**STUDENT LAB SAFETY, HIRARC, DATASHEET VERIFICATION CHECKLIST, AND BRIEF REPORT SUBMISSION**

**EXPERIMENT DSP1: DSP with MATLAB**

**STUDENT NAME** : _____
**MATRIC NO.** : _____
**GROUP** : _____
**DATE** : _____

## PART A: ENGINEERING LABORATORY VERIFICATION SUITE

### A. Software and Simulation Verification Checklist

| Item | Verification Requirement | ✓ |
|---|---|---|
| MATLAB | MATLAB/Simulink launched successfully | ☐ |
| DSP Toolbox | DSP System Toolbox available | ☐ |
| Basic Filter Model | Opened successfully | ☐ |
| Signal Sources | 1 kHz and 15 kHz sources configured | ☐ |
| Gaussian Noise | Added correctly | ☐ |
| Sample Rate | 44.1 kHz verified | ☐ |
| Spectrum Analyzer | Configured and operational | ☐ |
| Lowpass Filter | Default parameters verified | ☐ |
| Peak Finder | Measurements enabled | ☐ |
| Highpass Filter | Successfully configured | ☐ |
| Bandpass Design | Cascade implementation completed | ☐ |
| Project File | Saved successfully | ☐ |

### B. HIRARC Checklist

| Hazard / Unsafe Condition | Potential Consequence | Control Measure | ✓ |
|---|---|---|---|
| Incorrect filter parameters | Invalid filtering results | Verify parameters before simulation | ☐ |
| Wrong passband frequency | Signal attenuation errors | Confirm frequency settings | ☐ |
| Incorrect sample rate | Spectrum distortion | Verify 44.1 kHz sample rate | ☐ |
| Incorrect signal routing | Simulation malfunction | Check block connections | ☐ |
| Failure to save files | Data loss | Save project regularly | ☐ |
| Data recording errors | Incorrect conclusions | Verify measurements before reporting | ☐ |

| | | | |
|---|---|---|---|
| Improper spectrum interpretation | Incorrect analysis | Cross-check results with theory | ☐ |
| Poor workstation ergonomics | Fatigue and eye strain | Take periodic breaks | ☐ |
| Software crash | Loss of work | Backup files regularly | ☐ |
| Data fabrication | Violation of engineering ethics | Record actual measured results only | ☐ |

**C. Engineering Practice Verification**

| **Requirement** | ✓ |
|---|---|
| **FIR filter parameters documented** | ☐ |
| **Frequency response understood** | ☐ |
| **Spectrum Analyzer results recorded** | ☐ |
| **Peak powers measured using Peak Finder** | ☐ |
| **Lowpass filter performance evaluated** | ☐ |
| **Highpass filter performance evaluated** | ☐ |
| **Bandpass filter implemented successfully** | ☐ |
| **Results compared with filtering theory** | ☐ |
| **MATLAB file saved and backed up** | ☐ |
| **Results recorded accurately and honestly** | ☐ |

**D. Student Declaration**

**I confirm that:**

☐ MATLAB and Simulink simulations were performed according to laboratory instructions.

☐ All filter parameters were verified before simulation.

☐ Spectrum Analyzer measurements were obtained from actual simulation results.

☐ Risks associated with software use and data integrity have been identified.

☐ Experimental results reported are genuine and accurately recorded.

☐ Engineering ethics and academic integrity have been maintained throughout the experiment.

**Student Signature : _____**

**Date : _____**

# E. Experiment Data Results and Discussion

## In Lab Task (During Lab)

### B1. Exercise 1: Low-Pass Filter Design & Parameter Space

**Table 1: FIR Parameter Definitions**

| Parameter Name | Preset Entry | Units | System Definition / Operational Function |
|---|---|---|---|
| **Filter Type** | FIR | Unitless | |
| **Passband Edge Frequency** | 8.00E+03 | Hz | |
| **Stopband Edge Frequency** | 1.00E+04 | Hz | |
| **Maximum Passband Ripple** | 0.1 | dB | |
| **Minimum Stopband Attenuation** | 80 | dB | |
| **Input Sample Rate** | 44100 | Hz | |

**[Student Sketch Space]**

Draw an idealized low-pass filter frequency response diagram below.

Clearly label the Passband, Stopband, Transition Band, Ripple (Ap), and Attenuation (As).

### B2. Quantitative Spectrum Analysis (Default vs. Adjusted States)

**Table 2: Signal Spike Power Matrix**

| Signal Artifact ID | Center Freq (Hz) | Raw Peak Power (dBm) | Filtered Peak Power (dBm) | Measured Attenuation Delta (Δ dB) |
|---|---|---|---|---|
| **1 kHz Fundamental Tone** | 1000 | | | |
| **15 kHz Fundamental Tone** | 15000 | | | |
| **Gaussian Noise Floor** | Multi-band | | | |

**Theoretical Explanation of Spikes & Filtering Performance:**

In the box below, explain why the spikes appear in the raw spectrum, account for any overlapping signals, and analyze the filter's performance based on the power changes logged in Table 2.

**Table 3: Parametric Iteration Matrix**

| Target Operational Goal | Modified Parameter Name | New Assigned Value | Observed Effect on Output Signal Spectrum |
|---|---|---|---|
| **Pass Both Tones (Allow both 1 kHz & 15 kHz components to pass fully)** | Passband Edge Frequency<br>Stopband Edge Frequency | | |
| **Deepen Stopband (Enhance out-of-band rejection performance)** | Minimum Stopband Attenuation | | |

## B3. Exercise 2: High-Pass Filter Implementation & Evaluation

**Table 4: High-Pass Structural Settings**

| Configured Parameter | Value Programmed | Unit | Actual Component Isolation Effect |
|---|---|---|---|
| **Passband Edge Frequency** | | Hz | |
| **Stopband Edge Frequency** | | Hz | |
| **Minimum Stopband Attenuation** | | dB | |

**Table 5: High-Pass Spectral Performance**

| Isolated Signal Artifact | Frequency (Hz) | Input Power (dBm) | Output Power (dBm) | Performance Analysis & Comments |
|---|---|---|---|---|
| **Low Frequency Spike** | 1000 | | | |
| **High Frequency Spike** | 15000 | | | |

## B4. Exercise 3: Cascaded Band-Pass Filter (Open-Ended Design)

**Table 6: Block Sub-System Parameter Mapping**

| Cascaded Block Stage | Assigned Filter Type | Passband Edge (Hz) | Stopband Edge (Hz) | Target Attenuation (dB) |
|---|---|---|---|---|
| **Stage 1 Element** | | | | |
| **Stage 2 Element** | | | | |

**Conceptual Routing Topology:**

Draw the exact block diagram showing how the individual filter blocks and signal lines are linked to achieve the band-pass response.

**Band-Pass Verification & Analysis:**

Analyze how your Spectrum Analyzer results confirm that your custom cascaded band-pass filter works properly. State the exact frequency boundaries of your calculated passband channel.

**DISCUSSION:**

**CONCLUSION:**

**LAB LECTURER**

**SIGNATURE : _____**

**DATE : _____**

**INSTRUCTOR**

**SIGNATURE : _____**

**DATE : _____**