BRNS FORM-VII

CONSOLIDATED REPORT

Brief report on BRNS funded PROJECT

Sanction Number: **34/14/24/2014-BRNS**

Mode of Execution: **YSRA/RP**

Date of Start: **04/06/2014**

Date of Completion: **04/06/2017 (project is extended up to 31/12/2017)**

Total Amount Sanctioned (in Lakhs): **Rs. 33,25,478.00**

Amount Received (in Lakhs with date): **Rs. 31,90,700.00**

Institutes involved in case of MoU/CRP:

Category: Facility Development / Product Development / Technology Demonstration/ Applied Research/ Conceptual/Exploratory/ Survey/Others

Title: **Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators.**

	Name	Address	e-mail	Phone
PI	Dr. Nidhi. Saxena Bhattacharyya	Professor, Dept of Physics, Tezpur University, Nappam ,Tezpur Assam-784028	nidhi@tezu.ernet.in nidhisbhatta@gmail.com	(03712)267007 Ext.5551,5555 Mobile No: 9435084076 Fax No. 03712 267006
CI (i)	Dr. Satyajib Bhattacharyya	Professor Dept of Electronics & Communication Engineering, Tezpur University, Napaam, Tezpur Assam-784028	sb@tezu.ernet.in	(03712)267007 Ext.5255 Mobile No: 9435381270
(ii)	Dr. Subasit Borah	Assistant Professor, Dept. of Physics NETES Institute of Technology and Science,Mirza Mirza, Kamrup, 781125, Assam	subasitb@gmail.com subasit@nitsmirza.ac.in	09401629702
PC	R.S.Shinde Scientific Officer-H Head , Accelerator Magnet Technology Div	Room No. 1A Ferrite Lab Building ,MDL RRCAT, Indore- 452013 (M.P)	shinde@rrcat.gov.in shinderas@yahoo.co.in	07312488760 Mobile No. 919425315656 Fax No. 0731 2488740

Name of major Equipment procured and their cost: **Integrated S-parameter measurement system, Cost:- Rs. 18, 55,000.00**

Present working status of the Equipment: - **Working**

Number of other users & their affiliation and % use by others: - **Students from University of Science & Technology Meghalaya (USTM) (20%) and Kaziranga University (20%).**

Details of the High cost consumables used: **N/A**

Patent with brief description: **N/A**

Number of Journal Publications with impact factor (attach list as Annex- I):

Number of symposia presentations **N/A**

Number of staff trained under this project: **Two**

List of Objectives as mentioned in original proposal

Main objective is to design & develop test set up to measure the ferromagnetic resonance (FMR) linewidth in ferrites & garnets. Major activities to be taken as follows:

- Studies of FMR Phenomena in Polycrystalline / Nano-crystalline spinel & garnet systems.
- Development of FMR spectrometer system based on shorted waveguide technique.
- Measurements of FMR line-width for ferrites & garnets
- Analysis of FMR in ferrites, studies of Spin-Orbit interactions & grain size effect on FMR linewidth
- Measurement & analysis of Kittle & Polder resonance parameters and resonance relaxation coefficient in polycrystalline & nano crystalline ferrite & garnet systems.

I. Project Summary:

The ferromagnetic resonance is of great importance in the development of high power ferrite circulator. Ferromagnetic resonance (FMR) measurements give significantly important information about microwave loss, relaxation, damping processes and processional dynamics in ferrite & garnets. Microwave magnetic parameters like insertion loss, microwave relaxation damping, and resonance line width are crucial for development of below resonant CW Ferrite Circulators. The project involves the design & development of an FMR spectrometer system using shorted waveguide technique, calculation of FMR line width, resonance bias field, microwave relaxation & resonance losses in poly-crystalline and nano-crystalline spinel & garnets. Spherical spinel & garnet samples have been provided by Ferrite Lab, AMTD, RRCAT- Indore. This will help in design & development of indigenous ferrite circulators for RF system of electron accelerators at RRCAT & future accelerators being taken up in DAE.

II. **Work carried out at PI's institute: Tezpur University, Assam**

1. **Procurement of equipments, materials and related fabrication**

A. Procurement of Integrated S-parameter measurement system at microwave frequencies (DC-18 GHz). (December, 2015).

B. Nickel zinc ferrite is chosen as spinel ferrite for FMR line width measurement.

C. Nickel zinc ferrite (NZF) is synthesized using co-precipitation technique. The studies show spinel formation of ferrite with average crystallite size ~32 nm.

D. Nickel cobalt ferrite has been prepared using sol-gel combustion technique. The studies show spinel formation of ferrite with average crystallite size ~ (5-7) nm.

A. Prototype Gd –YIG & Calcium Vanadium garnet disks and spheres were developed in collaboration with PCs lab at RRCAT Indore. Structural and microwave magnetic characterization on spheres have been carried out. Measured results have been found useful in the calibration and FMR measurements for high power circulators.

2. **Design studies of FMR experimentation-set up**

A. **Experimental set up to measure FMR:** Design optimizations are carried out for measurement of accurate FMR. Prototype scheme has been made to develop FMR bench as shown in figure 1. Prototype studies of FMR are carried out on the test material. The sample is placed into the shorted waveguide for FMR line width measurement. External DC magnetic field is applied to the sample and the power absorbed is measured. Since the sample is very small, the amount of power that is absorbed is also very small. The absorbed power (P^{abs}) is measured from the slope

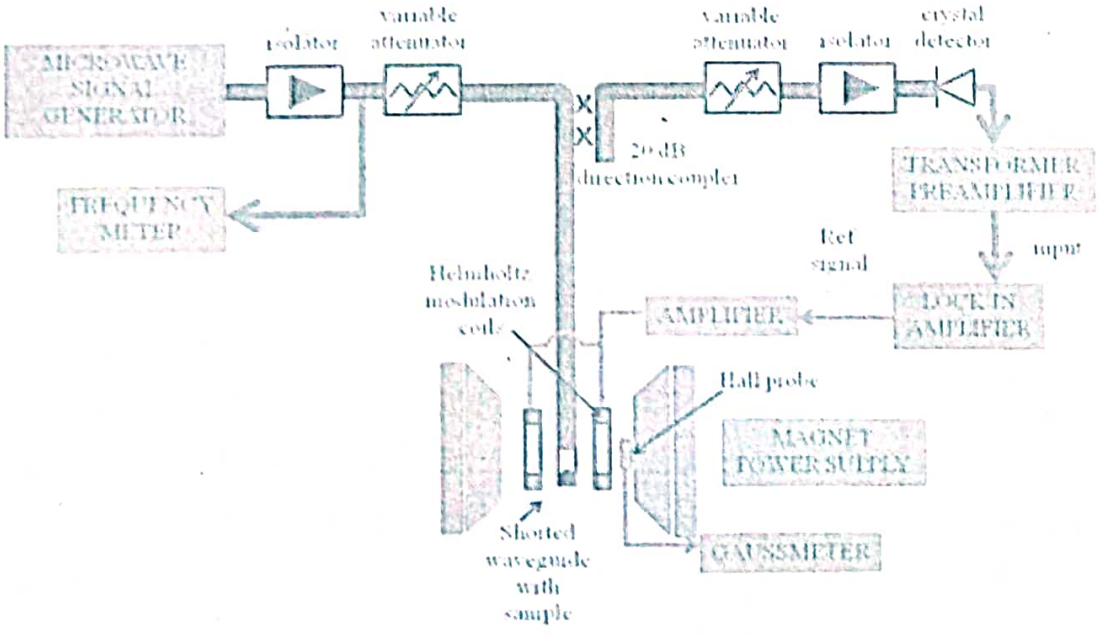

Figure 1. FMR measurement set up

of the absorbed power with respect to the DC magnetic field (ΔH_l). The biasing field is then swept to obtain the slope as a function of the DC field.

A Mat Lab program is developed to determine the FMR line width of the test sample. The half power line width of a ferrite material can be computed using the following equation

$$\Delta H = \sqrt{3}\Delta H_{pp}$$

Where ΔH is line width and ΔH_{pp} is peak-to-peak line width of the test sample. Assembling of waveguide and other required components for the FMR setup have been done and tested at PI's lab as shown in figure 2.

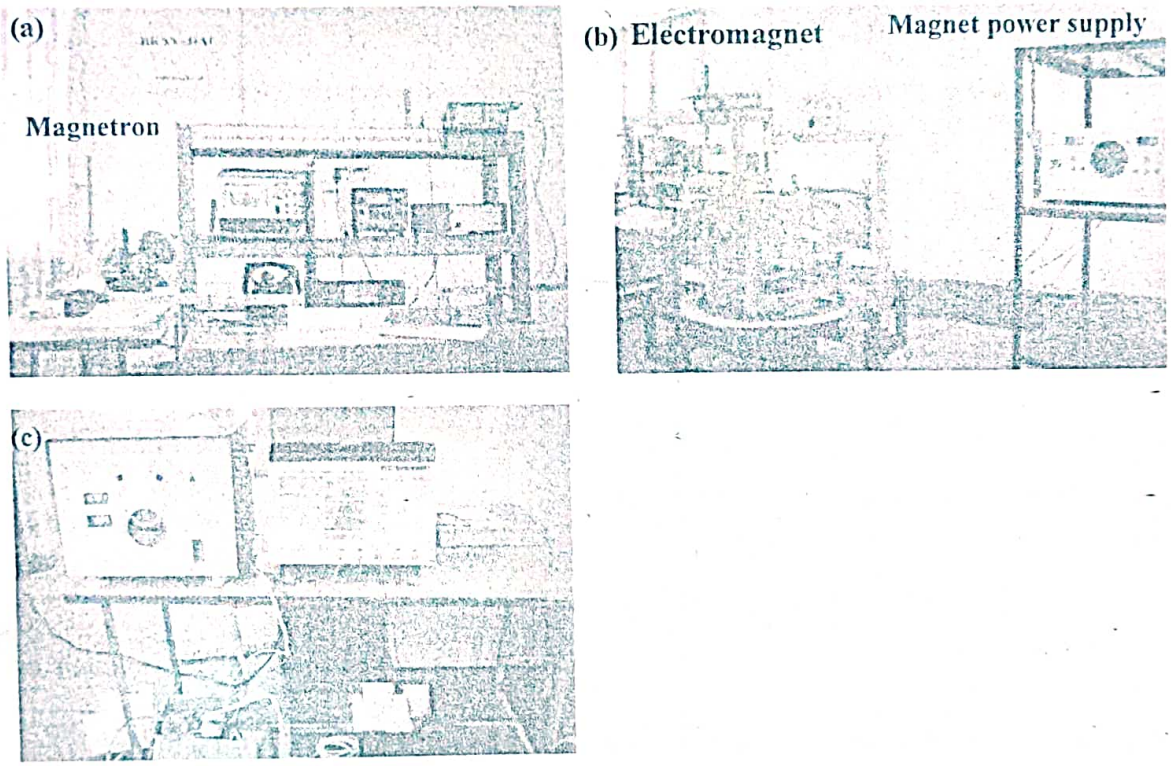

Figure 2. (a) Photograph of FMR measurement set up at PI's Lab, (b) Photograph of the electromagnet with rotational arrangement and (c) Photograph during online pulse waveform study of the pulse power supply with Magnetron load.

B. A prototype system as mentioned in the project has been designed. A TE103 reflection type shorted waveguide cavity is designed at 9 GHz as shown in figure 3 (a). The cavity is critically coupled through an iris hole with diameter of 8.42 mm. Q of the empty TE103 reflection cavity is found to be 1832.35 as shown in figure 3 (b). The fabricated test material is place within the cavity to measure the FMR line width as shown in figure 3 (c). The measurement procedure is to sweep the radio frequency field over ferrite or garnet samples placed in the sample holder at different

dc-magnetic field and determine first the onset of instability and from that point spin wave instability.

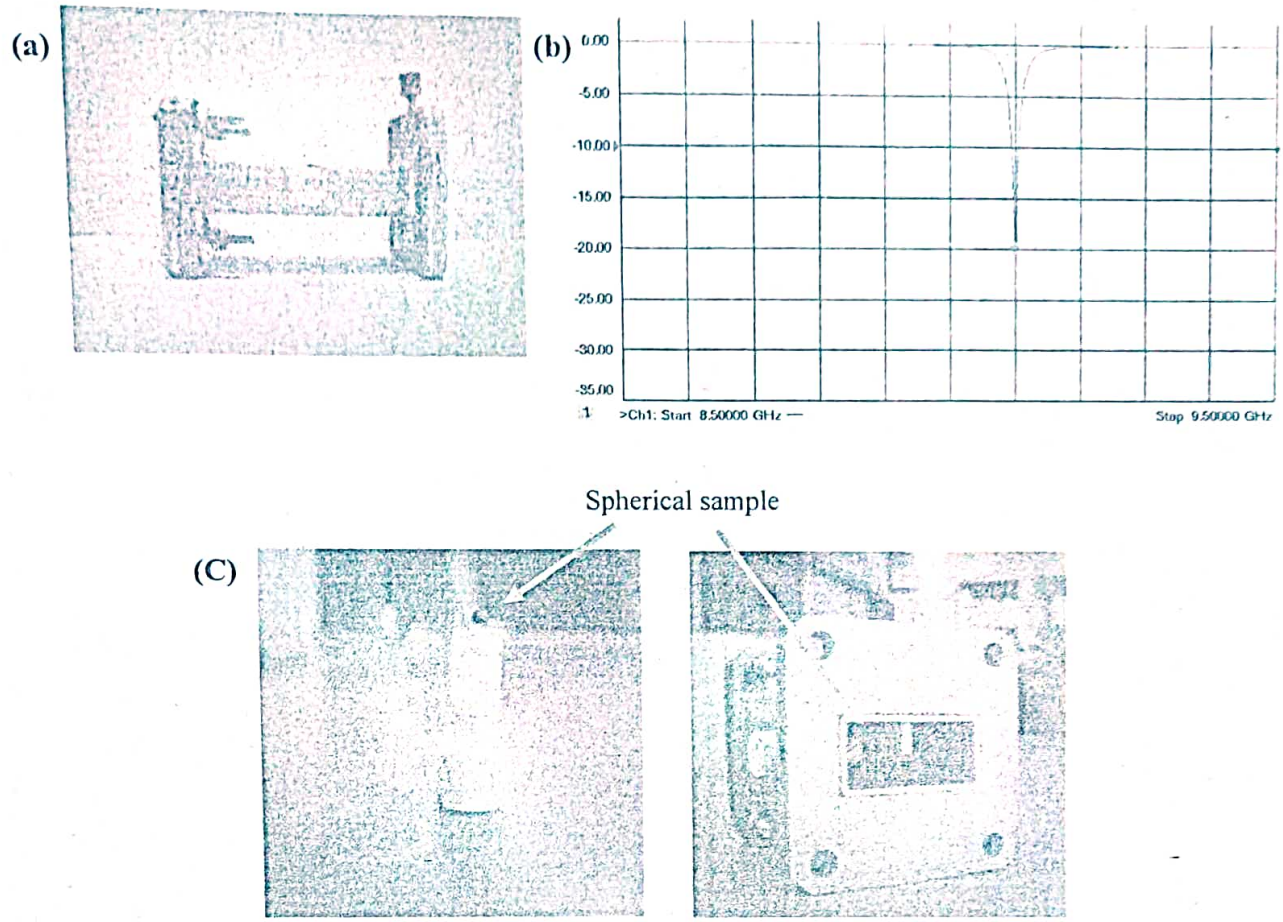

Figure 3: (a) TE103 shorted waveguide cavity, (b) Resonant frequency for the empty cavity at 9.1 GHz with -20.434 dB return loss and (c) Insertion of the spherical samples in to the resonant cavity.

C. An alternative method for determining FMR using co-planar waveguide (CPW) measurement technique is developed. Simulation and optimization of CPW on FR-4 (ε= 4.3 and tan δ= 0.025) substrate is carried out using CST microwave studio.

D. A prototype of Helmholtz coil with a diameter of 30 cm, to supply static magnetic field to measure FMR line width, has been designed and tested in PC's institute.

III. Work carried out at PC's institute: Ferrite Technology Lab, AMTD, RRCAT Indore

1. Development of Poly-crystalline ferrite & garnet spherical samples for FMR

A. Poly crystalline ferrites and garnets have been developed and some fundamental properties are measured.

B. A system has been developed to develop small spheres of ferrites with diameter ~1 mm.

2. Magnetic & Microwave Characterization of ferrite samples

Microwave magnetic characterization of ferrite & garnet spheres have been carried out. Complex permeability spectrum has been measured at a frequencies from 100 to 1000 MHz. Snoke's limit for ferromagnetic resonance has been measured. An excellent agreement between measured & simulated results have been observed.

3. Design and develop of variable gap electromagnet system with Helmholtz coil

Electromagnet with variable gap (50 mm) has been designed using Flux 2D for biasing of microwave ferrite & garnet spheres for measurement of FMR. Design optimized to get a field uniformity of 1 x 10-3 in the mid plane of aperture. The fabrication of electromagnet has been done and tested at PC's at Indore. The measured results are attached.

4. Development of Gadolinium (Gd) , Dysprosium (Dy) & Indium doped Yttrium garnets

Several composition of Gd, Dy and Indium doped Yttrium garnets have been developed & tested. Among these, Indium doped YIG spheres, discs & triangular components have made. Extremely low resonance width (< 15 dB) has been obtained with excellent magnetic stability w.r.t temperature. Based on measurements done at RRCAT & Tezpur University, both team now working on measurement of FMR at Tezpur University, Assam.

5. Development of RF sweeping set up to characterize Optimized ICVG, GdCVG Compositional system

Two coaxial airliners have been developed and tested with these garnet spheres. Measured data has been used for tuning of circulator & optimization of magnetic bias for correct magnetic state so as to operate device below resonant mode for high power operation. Optimized ferrite resonator has been made using several plural pieces of ICVG garnets for testing at 100 kW at RRCAT is shown in figure 4. Development of circulator using this resonators is under progress at RRCAT.

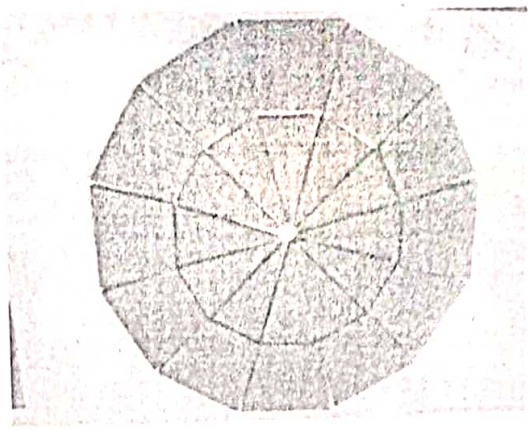

Figure 4. ICVG garnets pieces

6. Magnetic field measurement of Helmholtz coil system for FMR system, Accelerator Magnet Technology Division, RRCAT Indore

A homogenous Helmholtz coil system with variable gap has been developed for FMR measurement of spinels and garnets at microwave frequencies for use in high power circulator development at RRCAT Indore. The schematic diagram of the developed variable gap Helmholtz coil (number of turns, N=1117) is shown in the figure 5.

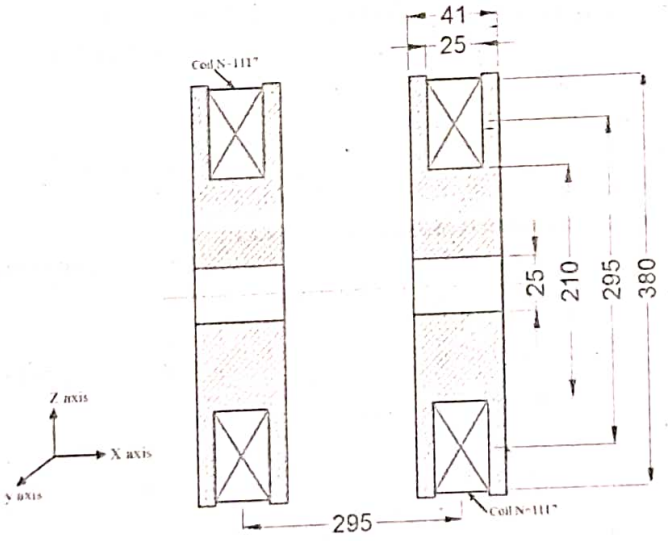

Figure 5. Schematic diagram of Helmholtz coil

The magnetic field measurement data of the Helmholtz coil at various gap position between the two coils as shown in figure 6 (a)-(c). The variation of magnetic field at the centre as a function of current is shown in figure 6 (d).

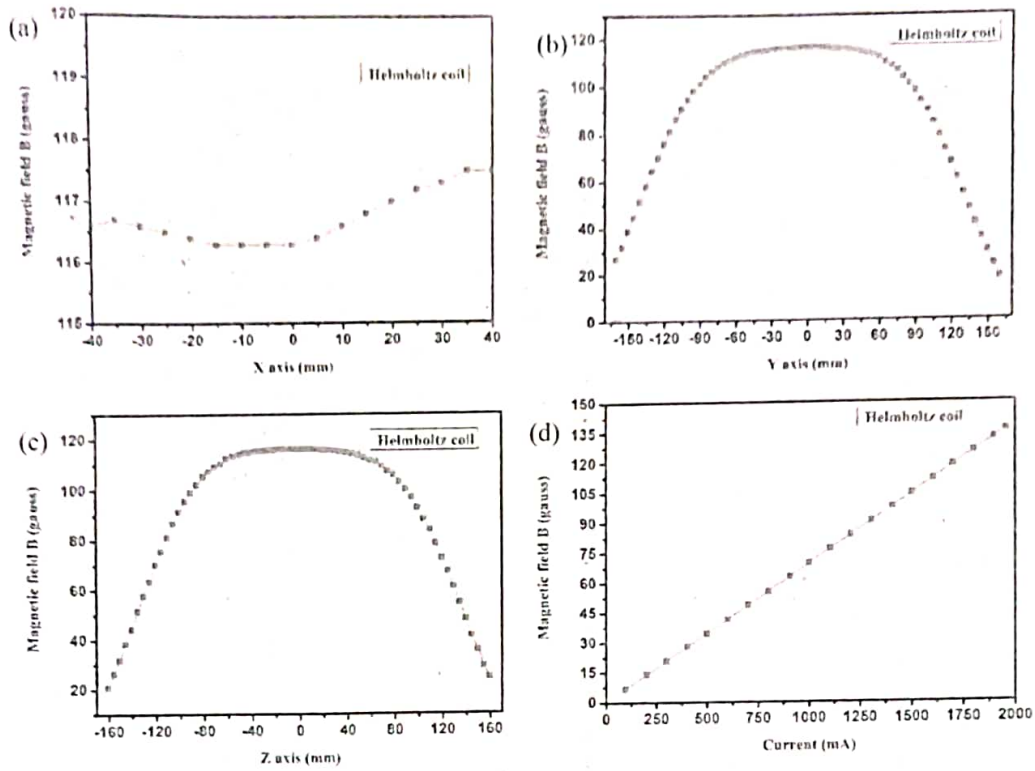

Figure 6. Helmholtz coil magnetic field distribution along the (a) X-axis (Y=Z=0), (b) Y-axis (X=Z=0) and (c) Z-axis (X=Y=0). (d) Helmholtz coil magnetic field at centre as function of current.

Signatures with dates & Place

Principal Investigator (PI) ---------- 28.01.2020

Co- Investigator (CI) ----------

Through (Head of Institution) ----------

Principal Collaborator (PC) ----------

2-6/01/2020

Ex. Outstanding scientist &
Head, AMTD
RRCAT, Indore

FORM-III

UTILISATION CERTIFICATE

(For the period 2014-2015)

Certificate that Grant-in-aid of **Rs. 22,77,400.00** (**Rupees twenty two lakhs seventy seven thousand and four hundred only**) sanctioned by the **Government of India, Department of Atomic Energy, Mumbai- 400 001** vide their letter No. **34/14/24/2014-BRNS/504** dated **4th June, 2014** and received on date(s) **11/09/2014** for the year(s) **2014-2015** there is an unutilised balance of **Rs. 21,22,937.00 (Rupees twenty one lakhs twenty two thousand and nine hundred thirty seven only)** of the said grant as on **31/03/2015** in respect of the Research project viz **"Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"**

Signature& Seal: Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20-20

Signature &Seal: Head of the Institution

Registrar
Tezpur University

Signature and Seal: Statutory Auditor (Govt.)/ Chartered Accountant/Internal Auditor

FORM-IV

Board of Research in Nuclear Sciences (BRNS)

STATEMENT OF ACCOUNTS (SA) as on **SEPTEMBER, 2014 to MARCH, 2015** (date)

Sanction No: **34/14/24/2014-BRNS/504** Dated: **June 04, 2014**

Sl. No.	1st Year (2014- 2015)	Sanctioned	Opening Balance (Brought Forward)	Received	Total (4+5)	Spent	Unspent (Carried Forward)
1	2	3	4	5	6	7	8
1.	Equipment	18,00,000	NIL	18,00,000	18,00,000	NIL	18,00,000
2.	Staff Salaries	1,92,000	NIL	1,92,000	1,92,000	1,41,935	50,065
3.	Consumables	40,000	NIL	40,000	40,000	NIL	40,000
4.	Travel	40,000	NIL	40,000	40,000	NIL	40,000
5.	Contingencies	50,000	NIL	50,000	50,000	12,528	37,472
6.	Overheads	1,55,400	NIL	1,55,400	1,55,400	NIL	1,55,400
7.	**Interest Earned*		NIL				
	TOTAL:	22,77,400	NIL	22,77,400	22,77,400	1,54,463	21,22,937

Remarks:

This statement of accounts is from September, 2014 to 31st March, 2015. The amount of Rs. 21, 22,937/- (Rupees twenty one lakhs twenty two thousand and nine hundred thirty seven only) is keeping as committed expenditure towards equipments and accessories.

Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20-205

Auditor/ Chartered Accountant/
Accountant General

12/11/15

Head of the Institution

Registrar
Tezpur University

FORM-III

UTILISATION CERTIFICATE

For the period **2015-2016** (Up to **31st March, 2016**)

Certificate that Grant-in-aid of **Rs.5,60,875.00** (**Rupees Five Lakhs Sixty Thousand Eight Hundred and Seventy Five only**) sanctioned by the **Government of India, Department of Atomic Energy, Mumbai- 400 001** vide their letter No. **34/14/24/2014-BRNS/10513** dated **19th June, 2015** and received on date(s) **18/03/2016** for the year(s) **2015-2016** and **Rs. 21,22,937(Rupees Twenty One Lakhs twenty Two Thousand Nine Hundred and Thirty Seven Only)** on account of unspent balance of previous year (2014-2015) and **Rs. 8417(Rupees Eight Thousand Four Hundred and Seventeen Only** earned as interest during the year **2015-16**. A sum of **Rs. 17, 52,212(Rupees Seventeen Lakhs Fifty Two Thousand Two Hundred and Twelve Only)** has been utilized during the financial year **2015-2016**, leaving an unutilized balance of **Rs. 9, 40,017 (Rupees Nine Lakhs Forty Thousand and Seventeen only** of the said grant as on **31/03/2016** in respect of the Research project viz **"Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"**

Signature& Seal: Principal Investigator
Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20.

Signature &Seal: Head of the Institution
Registrar
Tezpur University

Signature and Seal: Statutory Auditor (Govt.)/ Chartered Accountant/Internal Auditor

FORM-IV

Board of Research in Nuclear Sciences (BRNS)

STATEMENT OF ACCOUNTS (SA) for the financial year **2015-1016** (Up to **31st March, 2016**)

Sanction No: **34/14/24/2014-BRNS/504** Dated: **June 04, 2014**

Sl. No.	1st Year (2014-2015)	Sanctioned	Opening Balance (Brought Forward)	Received	Total (4+5)	Spent	Unspent (Carried Forward)	Remarks
1	2	3	4	5	6	7	8	
1.	Equipment	---	18,00,000	---	18,00,000	14,84,000	3,16,000*	*Committed expenditure
2.	Staff Salaries	3,54,000	50,065	3,54,000	4,04,065	80,000	3,24,065	
3.	Consumables	75,000	40,000	75,000	1,15,000	39,976	75,024	
4.	Travel	50,000	40,000	50,000	90,000	13,647	76,353	
5.	Contingencies	50,000	37,472	50,000	87,472	37,464	50,008	
6.	Overheads	31,875	1,55,400	31,875	1,87,275	97,125	90,150*	*Committed expenditure
7.	**Interest Earned*						8417	
	TOTAL:	**5,60,875**	**21,22,937**	**5,60,875**	**26,83,812**	**17,52,212**	**9,40,017**	

Remarks:

The total cost of integrated S-parameter measurement system at microwave frequencies (DC-18 GHz) is Rs.18, 55,000.00 (Rupees eighteen lakhs fifty five thousand only). Rs.18, 00,000.00 (Rupees eighteen lakhs only) will paid from equipment head and Rs.55, 000 from overhead.

An advance of Rs.14, 84,000 (Rupees fourteen lakhs eighty four thousand only) i.e. 80% of Rs.18, 55,000 has been already paid to the supplier. The rest 10% i.e. Rs.1, 85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid against the installation after the submission of invoice and another 10% i.e. Rs.1, 85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid after 3 years of warranty period.

Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20-20

Finance Officer
Tezpur University

Auditor/ Chartered Accountant/
Accountant General

Head of the Institution
Registrar
Tezpur University

FORM-III

UTILISATION CERTIFICATE

For the period **2016-2017** (Up to **10.11.2016)**

Certificate that Grant-in-aid of –**NIL-** sanctioned by the **Government of India, Department of Atomic Energy, Mumbai- 400 001** for the year(s) **2016-2017** and **Rs. 9, 40,017 (Rupees Nine Lakhs Forty Thousand and Seventeen only)** on account of unspent balance of previous year (2015-2016). A sum of **Rs. 6, 22,842(Rupees Six Lakhs Twenty Two Thousand Eight Hundred and Forty Two Only)** has been utilized during the financial year 2016-2017, leaving an unutilized balance of **Rs. 3, 17,175 (Rupees Three Lakhs Seventeen Thousand One Hundred and Seventy Five only)** of the said grant as on **10/11/2016** in respect of the Research project viz **"Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"**

Signature& Seal: Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20-205

Signature &Seal: Head of the Institution
Registrar
Tezpur University

Signature and Seal: Statutory Auditor (Govt.)/ Chartered Accountant/Internal Auditor

FORM-IV

Board of Research in Nuclear Sciences (BRNS)

STATEMENT OF ACCOUNTS (SA) for the financial year **2016-1017** (up to **10.11.16**)

Sanction No: **34/14/24/2014-BRNS/504** Dated: **June 04, 2014**

Sl. No.	2nd Year (2015-2016)	Sanctioned	Opening Balance (Brought Forward)	Received	Total (4+5)	Spent	Unspent (Carried Forward)	Remarks
1	2	3	4	5	6	7	8	
1.	Equipment	---	3,16,000	NIL	3,16,000	1,85,500	1,30,500	*Committed expenditure
2.	Staff Salaries	---	3,24,065	NIL	3,24,065	4,09,377	-85,312	
3.	Consumables	---	75,024	NIL	75,024	18,335	56,689	
4.	Travel	---	76,353	NIL	76,353	520	75,833	
5.	Contingencies	---	50,008	NIL	50,008	9,110	40,898	
6.	Overheads	---	90,150	NIL	90,150	---	90,150*	*Committed expenditure
7.	*Interest Earned*		8417	NIL	8417	---	8417	
	TOTAL:	---	**9,40,017**	NIL	**9,40,017**	**6,22,842**	**3,17,175**	

Remarks:

The total cost of integrated S-parameter measurement system at microwave frequencies (DC-18 GHz) is Rs.18, 55,000.00 (Rupees eighteen lakhs fifty five thousand only). Rs.18, 00,000.00 (Rupees eighteen lakhs only) will paid from equipment head and Rs.55, 000 from overhead.

An advance of Rs.14, 84,000 (Rupees fourteen lakhs eighty four thousand only) i.e. 80% of Rs.18, 55,000 and Rs. 1, 85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) i.e. 10 % of Rs. 18, 55,000.00 against the installation has been already paid to the supplier. The rest 10% i.e. Rs.1,.85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid after 3 years of warranty period.

Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"
DEPARTMENT OF PHYSICS
TEZPUR UNIVERSITY
R & D Reg. No. DoRD/Phy/NSB/20-205

Finance Officer
Tezpur University
Auditor/ Chartered Accountant/
Accountant General

Head of the Institution
Registrar
Tezpur University

FORM-III

UTILISATION CERTIFICATE

For the period **2017-2018**

Certificate that Grant-in-aid of **Nil** sanctioned by the **Government of India, Department of Atomic Energy, Mumbai- 400 001** vide their letter No: **Nil** dated **Nil** and **Nil** were paid on dated **Nil** for the year(s) **Nil** and **Rs. 5, 39,568** (Rupees Five Lakhs Thirty Nine Thousand Five Hundred and Sixty Eight Only) on account of unspent balance of previous year **2016-2017** brought forwarded. A sum of **Rs. 1, 71,594** (Rupees One Lakhs Seventy One Thousand Five Hundred And Ninety Four Only) has been utilized and there is an unutilised balance of **Rs. 3, 67,974** (Three Lakhs Sixty Seven Thousand Nine Hundred and Seventy Four Only) of the said grant as on **31st March 2018** will be adjusted towards the grants-in-aid payable during the next year 2018-**2019** in respect of this Research Project viz **"Studies of ferromagnetic resonance in spinel ferrite & garnets for high power circulators"**.

Signature& Seal: Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of...Circulators"
Department of Physics
Tezpur University
R&D Reg No. DoRE/Phy/BRSB/20

Signature &Seal: Head of the Institution

Registrar
Tezpur University

Signature and Seal: Statutory Auditor (Govt.)/ Chartered Accountant/Internal Auditor

FORM-IV

Board of Research in Nuclear Sciences (BRNS)

STATEMENT OF ACCOUNTS (SA) for the financial year **2017-2018**

Sanction No: **34/14/24/2014-BRNS/504** Dated: **June 04, 2014**

Sl. No.	2nd Year (2015-2016)	Sanctioned	Opening Balance (Brought Forward)	Received	Total (4+5)	Spent	Unspent (Carried Forward)	Remarks
1	2	3	4	5	6	7	8	
1.	Equipment	---	1,30,500	--	1,30,500	--	1,30,500	*Committed expenditure
2.	Staff Salaries	--	1,13,753	--	1,13,753	1,25,000	-11,247	
3.	Consumables	--	54,022	--	54,022	--	54,022	
4.	Travel	--	74,863	--	74,863	13,567	61,296	
5.	Contingencies	--	67,863	--	67,863	13,964	53,899	
6.	Overheads	--	90,150*	--	90,150*	19,063	71,087	*Committed expenditure
7.	*Interest Earned*		8417	--	8417	---	8417	
	TOTAL:	---	**5,39,568**	--	**5,39,568**	**1,71,594**	**3,67,974**	

Remarks:

The 10% of total cost of integrated S-parameter measurement system at microwave frequencies (DC-18 GHz) i.e. Rs.1, 85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid after 3 years of warranty period.

Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of.. Circulators"
Department of Physics
Tezpur University
R&D Reg No. DoRD/Phy/NSB/20

Auditor/ Chartered Accountant/
Accountant General

Finance Officer
Tezpur University

Head of the Institution

Registrar
Tezpur University

FORM-III

UTILISATION CERTIFICATE

For the period **2018-2019 (upto 30th June 2018)**

Certificate that Grant-in-aid of **Nil** sanctioned by the **Government of India, Department of Atomic Energy, Mumbai- 400 001** vide their letter No: **Nil** dated **Nil** and **Nil** were paid on dated **Nil** for the year(s) **Nil** and **Rs. 3, 67,974** (Rupees Three Lakhs Sixty Seven Thousand Nine Hundred and Seventy Four Only) on account of unspent balance of previous year **2017-2018** and **Rs. 11,039** (Rupees Eleven Thousand and Thirty Nine Only) earned as interest. A sum of **Rs. 70,673 (Rupees Seventy Thousand Six Hundred and Seventy Three Only)** has been utilized and there is an unutilised balance of **Rs. 3,08,340 (Three Lakhs Eight Thousand Three Hundred and Forty Only)** of the said grant as on **30th June 2018** will be surrendered to the Government.

Remarks:

The 10% of total cost of integrated S-parameter measurement system at microwave frequencies (DC-18 GHz) i.e. Rs.1, 85,500/- (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid after 3 years of warranty period from the unutilised balance of **Rs. 3,08,340**.

Signature& Seal: Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of...Circulators"
Department of Physics
Tezpur University
R&D Req No DoRD/Phy/NSB/20

Signature &Seal: Head of the Institution

Registrar
Tezpur University

Signature and Seal: Statutory Auditor (Govt.)/ Chartered Accountant/Internal Auditor

FORM-IV

Board of Research in Nuclear Sciences (BRNS)

STATEMENT OF ACCOUNTS (SA) for the financial year **2018-2019 (upto 30th June 2018)**

Sanction No: **34/14/24/2014-BRNS/504** Dated: **June 04, 2014**

Sl. No.	2nd Year (2015-2016)	Sanctioned	Opening Balance (Brought Forward)	Received	Total (4+5)	Spent	Unspent (Carried Forward)	Remarks
1	2	3	4	5	6	7	8	
1.	Equipment	---	1,30,500	--	1,30,500	--	1,30,500	*Committed expenditure
2.	Staff Salaries	--	-11,247	--	-11,247	--	-11,247	
3.	Consumables	--	54,022	--	54,022	50,751	3,271	
4.	Travel	--	61,296	--	61,296	--	61,296	
5.	Contingencies	--	53,899	--	53,899	--	53,899	
6.	Overheads	--	71,087	--	71,087	19,922	51,165	*Committed expenditure
7.	*Interest Earned*		8417	11,039	19,456	---	19,456	
	TOTAL:	---	**3,67,974**	--	**3,79,013**	**70,673**	**3,08,340**	

Remarks:

The 10% of total cost of integrated S-parameter measurement system at microwave frequencies (DC-18 GHz) i.e. Rs.1, 85,500.00 (Rupees One Lakhs Eighty Five Thousand and Five Hundred only) will be paid after 3 years of warranty period.

Principal Investigator

Principal Investigator
BRNS-DAE Project
Title "Studies of...Circulators"
Department of Physics
Tezpur University
R&D Reg No. BCRD/Phy/BNS/2014

Auditor/ Chartered Accountant/ Accountant General

4/9/18
Finance Officer
Tezpur University

Head of the Institution

4/9/18
Registrar
Tezpur University