Modulation and demodulation	09	01	02	25
6	Frequency Modulation and demodulation	08	00	02	20
	Total	**52**	**09 (45 Marks)**	**10 (100 Marks)**	**145**

Note:. Sub-questions on different CLs may be combined to frame 10-marks questions or 10-marks questions given here can be splitted into 5-marks questions if necessary keeping weightage of CLs approximately intact and adhering to SEE end-exam pattern

(ii) Model question paper

Course Title : **ANALOG COMMUNICATION**

Course Code : **15EC33T** Time : **3 Hrs**

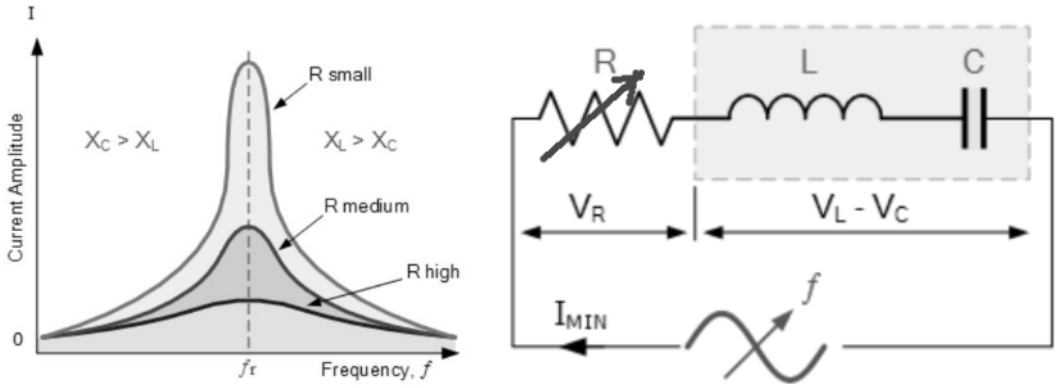
Semester : **Third** Max. Marks: **100**

Instructions: *1. Answer any **SIX** question from **Part A** (5x6=30 Marks)*

*2. Answer any **SEVEN** full questions from **Part B** (7x10=70 Marks)*

Part-A

1. Employ the suitable circuit and describe it with respect to superposition theorem
2. State the relevance of Maximum Power Transfer theorem with suitable circuit diagram
3. Define resonance, mention types and its application
4. Whether the curve represents the response of the circuit given below. Justify why current is maximum at resonance.



5. Write a note on single-stub matching and double-stub matching.
6. Point out the working of parabolic reflector (Dish Antenna) – Feed mechanisms – Cassegrain and Horn feed.
7. Compare the modes of wave propagation.
8. Distinguish analog and digital modulation technique.
9. Write a short note on FM detectors.

Part-B

1. Problem on Thevenin's theorem
2. Illustrate the application of the Norton's theorem with an example.
3. Derive expression for frequency of resonance, Q factor, power factor and bandwidth
4. (a)Realize BPF & BRF using LPF & HPF
   (b)Problem on attenuator
5. Discuss the concepts of reflection and standing waves, expressions for standing wave ratio
6. With relevant expression/figures define Polarization, Isotropic radiator, Radiation pattern, Directive gain, Directivity, Power gain, Antenna resistance, Antenna efficiency, Beam width.
7. (a)Derive modulation index in terms of V_{max} and V_{min}
   (b)Compare SSBSC, DSBSC and VSB
8. Identify the modulation technique described by the following equation. Also sketch the waveform and block diagram that can generate the waveform.
   $S(t) = V_{m1}(t)\ Cos(w_c t) + V_{m2}(t)\ Cos(w_c t + 90^0)$

9. Define the phase modulation of Selectivity, Sensitivity, Gain, Fidelity , Image Frequency and its Rejection, Double Spotting, Noise Figure
10. (a)Write and explain Varactor diode method for generating FM
    (b) Explain need for pre-emphasis and de-emphasis along with circuits.

Institutional activities (No marks)

The following are suggested institutional activities, to be carried out at least one during the semester. The course teacher/coordinator is expected to maintain the relevant record (Containing, Activity name, Resource persons and their details, duration, venue, student feedback, etc) pertaining to Institutional activities.

Sl. No.	Activity
1	Organize Seminar, workshop or Lecture from experts on the modern trends in communication
2	One day visit to nearby industry/ electronic equipment service centre/radio station/TV station/ Microwave tower
3	Motivation class for the students to take case study on different communication-based mini projects (small applications) to inculcate self and continuous learning.

End