



Date: 16-12-2025	CIE 2	Max. Marks: 10+50
Semester: VII	UG	Duration: 2 Hrs (1:20PM- 3:20PM)
Course Title: Mathematics of Music		Course code: MA375TGR

Department of Mathematics

D^b C[#]	E^b D[#]	G^b F[#]	A^b G[#]	B^b A[#]	D^b C[#]	E^b D[#]	G^b F[#]	A^b G[#]	B^b A[#]	C	D	E	F	G	A	B	C	D	E	F	G	A	B
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S No	Quiz	M	BT	CO
1.	Construct the swara sequence for the 52 nd Melakartha (Ramapriya).	2	1	2
2.	Write the continued fraction expansion of $\log_2(3/2)$ up to three terms.	2	2	1
3.	Give the Fourier series form of a periodic function and explain what the coefficients represent physically.	2	2	2
4.	Define the spectral centroid and compute it for a harmonic spectrum with amplitudes $A = \{5, 3, 1\}$ at frequencies $\{f, 2f, 3f\}$.	2	3	3
5.	Define a pitch class and express pitch class addition formally in modulo 12.	2	2	3

S No	Test	M	BT	CO
1a	Prove that $\log_2(3/2)$ is irrational using proof by contradiction. Explain in detail the musical consequence of it.	10	2	1
2a	Derive the formula for (or explanation on) the total number of Melakartha rāgas (72) starting from the combinatorial possibilities of swaras, and elaborate on the <i>Katapayadi sutra</i> therein.	10	3	2
3	Derive the mathematical explanation for difference tones using the nonlinear distortion equation: $y = ax + bx^2$. If two pure tones at frequencies f_1 and f_2 are input, show that the output contains the difference frequency $ f_1 - f_2 $. When two notes at 600 Hz and 800 Hz are played simultaneously: (i) Calculate the first-order difference tone. (ii) Calculate the first-order summation tone. (iii) Identify the musical interval represented by 600 Hz and 800 Hz. Also, explain why combination tones are more prominent in organs and brass instruments.	10	3	4



RV College of Engineering®

Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

4	<p>For a square wave $f(t) = \begin{cases} k & \text{for } 0 < t < \frac{T}{2} \\ -k & \text{for } \frac{T}{2} < t < T \end{cases}$, derive its Fourier series representation showing that it contains only odd harmonics with amplitudes decreasing as $1/n$. Explain why the square wave sounds different from a sawtooth wave despite both being periodic.</p>	10	2	3
5	<p>Prove that the set of all transposition operations $\{T_0, T_1, T_2, \dots, T_{11}\}$ forms a cyclic group under composition, isomorphic to $(\mathbb{Z}_{12}, +)$. Show that:</p> <p>(i) Closure: $T_m \circ T_n = T_{(m+n) \bmod 12}$</p> <p>(ii) Associativity holds</p> <p>(iii) Identity element exists</p> <p>(iv) Inverse elements exist</p>	10	4	4