

## **JIGSAW (Collaborative Learning)**

<b>Course</b>	: Signals and Systems
<b>Class</b>	: II ECE A, I SEM
<b>Academic Year</b>	: 2016-17
<b>Topic</b>	: Fourier Transforms
<b>Activity Chosen</b>	: JIGSAW- Collaborative

### **Concept for activity:**

1. Fourier transform from Fourier series
2. Fourier transform of arbitrary and standard signals.
3. Properties of Fourier transform

### **Goals of this activity:**

At the end of this activity, students will be able to:

1. Determine the Fourier transform of various functions.
2. Analyze the spectral characteristics of signals using Fourier analysis.
3. Identify system properties based on impulse response and Fourier analysis.

### **Outcome of the Activity:**

- Builds self-esteem in students
- Increases student retention
- Enhances student knowledge with the learning experience
- Develops oral communication skills
- Develops social interaction skills

### **Time planned:**

Time required to execute the event is maximum 150 min (3 sessions) including survey of student learning styles, JIGSAW and EXPERT groups formation, peer discussion, student evaluation.

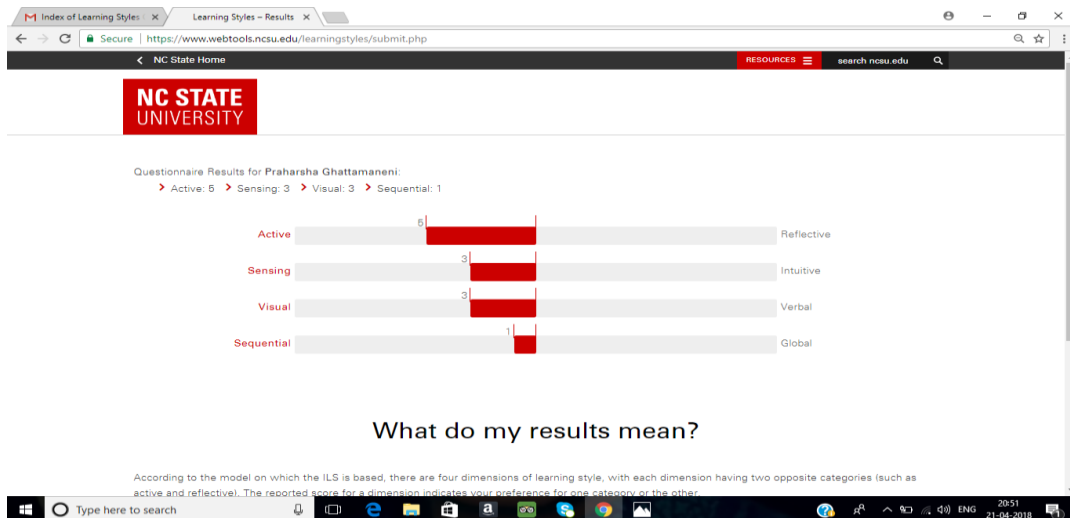


Figure : Learning style of a student based on questionnaire

Learning Styles	Number of students	Percentage of students (%)
Active	15	24.61
Reflective	3	3.07
Sensing	5	6.15
Intuitive	5	6.15
Visual	20	33.8
Verbal	3	3.07
Sequential	8	12.30
Global	7	10.76

Table 1: Percentage of student distribution based on their learning styles

### Implementation of Activity

**Course** : Signals and Systems  
**Academic Year** : 2016-17  
**Class** : II ECE A, I SEM  
**Topic** : Fourier Transforms  
**Activity Chosen** : JIGSAW

**Concept for activity:** Fourier transforms from Fourier series, Fourier transform of arbitrary and standard signals. Properties of Fourier transform

The Instruction execution is subdivided into 6 segments.

- i) Fourier transform from Fourier series.
- ii) Fourier transform of arbitrary signals

- iii) Fourier transform of standard signals
- iv) Fourier transform of periodic signals
- v) Properties of Fourier transform
- vi) Fourier transforms involving impulse function and signum function

<b>Group No.</b>	<b>JIGSAW Home Group</b>	<b>Student Roll No</b>	<b>Member ID</b>	<b>Student learning ability</b>	<b>Topic Assigned to group</b>
1	Albert Einstein (A)	15NM1A0413	A1-Leader	Strong Active Learner	Fourier transform from Fourier series
		15NM1A0430	A2	Strong Reflective Learner	
		15NM1A0402	A3	Strong Verbal Learner	
		15NM1A0408	A4	Strong Intuitive Learner	
		15NM1A0441	A5	Strong Visual Learner	
2	Isaac Newton (B)	15NM1A0429	B1-Leader	Strong Global Learner	Fourier transform of arbitrary signals
		15NM1A0454	B2	Strong Sequential Learner	
		15NM1A0459	B3	Strong Active Learner	
		16NM5A0404	B4	Strong Visual Learner	
		15NM1A0431	B5	Strong Visual Learner	
3	Stephen Hawking (C)	15NM1A0432	C1-Leader	Strong Global Learner	Fourier transform of standard signals
		15NM1A0458	C2	Strong Sequential Learner	
		15NM1A0457	C3	Strong Active Learner	
		15NM1A0421	C4	Strong Reflective Learner	
		15NM1A0433	C5	Strong Visual Learner	
4	Niels Bohr (E)	15NM1A0445	D1-Leader	Strong Global Learner	Fourier transform of periodic signals
		15NM1A0460	D2	Strong Sequential Learner	
		15NM1A0442	D3	Strong Active Learner	
		15NM1A0406	D4	Strong Verbal Learner	
		15NM1A0437	D5	Strong Visual Learner	
5	Faraday (F)	15NM1A0461	E1-Leader	Strong Global Learner	Properties of Fourier transform
		15NM1A0407	E2	Strong Active Learner	
		15NM1A0403	E3	Strong Intuitive Learner	
		15NM1A0438	E4	Strong Visual Learner	
		15NM1A0402	E5	Strong Global Learner	
6	Galileo (G)	15NM1A0405	F1-Leader	Strong Sensing Learner	Fourier transforms involving impulse function and signum function
		15NM1A0415	F2	Strong Active Learner	
		15NM1A0412	F3	Strong Intuitive Learner	
		15NM1A0440	F4	Strong Visual Learner	
		15NM1A0409	F5	Strong Verbal learner	
7	Thomas Edison (H)	15NM1A0427	G1-Leader	Strong Global Learner	Fourier transform from Fourier series
		15NM1A0419	G2	Strong Active Learner	
		15NM1A0418	G3	Strong Intuitive Learner	
		15NM1A0448	G4	Strong Visual Learner	
		15NM1A0422	G5	Strong Sensing Learner	
8	Graham Bell	16NM5A0403	H1-Leader	Strong Sequential Learner	Fourier transform

	(K)	15NM1A0401	H2	Strong Active Learner	of arbitrary signals
		15NM1A0404	H3	Strong Visual Learner	
		15NM1A0451	H4	Strong Visual Learner	
		15NM1A0428	H5	Strong Active Learner	
9	Charles Darwin (I)	15NM1A0444	I1-Leader	Strong Sequential Learner	Fourier transform of standard signals
		15NM1A0425	I2	Strong Active Learner	
		15NM1A0411	I3	Strong Visual Learner	
		16NM5A0405	I4	Strong Visual Learner	
		15NM1A0446	I5	Strong Active Learner	
10	Archimedes (J)	15NM1A0447	J1-Leader	Strong Sequential Learner	Fourier transform of periodic signals
		15NM1A0434	J2	Strong Active Learner	
		15NM1A0416	J3	Strong Visual Learner	
		15NM1A0410	J4	Strong Sensing Learner	
		15NM1A0449	J5	Strong Visual Learner	
11	Rutherford (K)	15NM1A0450	K1-Leader	Strong Sequential Learner	Properties of Fourier transform
		15NM1A0436	K2	Strong Active Learner	
		15NM1A0424	K3	Strong Visual Learner	
		15NM1A0414	K4	Strong Sensing Learner	
		15NM1A0455	K5	Strong Visual Learner	
12	James Maxwell (L)	15NM1A0453	L1-Leader	Strong Sequential Learner	Fourier transforms involving impulse function and signum function
		15NM1A0439	L2	Strong Active Learner	
		16NM5A0401	L3	Strong Visual Learner	
		15NM1A0435	L4	Strong Visual Learner	
		15NM1A0452	L5	Strong Visual Learner	
13	Charles-Augustin de Coulomb (M)	15NM1A0443	M1-Leader	Strong Global Learner	Fourier transform of standard signals
		15NM1A0423	M2	Strong Active Learner	
		15NM1A0420	M3	Strong Intuitive Learner	
		15NM1A0417	M4	Strong Reflective Learner	
		15NM1A0426	M5	Strong Sensing Learner	
		15NM1A0462	M6	Strong Visual Learner	

Table 2: Formation of JIGSAW Home Groups (Heterogeneous Groups)

**Quiz Marks for Homogeneous Teams (10Marks)**

EG1	15NM1A0413	A1(L)	Strong Active Learner	9
	15NM1A0429	B1(L)	Strong Global Learner	
	15NM1A0432	C1(L)	Strong Global Learner	
	15NM1A0445	D1(L)	Strong Global Learner	
	15NM1A0461	E1(L)	Strong Global Learner	
	15NM1A0405	F1(L)	Strong Sensing Learner	
	15NM1A0443	M1(L)	Strong Global Learner	
EG2	15NM1A0430	A2	Strong Reflective Learner	8
	15NM1A0454	B2	Strong Sequential Learner	
	15NM1A0458	C2	Strong Sequential Learner	

	15NM1A0460	D2	Strong Sequential Learner	
	15NM1A0407	E2	Strong Active Learner	
	15NM1A0415	F2	Strong Active Learner	
	15NM1A0423	M2	Strong Active Learner	
EG3	15NM1A0402	A3	Strong Verbal Learner	8
	15NM1A0459	B3	Strong Active Learner	
	15NM1A0457	C3	Strong Active Learner	
	15NM1A0442	D3	Strong Active Learner	
	15NM1A0403	E3	Strong Intuitive Learner	
	15NM1A0412	F3	Strong Intuitive Learner	
	15NM1A0420	M3	Strong Intuitive Learner	
EG4	15NM1A0408	A4	Strong Intuitive Learner	7
	16NM5A0404	B4	Strong Visual Learner	
	15NM1A0421	C4	Strong Reflective Learner	
	15NM1A0406	D4	Strong Verbal Learner	
	15NM1A0438	E4	Strong Visual Learner	
	15NM1A0440	F4	Strong Visual Learner	
	15NM1A0417	M4	Strong Reflective Learner	
EG5	15NM1A0441	A5	Strong Visual Learner	7
	15NM1A0431	B5	Strong Visual Learner	
	15NM1A0433	C5	Strong Visual Learner	
	15NM1A0437	D5	Strong Visual Learner	
	15NM1A0402	E5	Strong Global Learner	
	15NM1A0409	F5	Strong Verbal learner	
	15NM1A0426	M5	Strong Sensing Learner	
EG6	15NM1A0427	G1-Leader	Strong Global Learner	8
	16NM5A0403	H1-Leader	Strong Sequential Learner	
	15NM1A0444	I1-Leader	Strong Sequential Learner	
	15NM1A0447	J1-Leader	Strong Sequential Learner	
	15NM1A0450	K1-Leader	Strong Sequential Learner	
	15NM1A0453	L1-Leader	Strong Sequential Learner	
EG7	15NM1A0419	G2	Strong Active Learner	8
	15NM1A0401	H2	Strong Active Learner	
	15NM1A0425	I2	Strong Active Learner	
	15NM1A0434	J2	Strong Active Learner	
	15NM1A0436	K2	Strong Active Learner	
	15NM1A0439	L2	Strong Active Learner	
	15NM1A0462	M6	Strong Visual Learner	
EG8	15NM1A0418	G3	Strong Intuitive Learner	8
	15NM1A0404	H3	Strong Visual Learner	
	15NM1A0411	I3	Strong Visual Learner	
	15NM1A0416	J3	Strong Visual Learner	
	15NM1A0424	K3	Strong Visual Learner	
	16NM5A0401	L3	Strong Visual Learner	

EG9	15NM1A0448	G4	Strong Visual Learner	7
	15NM1A0451	H4	Strong Visual Learner	
	16NM5A0405	I4	Strong Visual Learner	
	15NM1A0410	J4	Strong Sensing Learner	
	15NM1A0414	K4	Strong Sensing Learner	
	15NM1A0435	L4	Strong Visual Learner	
EG10	15NM1A0422	G5	Strong Sensing Learner	8
	15NM1A0428	H5	Strong Active Learner	
	15NM1A0446	I5	Strong Active Learner	
	15NM1A0449	J5	Strong Visual Learner	
	15NM1A0455	K5	Strong Visual Learner	
	15NM1A0452	L5	Strong Visual Learner	

### Formation of EXPERT groups (Homogeneous)

Sl. No.	Expert Group Name	Expert Group Members
1	EG1	A1, B1, C1, D1, E1, F1, M1: HOME Group Leaders
2	EG2	A2, B2, C2, D2, E2, F2, M2: HOME groups members
3	EG3	A3, B3, C3, D3, E3, F3, M3: - do-
4	EG4	A4, B4, C4, D4, E4, F4, M4: - do-
5	EG5	A5, B5, C5, D5, E5, F5, M5: - do-
6	EG6	G1, H1, I1, J1, K1, L1: HOME Group Leaders
7	EG7	G2, H2, I2, J2, K2, L2, M6: HOME group member
8	EG8	G3, H3, I3, J3, K3, L3: - do-
9	EG9	G4, H4, I4, J4, K4, L4: - do-
10	EG10	G5, H5, I5, J5, K5, L5: - do-

Table 5.5.7: List of Expert Groups (Homogeneous) and their Team Members



## Process of Evaluation:

### Question 1

What can you say about the aspects of JIGSAW practices which have positive effects on you?

Student responses: Out of 66 students great many reported that 'JIGSAW technique was very 'Instructive', 'Created interest on the subject', 'responded positively ', affected the interaction and cooperation in the classroom', and it was 'enjoyable'

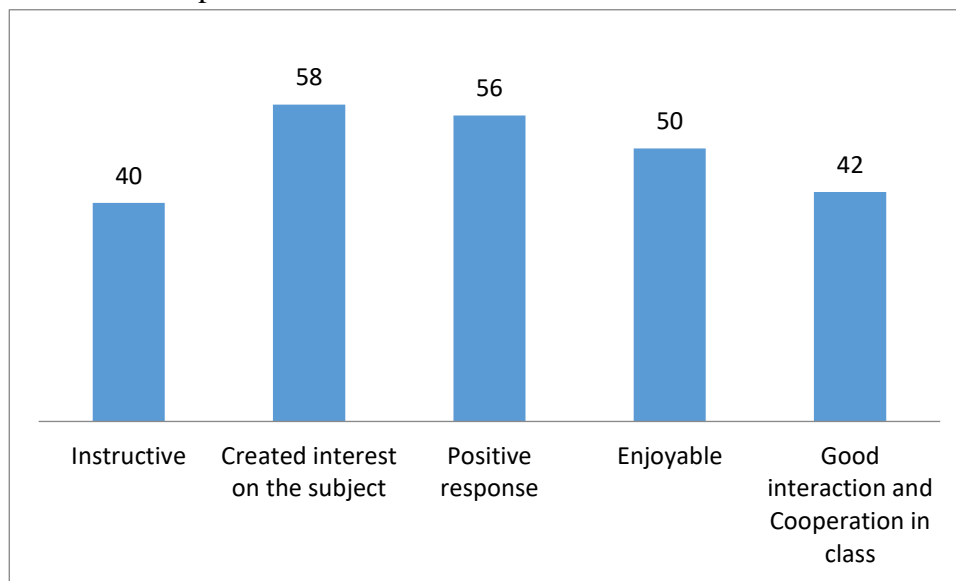
Instructive: 40

Created interest on the subject: 58

Positive response: 56

Enjoyable: 50

Good interaction and Cooperation in class: 42



**Figure B.5.5.e: Feedback for JIGSAW technique.**

### Question 2

What can you say about the sides of the JIGSAW technique with negative effects in your opinion?

Student responses: Few students reported that JIGSAW technique was 'time-consuming', "Their friends with low achievement made them tired" and "The noise occurred during group works was disturbing". Besides, 2 - 3 students expressed that it would be more effective if the topic was taught by the teacher instead of using this method.

After considering their feelings, noticed that they are slow learners in my class and their native language is Telugu (a local language)

### Question 3

What are the changes you have observed after the application of this technique?

Most students reported that this technique enhanced our learning capacity', 'it increased our self-confidence', 'provided peer interaction and cooperation', 'and they felt that they were more 'active', 'learned a lot on our own'.

S.No	Student Roll No	Name of the Student	Instructive	Created Interest on the Subject	Positive Response	Enjoyable	Good Interaction and Cooperation in the class
1	15NM1A0401	ALLAVARAPU GANESWARI RUPAVATHI	Y	Y	Y	Y	Y
2	15NM1A0402	ANDIBOYINA JANAKI	Y	Y	Y		
3	15NM1A0403	ANUMPALLI JHANSI		Y	Y	Y	Y
4	15NM1A0404	ARISANKALA YASODA SRIDEVI	Y	Y	Y	Y	
5	15NM1A0405	AVULLA BHARATHI LAKSHMI		Y	Y	Y	
6	15NM1A0406	AYENAMPUDI ALEKHYA	Y	Y	Y		Y
7	15NM1A0407	BADDI VIJAYA	Y	Y	Y	Y	
8	15NM1A0408	BANDARU SARANYA	Y	Y	Y	Y	
9	15NM1A0409	BARRI RAMA DEVI	Y	Y	Y	Y	Y
10	15NM1A0410	BASA KAVYA VIJAYA LAKSHMI		Y	Y		
11	15NM1A0411	BASANGI SHARUN ROJA		Y	Y	Y	Y
12	15NM1A0412	BASWA RAJANI		Y		Y	
13	15NM1A0413	BODDAPATI SHANMUKALAKSHMI KATYAYANI		Y	Y		Y
14	15NM1A0414	BODDAPU PRIYANKA	Y	Y	Y	Y	Y
15	15NM1A0415	BODDEPALLI SANDHYAREKHA	Y	Y	Y	Y	Y
16	15NM1A0416	BUGATHA LEELA	Y	Y	Y	Y	Y
17	15NM1A0417	CHANDAKA VASAVI	Y	Y	Y		
18	15NM1A0418	CHAPPA PADMINI	Y	Y	Y	Y	Y
19	15NM1A0419	CHILAKA LALITA LAVANYA		Y	Y	Y	
20	15NM1A0420	CHINTALA MOUNICA		Y		Y	Y
21	15NM1A0421	CHITIMISSETTI HARITHA		Y	Y		Y
22	15NM1A0422	CHUKKA SHYAMALA	Y	Y	Y	Y	
23	15NM1A0423	DADI LOHITHA LAHARI		Y	Y	Y	Y
24	15NM1A0424	DAMA MANASA	Y	Y	Y	Y	Y
25	15NM1A0425	DANDA JAHNAVI		Y	Y	Y	Y
26	15NM1A0426	DATLA SAI KRISHNA SRAVANTHI	Y	Y	Y	Y	Y
27	15NM1A0427	DOKALA ANUSHA		Y	Y	Y	Y



28	15NM1A0428	DUNGA VENKATA PAVANI	Y	Y		Y	
29	15NM1A0429	GANAGALA DIVYASRI	Y	Y	Y	Y	
30	15NM1A0430	GANDRETI KANAKA DIVYA	Y	Y	Y	Y	Y
31	15NM1A0431	GANTLA POOJITHA	Y	Y			
32	15NM1A0432	GEDELA RENUKA		Y		Y	Y
33	15NM1A0433	GOGULAMUDI POOJA	Y	Y	Y	Y	Y
34	15NM1A0434	GOLLAKOTI MANI DEEPIKA		Y		Y	
35	15NM1A0435	GOLLAVILLI REVATHI	Y	Y	Y	Y	Y
36	15NM1A0436	GONTINA ROHITA KRISHNA			Y	Y	Y
37	15NM1A0437	GORLE AKHILA	Y	Y	Y	Y	Y
38	15NM1A0438	GUNDALA SANTHI	Y	Y	Y	Y	Y
39	15NM1A0439	GUNDALA SRAVANTHI				Y	Y
40	15NM1A0440	GURUGUBELLI MADHURI	Y	Y	Y		Y
41	15NM1A0441	ILLINDA VENKATA SAKUNTALA	Y	Y		Y	
42	15NM1A0442	INDURI RAMANI	Y	Y	Y	Y	Y
43	15NM1A0443	JADDU AMMADU	Y	Y			Y
44	15NM1A0444	JALLEPALLI GAYATHRI REIKI PRATHYUSHA	Y	Y	Y	Y	Y
45	15NM1A0445	KADHAMBAM BINDUPRIYA	Y	Y	Y		
46	15NM1A0446	KALAGA LAKSHMI PRASANNA	Y	Y	Y	Y	Y
47	15NM1A0447	KALLEPALLI SAI MOUNICA	Y	Y	Y	Y	Y
48	15NM1A0448	KAMUJU TEJASRI	Y	Y	Y	Y	Y
49	15NM1A0449	KANDIPALLI SARIKA	Y	Y	Y	Y	Y
50	15NM1A0450	KANDULA MANJU BHARGAVI	Y	Y	Y	Y	Y
51	15NM1A0451	KANITHI MAMATHA	Y	Y	Y	Y	Y
52	15NM1A0452	KANTE SUMA	Y	Y	Y	Y	
53	15NM1A0453	KANURI MAMATHA			Y	Y	Y
54	15NM1A0454	KARAKA POORNA	Y	Y	Y	Y	
55	15NM1A0455	KARANAM SRAVANI			Y	Y	Y
56	15NM1A0457	KARRI NAGA VARALAKSHMI	Y	Y	Y	Y	Y

57	15NM1A0458	KOENANA ANITHA	Y	Y			
58	15NM1A0459	KOLAPARTHY CHARISHMA DEVI MARIYAMMA			Y	Y	Y
59	15NM1A0460	KORADA GEETHA MADHURI	Y	Y	Y		Y
60	15NM1A0461	KORIBILLI SRAVANI		Y	Y	Y	Y
61	15NM1A0462	KOVAGAPU RAMYA	Y	Y	Y	Y	
62	16NM5A0401	ADDURI HYNDHAVI			Y		Y
63	16NM5A0402	BOGGU LEELA AMRUTA VARSHINI		Y	Y	Y	Y
64	16NM5A0403	BONGU SUNEETHA	Y	Y	Y		Y
65	16NM5A0404	BOTTA PAVITHRA		Y	Y	Y	Y
66	16NM5A0405	BUSKALA SRAVANI	Y	Y	Y	Y	

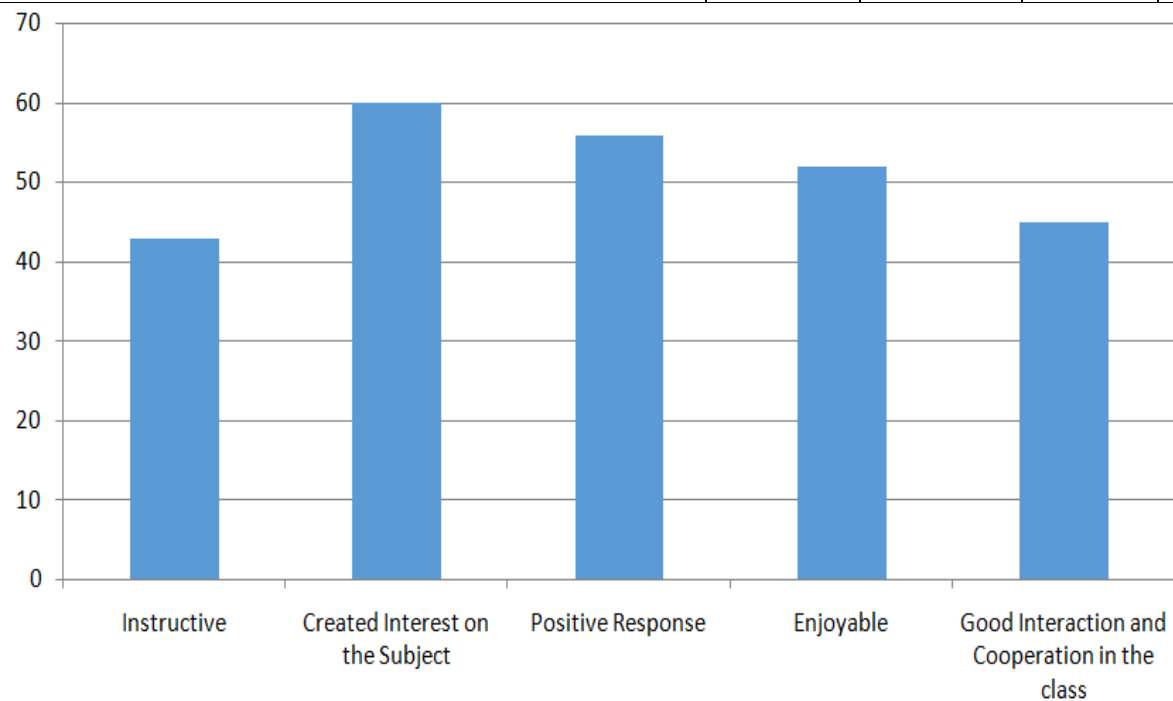


Figure 5.5.5: Feedback for JIGSAW technique.

**Assessment:**

Team No	JIGSAW Team	Home Group Member ID	Formative Assessment		Summative Assessment		Final Score (50M)	Median Score:45
			Individual Observation (10M)	Group Observation (10M)	Individual Quiz (15M)	Group Quiz (15M)		Performed less than Median Score (Yes/No)
1	Albert Einstein (A)	A1- Leader	10	10	14	13	47	NO
		A2	8		14		44	YES
		A3	9		13		45	NO
		A4	8		15		46	NO
		A5	10		12		45	NO
2	Isaac Newton (B)	B1-Leader	10	8	15	15	48	NO
		B2	9		12		44	YES
		B3	8		13		44	YES
		B4	7		14		44	YES
		B5	6		13		42	YES
3	Stephen Hawking (C)	C1-Leader	9	9	15	14	47	NO
		C2	7		12		42	YES
		C3	9		14		46	NO
		C4	10		13		46	NO
		C5	8		15		46	NO
4	Niels Bohr (D)	D1	10	10	15	13	48	NO
		D2	9		14		46	NO
		D3	8		15		46	NO
		D4	10		14		47	NO
		D5	10		15		48	NO
5	Faraday (E)	E1-Leader	10	9	15	12	46	NO
		E2	8		14		43	YES
		E3	9		13		43	YES
		E4	9		12		42	YES

		E5	8		14		43	YES
6	Galileo (F)	F1-Leader	9	9	15	15	48	NO
		F2	8		14		46	NO
		F3	7		13		44	YES
		F4	9		15		48	NO
		F5	10		12		46	NO
7	Thomas Edison (G)	G1-Leader	10	8	14	14	46	NO
		G2	9		13		44	YES
		G3	7		12		41	YES
		G4	8		13		43	YES
		G5	9		15		46	NO
8	Graham Bell (H)	H1-Leader	10	8	14	13	45	NO
		H2	8		15		44	YES
		H3	9		13		43	YES
		H4	7		14		42	YES
		H5	6		12		39	YES
9	Charles Darwin (I)	I1-Leader	8	10	14	12	44	YES
		I2	9		15		46	NO
		I3	10		13		45	NO
		I4	9		12		43	YES
		I5	8		11		41	YES
10	Archimedes (J)	J1-Leader	8	10	12	15	45	NO
		J2	9		15		49	NO
		J3	10		14		49	NO
		J4	9		13		47	NO
		J5	7		14		46	NO
11	Rutherford (K)	K1-Leader	9	8	12	14	43	YES
		K2	8		15		45	NO
		K3	10		13		45	NO
		K4	9		14		45	NO
		K5	6		13		41	YES

12	James Maxwell (L)	L1-Leader	10	9	12	14	45	NO
		L2	8		13		44	YES
		L3	9		14		46	NO
		L4	7		15		45	NO
		L5	6		14		43	YES
13	Charles- Augustin de Coulomb	15NM1A0443	8	9	13	14	44	YES
		15NM1A0423	9		15		47	NO
		15NM1A0420	10		13		46	NO
		15NM1A0417	9		14		46	NO
		15NM1A0426	7		13		43	YES
		15NM1A0462	8		14		45	NO

Table 5.5.8: Assessment sheet for JIGSAW activity

### Activity Outcomes to PO Mapping:

Activity Outcomes	Mapping to Pos
Determine the Fourier transform of various functions.	PO1, PO2, PO3, PO4, PO5
Analyze the spectral characteristics of signals using Fourier analysis.	PO7, PO6
Identify system properties based on impulse response and Fourier analysis.	PO9, PO11, PO12

### Post Implications:

- Heterogeneous groups performed better than Homogeneous groups.
- Both active and slow learners actively participated in the activity.