**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS : BTECH** **SEMESTER: IV**
**BRANCH: ECE** **SESSION: SP/2024**

**SUBJECT: EC253 ANALOG COMMUNICATION**

**TIME: 3 Hours** **FULL MARKS: 50**

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

---

| | | | CO | BL |
|---|---|---|---|---|
| Q.1(a) | Write the Dirichlet's conditions for Fourier transform. State and prove the frequency-shifting property of Fourier transform. | [6] | CO1 | BL2 |
| Q.1(b) | Find the Fourier transform of an RF pulse given as $g(t) = A rect\left(\frac{t}{T}\right)\cos 2\pi f_C t$ and plot its amplitude spectrum. | [4] | CO1 | BL5 |
| Q.2(a) | Briefly discuss any four needs for modulation. Explain the operation of a square-law detector for AM-wave detection and identify the conditions that must be met to recover the baseband signal without distortion. | [6] | CO2 | BL2 |
| Q.2(b) | An AM superheterodyne broadcast receiver is tuned to 600 KHz. If the loaded Q of its single-stage RF amplifier tank circuit is 60 and the intermediate frequency for the receiver is 455 KHz, determine the image frequency rejection ratio (IFRR) of the receiver in dB. In case it has a two-stage RF amplifier with identical tank circuits, what will be the IFRR in dB. | [4] | CO2 | BL5 |
| Q.3(a) | Assuming single-tone modulation, derive an expression for the spectrum of a frequency-modulated wave. Explain how the transmission bandwidth changes for changes in the modulating signal frequency. | [6] | CO3 | BL2 |
| Q.3(b) | An angle modulated signal $x(t)$ is given as, $x(t) = 100\cos[2\pi f_C t + 4\sin 2000\pi t]$, where $f_C = 10\,MHz$. Determine the average transmitted power, peak phase deviation, and the peak frequency deviation for this modulated signal. | [4] | CO3 | BL5 |
| Q.4(a) | State and prove the sampling theorem in the time domain. Explain aliasing errors and discuss how to combat the effects of aliasing in practice. | [6] | CO4 | BL2 |
| Q.4(b) | A signal $g(t) = 10\cos(60\pi t)\,cos^2(160\pi t)$ is sampled at the rate of 400 samples per second. Determine the permissible cutoff frequency for an ideal reconstruction filter to receive $g(t)$ from its sampled version. | [4] | CO4 | BL5 |
| Q.5(a) | Define the figure of merit for evaluating the noise performance of a communication system. Calculate the figure of merit for a DSB-SC system using coherent detection at the system receiver. | [6] | CO5 | BL2 |
| Q.5(b) | A 10 KΩ and a 20 KΩ resistor are both at a room temperature of $27^{\circ}C$. For a 200 KHz bandwidth, determine the r.m.s. value of the thermal noise voltage across (i) each one of them, (ii) their series combination, and (iii) their parallel combination. | [4] | CO5 | BL5 |

**::::::25/04/2024::::::M**