

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Fourth Semester B.E. Degree Examinations, July 2026

COMMUNICATION SYSTEMS-I

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO: PI)</u>
Module-1			
1.	a. Apply the concept of modulation to justify its necessity in a communication system by relating it to practical issues such as antenna size, signal transmission range, and interference.	10	(2 :1: 1.3.1)
	b. Apply the principles of amplitude modulation to construct the mathematical representation of an AM signal for an arbitrary message signal $m(t)$, and demonstrate its corresponding time-domain and frequency-domain waveforms.	10	(3 :1: 1.3.1)
(OR)			
2.	a. An audio frequency signal $8 \sin(2\pi 300)t$ is used to amplitude modulate a carrier of $40 \sin(2\pi \times 10^6)t$. Calculate (i) Bandwidth required (ii) Sideband frequencies (iii) Amplitude of each sideband (iv) Total power delivered to a load of 500Ω	10	(3 :1: 2.1.3)
	b. In an amplitude modulation system, the modulation index is restricted to a maximum value of 1 to avoid distortion. (i) Explain why the modulation index cannot exceed unity in standard AM and describe what happens if it does. (ii) Derive the expression for total transmitted power in AM and show how it depends on the modulation index. (iii) Calculate the maximum efficiency of an AM system and justify why it cannot be improved beyond this limit under normal conditions.	10	(3 :1: 1.4.1)
Module-2			
3.	a. Derive the time domain representation of an FM signal generated using an arbitrary $m(t)$. Based on this relationship, describe how frequency modulation can be generated indirectly through phase modulation, clearly outlining the underlying principle.	10	(3 :2: 1.3.1)
	b. A single-tone frequency modulated signal is given by $S(t) = 15 \cos[(8 \times 10^8)t + 3 \sin(2000 t)]$. Calculate: (i) Modulation index (ii) Modulating frequency (iii) Frequency deviation (iv) Carrier frequency (v) Power dissipated in a 20Ω resistive load	10	(3 :2: 2.1.3)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

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| 4. | a. With relevant block diagram, explain FM stereo multiplexing. | 10 | (2 :2: 1.3.1) |
| | b. Explain how a frequency modulated signal can be demodulated using a balanced arrangement of two tuned circuits. Illustrate how frequency variations are converted into amplitude variations in the process. | 10 | (2 :2: 1.3.1) |

Module-3

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| 5. | a. Describe the model of a noisy communication receiver with the aid of a neat and properly labelled diagram. Based on this model, explain the concept of the figure of merit and discuss its significance in evaluating receiver performance under noise conditions. | 10 | (2 :3: 1.3.1) |
| | b. Show that the figure of merit for DSB-SC system is unity. | 10 | (3 :3: 1.3.1) |

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| 6. | a. Analyze the threshold effect in FM systems. | 10 | (3 :3: 1.3.1) |
| | b. Discuss about the necessity of Pre-emphasis and De-emphasis in FM. | 10 | (2 :3: 1.3.1) |

Module-4

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| 7. | a. Outline the benefits of digitizing analog sources in communication systems. | 10 | (2 :4: 1.3.1) |
| | b. Illustrate the principle of Time Division Multiplexing (TDM) using a neat block diagram, and explain its operation by analyzing how multiple signals are combined and separated in the time domain. | 10 | (2 :4: 1.3.1) |

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| 8. | a. State and interpret the sampling theorem, and explain the sampling process with appropriate illustrations. | 10 | (2 :4: 1.3.1) |
| | b. With neat block diagram and waveforms explain the generation of PPM wave. | 10 | (2 :4: 1.3.1) |

Module-5

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| 9. | a. Illustrate the process of Pulse Code Modulation (PCM) signal generation and reconstruction using neat block diagrams, and analyze the function of each block involved in the system. | 10 | (2 :5: 1.3.1) |
| | b. Derive an expression for the output Signal-to-Noise Ratio (SNR) due to quantization and interpret its dependence on system parameters. | 10 | (3 :5: 1.3.1) |

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| 10. | a. For the given binary sequence 00100110, construct and compare its waveform representations using the following line coding schemes:
(i) Unipolar RZ (ii) Unipolar NRZ (iii) Bipolar RZ (iv) Bipolar NRZ and (v) Polar NRZ | 10 | (3 :5: 1.3.1) |
| | b. Illustrate the working of Delta Modulation (DM). What is slope overload error? State the condition under which it occurs and illustrate it with suitable waveforms. | 10 | (2 :5: 1.3.1) |

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