DR. FNA 30/5/23

OFFICE OF THE DEAN ACADEMIC AFFAIRS
RAJASTHAN TECHNICAL UNIVERSITY

AKELGARH, RAWATBHATA ROAD, KOTA-324010
Ph-0744- 2473015, website : www.rtu.ac.in, email : dean.academic@rtu.ac.in

RTU/Acad./F(17)14/2023/ 1042-43 **Date: 23.05.2023**

Principal/Director
Swami Keshvanand Institute of Technology Management & Gramothan
Ramnagaria, Jagatpura,
Jaipur-302017

Sub: Recognition of Centre of Excellence in **Antenna Microwave and RF Engineering.**
Ref.: Your proposal dtd. 11.03.2022.

With reference to University call for proposals for establishment of Centre of Excellence, your application for recognition of Centre of Excellence in the area of **Antenna Microwave and RF Engineering** was considered. On the recommendation of Expert Evaluation Team and subsequent approval of 75th Board of Inspection vide agenda no. 75.3.1, University recognised the Centre of Excellence in the area of **Antenna Microwave and RF Engineering** at your institute from session 2022-23.

Further, BOI has not approved the COE proposal for Solar and Biofuel Research for Sustainable Future.

The operation of Centre of Excellence would be governed under the Guidelines for Establishment, Recognition and Operation of COE approved in 74thBOI vide agenda no. 74.4 and subsequently amended time to time.

(**Prof. D.K. Palwalia**)
Dean, Academic Affairs

C.C.to:
PS to HVC

(**Diwakar Joshi**)
Dy. Registrar, A/A

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

A

Report on

Centre of Excellence for Antenna, Microwave and RF Engineering (CoE-A,M & RF)

(Academic year: 2023-24)

Department of Electronics & Communication Engineering

TABLE OF CONTENTS

1. Introduction

The Centre of Excellence for "Antenna, Microwave and RF Engineering" (CoE- A,M & RF) at SKIT, Jaipur, has been established under the recognition and guidance of Rajasthan Technical University (RTU), Kota in May, 2023. It is a facility dedicated to advancing knowledge, expertise and innovation in the field if wireless communication and electromagnetics. The main purpose of this center of excellence is to help students, researchers and academicians to know many things about antennas and microwave components used in communication system.

CoE has a strong team of faculties and staff members with extensive experience working on various areas related to design, simulation, analysis, fabrication, integration and testing of advanced microwave components and antennas for communication, navigation and sensor applications. Also CoE has well equipped infrastructure facilities comprising of both hardware and software.

Experts from the reputed institutes and industries are periodically invited to give expert lectures/demonstrations to the students /faculty members on the latest developments in the field. Students are given exposure to industries by industrial visits and industrial training sessions. FDPs, Conference, Short Term training programs and workshops for benefits of faculties, students and research fellows are conducted under the aegis of CoE.

2. Vision, Mission and Objectives of CoE- A,M & RF

Vision

To emerge as globally recognized center for training, research and product innovation & development in the field of RF, antennas and microwave to meet the socio-economic needs.

Mission

To empower undergraduates and postgraduates by imparting quality training, research, collaborations with industries, product design & developments in the field of wireless communication and electromagnetic; and preparing them to be competent in dealing with industrial and societal challenges.

Objectives

The CoE – “Antenna, Microwave and RF Engineering” is committed to achieving the following objectives:

1. Research Excellence: To conduct quality research that advances the frontiers of antenna,

microwave, and RF engineering; addressing key challenges and driving innovation.

2. Education and Training: To provide quality education and training programs by involving experts and professionals in these fields.

3. Industry Collaboration: To collaborate with industries and Institutes, fostering the development of practical solutions and technologies with real-world applications.

4. Technology Transfer: To facilitate the transfer of knowledge and technology from our research endeavors to benefit society and industry.

5. Global Leadership: To establish this CoE as a global leader in antenna, microwave, and RF engineering; contributing to the growth and advancement in these fields.

3. List of mentor faculties associated with COE

S.N.	Name of mentor faculty	Designation	Qualification	Expertise details in Relevant COE	Experience (in years) (Teaching and Industry)
1	Prof.(Dr.) Mukesh Arora	Professor	B.E, M. Tech, Ph.D	Wireless communication and Antennas	20
2	Prof. (Dr.) Satish Kumar Bhatnagar	Professor & Director (Research)	Ph.D	Wireless communication and Antennas	50
3	Dr. Braj Raj Sharma	Professor and Head, Physics Department	M.Sc. (Physics), Ph.D.	Microstrip Patch Antennas	20
4	Dr. Monika Mathur	Professor & PG Co-ordinator	B.E, M. Tech, Ph.D	Microstrip antenna designing	17
5	Dr. Shubhi Jain	Associate Professor	B.E, M. Tech, Ph.D	Microstrip antennas, metamaterials	12
6	Dr. Komal Sharma	Associate Professor	M.Sc., Ph.D.	Microstrip Patch Antennas	22

7	Dr. Suman Sharma	Associate Professor	B.E, M. Tech, PGDBA, PhD	Wireless communication and Antennas	14
8	Dr. Pallav Rawal	Associate Professor	B.Tech., M. Tech, PhD	Reconfigurable Antennas	13
9	Ms. Rajni Idiwal	Assistant Professor	B.E, M. Tech, PhD*	Optical antenna	13
10	Mr. Harshal Nigam	Assistant Professor	B.E, M. Tech, PhD*	Phased array antennas	9
11	Dr. Pawan Kumar Jain	Assistant Professor	M.Sc.,PhD*	Microwave Electronics, Microstrip Patch Antenna	18
12	Ms. Gloria Joseph	Assistant Professor	B.Tech., M. Tech	Photonics, optical antenna	12
13	Mr. Sunil Lakhawat	Assistant Professor	B.Tech., M. Tech	Digital communications	11
14	Mr. Dinesh kumar	Assistant Professor	B.E, M. Tech, PhD*	PCB designing and fabrication	14

4. Support staff details

S.No.	Name of support staff	Designation	Qualification	Expertise details in Relevant COE	Total Experience (in years)
1	Mr. Dhurendra Singh	Technical Assistant	B.Tech.	PCB designing, Software Handling	14
2	Mr. Prema Ram	Sr. Technical Assistant	B.Tech.	Project assistance, PCB designing and Software handling	14

5. Infrastructural facilities

I. Major equipment's

S.No.	Name of Equipment	Specification	Year of purchase	Research Application	Total Cost (Rs.)
1	Vector Network Analyzer	Two port handheld VNA from Keysight technologies, Range is 14 GHz	2017	To analyze cables and antennas, field strength measurement, Spectrogram analysis and stimulus response Measurement of fabricated RF and Microwave components, Antenna parameters measurement	14,60,000
2	5G VolTE smart phone training system	Supporting bands: 5G Sub 6 FDD, 5G Sub 6 TDD Networks, along with 4G LTE FDD, 4G LTE TDD, 3G WCDMA, 2G GSM. 6.6" Touch screen TFT LCD full HD.	2024	Study of 5G Smart phone and understanding 5G technology.	1,00,300
3	Automatic Spin Coating machine	Apex Instruments EZspin A1	2022	To deposit photo resist coating for fabrication on substrate	1,89,991

4	Spectrum Analyzer	Caddo 8010, 150 kHz to 1050 MHz	2009	It can be used for measurement of spectrum, Circuit testing, and troubleshooting	1,19,500
5	Proto Cure PCB Curing Machine (Oven)	Maximum allowable PCB size: 250 X 300 mm (10" X 12"), finned heaters with thermostat controls	2007	Table top unit for curing of liquid photoresist	12,375
6	Photoresist dip coating machine	Maximum allowable PCB size: 250 X 300 mm (10" X 12"), Rectangular tank 2 L capacity	2007	Coating of laminates with photoresist	19,923
7	PCB art work film maker	Working area: 250 X 300 mm (10" X 12") with diffused light	2007	Negative making contact printer as well as an Illuminated art work table	15,675
8	PCB double sided UV exposure machine	Maximum size: 250 X 300 mm (10" X 12"), UV tubes: 2X4= 8 Watts	2007	Double sided UV exposure	29,452
9	Microwave USB Power Sensor	Keysight U2000A 10 MHz-18 GHz	2018	To measure microwave power through various microstrip components	2,86,946

II. Major softwares

S.N	Name of Software	Research Application	Total Cost (Rs.)
1	Ansys Academic Teaching HF Package , Version 13,(25users)	To compute basic electromagnetic field quantities, Simulation of high frequency RF and microwave components along with antenna design simulation	9,00,000
2	MATLAB & Simulink R2006a	To simulate different algorithms related to transmission and reception of signals for communication system.	2,15,500
3	MW- 5G toolbox	5G Toolbox provides standard-compliant functions and reference examples for the modeling, simulation, and verification of 5G New Radio (NR) and 5G-Advanced communications systems. The toolbox supports link-level simulation, golden reference verification, conformance testing, and test waveform generation.	1,69,795
4	Lab View Academy standard suite z	It is used for microwave measurements in simplified manner with appropriate step by step explanations of instrument capabilities.	2,76,000

III. Other available infrastructure facilities

S.N	Description of the Infrastructure		Use in Research Center	Total
1	MT 9000	Micowave test bench (Klystron based)	Used for performing measurements of different Microwave parameters	4
2	MT 9001	Micowave test bench (Gunn based)	Used for performing measurements of different Microwave parameters	2
3	NV 9008	MIC Trainer kit	Contains different Microstrip components for measuring their characteristics	1
4	U2000A	Microwave Power sensor	To measure microwave power through various microstrip components	1
5	VS411	VSWR meter	To measure Microwave power and VSWR	2
6	Nvis104	Microwave generator S band	Microwave source to excite microstrip components	2
7	NV102	Klystron power	Microwave source for test bench	1

		supply		
8	NV101A	Gunn power supply	Microwave source for test bench	2
9	HM 5012-2, 150 kHz to 1 GHz	Spectrum Analyzer	It can be used for measurement of spectrum, Circuit testing, and troubleshooting	1
10	Model No. 401-DSO-Scientech 50 MHz, 500 ms/s, Channel-2	DSO	Circuit testing, measurement and troubleshooting	2
11	1. Model No. HM1507-3, 150 MHz, 200 ms/s, Channel -2 (Analog and digital) 2. Keysight DSO 1012 A/ 100 MHz/ two channel	DSO	Circuit testing, measurement and troubleshooting	2
12	Digital microscope	Digital microscope	USB digital microscope magnifier	1
13	Caddo 803/Scientech ST251/ 30 MHz/ Two Channel	CRO	Circuit testing, measurement and troubleshooting	4
14	ScientiFic SM 5081	Milli ohm meter		3
15	ScientiFic SM 5051/ 1 GHz	Frequency counter		5
16	ScientiFic SM 5027	Distortion meter		1
17	Caddo 9302	Digital LCR meter		4
18	ScientiFic SM 5035/ 20 MHz	Pulse generator		1
19	ScientiFic SM 7022/metravi 19 F/Agilent U-1252 A	Digital Multimeter		14
20	ScientiFic SM 5070/caddo 4061/ 3 MHz	Function generator		3
21	VPL –VICT	Universal IC tester		1
22	TI	Project interfacing board	Designing and developing of electronics and embedded systems	5
23	Dynalog/NVIS NV 5001, NV 5002,	Microcontroller development board		6
24	ScientiFic SM 5015	Programmable multiplier		4
25	ScientiFic SM 901/ 30 MHz	Power scope		1
26	Scientech ST-4070,	Power Supply		3

	ST-4077			
27	Scientech ST-2610	Project Board		5
28	TI/ AD58364M-EVM	ADC interfacing kit		1
29	TI	DAC interfacing kit		1
30	TI	GSM modem interface kit		1

IV. List of Consumables

S.N	Item	Quantity	Total Cost (Rs.)
1	Klystron tube 2k25 (2)	2	10400X2= 20800
2	Gunn diode tube (2)	2	10000X2=20000
3	RF Microwave amplifier BXHF1084 Bandwidth 2-20 GHz, high gain: 26dB (1)	1	9000
4	Microwave power detector (1)	1	8000
5	SMA M/M cable (10)	10	1000X10=10000
6	2.92(F) 2 Hole Connector, DC-40GHz	5	5310X5=26,550
7	SMA M/M connector (10)	10	1200X10=12000
8	SMA female connector (10)	10	1000X10=10000

6. Internship organized for B.Tech. ECE students

45- days summer internship was organized for B.Tech. IV sem ECE students from the duration July 19- September 1, 2023 in the field of Antennas, Microwaves & IoTs. Total 16 students participated in this internship. Total 3 hrs per day theory and hands-on sessions were organized in the field of RF and IoTs by the experts in the related fields. Different institutional and industrial visits were also organized in the internship duration. Here are some glimpses of the internship:


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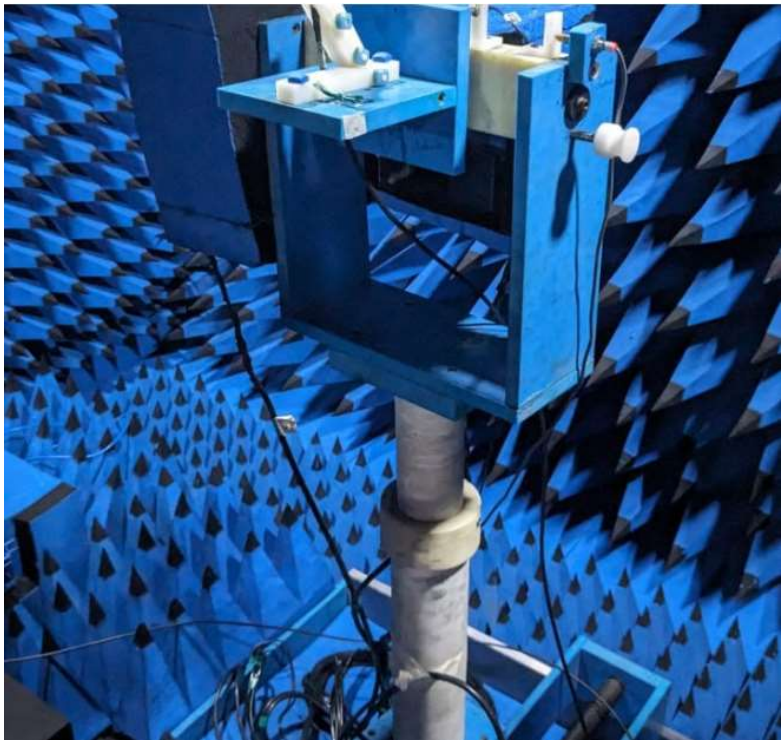


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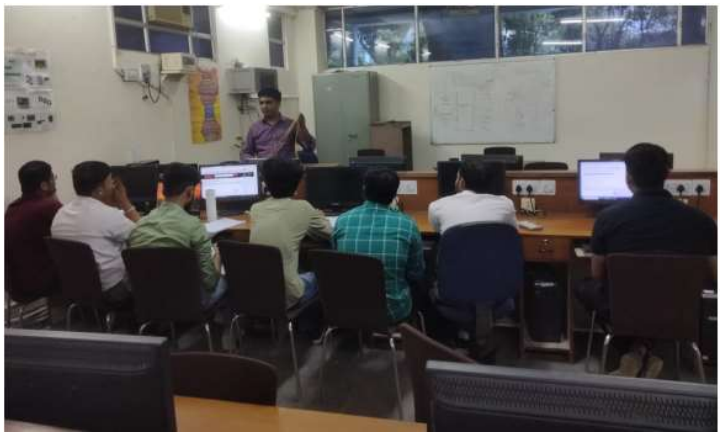


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CERTIFICATE

OF INTERNSHIP

This certificate awarded to

NITIN NAGAR

Of Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

For successfully completing the 45 days summer internship in

Antennas, Microwaves and IoTs

Conducted from 19th July – 1st September, 2023, under the aegis of **Centre of Excellence- "Antenna, Microwave & RF Engineering"**, SKIT, Jaipur.

Prof. Mukesh Arora
Head, ECE

Prof. S.L. Surana
Director(Academics)

Prof. Ramesh Pachar
Principal


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BSNL
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कार्यालय प्रधान महाप्रबंधक
BHARAT SANCHAR NIGAM LIMITED
OFFICE OF THE PRINCIPAL GENERAL MANAGER
BSNL


BSNL
कार्यालय प्रधान महाप्रबंधक
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7. Industry collaborations

Two industry collaborations made with the CoE- A,M & RF, SKIT Jaipur.

I. Jyoti Electronics, India

Jyoti Electronics is a recognized techno-trading house based in India (Ahmedabad), serving the Indian market since 1981 while diversified towards the distribution of RF/Microwave design software & related hardware since 2000.

They provide a complete solution to the design software requirements by bringing industry-standard CAD & EM tools which includes circuit simulation tools, system simulation tools, EM simulation tools and many more. These tools provide the best option to design analyze any electrical or RF component covering the frequency range from statics up to the optical regime.

They have a legacy to provide all sort of spaced qualified components including cables, cable. assemblies, connectors, a wide range of antennas and all test & measurement instruments.

II. Tesca Technologies Pvt. Ltd.

Tesca Technologies Pvt. Ltd. is World's Leading ISO Certified Manufacturer & Exporter of Test, Measuring & Technical Education Equipment. We are Member for Electronics & Computer Software Export Promotion Council, New Delhi, India having sales in more than 85+ Countries Worldwide. Tesca's operations are spread out in 23000 Square Feet encompassing more then 2000 manufactured Innovative Products and Turnkey Project Capabilities for International Tenders. Tesca is an Export House established in December 2009 with our Registered & Corporate Office both set up at Jaipur. They are actively doing business in Middle East, CIS, South East Asia, Africa as well as South America Countries. They do have their representatives in almost all Countries. They are doing projects meant for School Education, Vocational Training, Laboratory, Health Center, Hospital Equipment, Agricultural Modernization, Industrial Modernization, Rural Water Supply as well as Small Scale Enterprises funded by Ministry of Education, World Bank, Asian / African Development Bank as well as GOI LOC.

Areas of collaboration are: Research and development, setup of development boards, student internships, trainings and workshops, placements.

8. FDPs/Workshops/Conferences/ Expert Lecture and Other Events Organized in AY 2023-24 Related to the Field of CoE

S. No.	Academic Year	Title of the FDP/WorkshopsConference/ Expert Lecture	Duration/ Date	No. of participants
1	2023-24	Lecture series on Recent Trends in Electronics and Communications	9-10-2023 to 20-10-2023	61
2	2023-24	International Conference on Advancements in Nano-electronics &Communication Technologies	16-02-2024 to 17-02-2024	192
3	2023-24	Lecture series on Technological Advances in Electronics and Communication Engineerings	19-02-2024 to 23-02-2024	58
4	2023-24	Student workshop on advancement in Communication technology	20-02-2024 to 22-02-2024	61
5	2023-24	Expert talk on Igniting young minds to innovate by Mr. Brijesh Prajapati, ADG (Telecom), Head of DOT, Govt of Rajasthan and Dr. Manish Tiwari, Professor, Manipal Uniersity, Jaipur	11-05-2024	110
6	2023-24	Expert talk on Portable Radar System at the Human Microwave Frontier: Life Activity Sensing & Human Tracking by Dr. Changzhi Li (Texas Tech University USA)	24-04-2024	30

7	2023-24	Expert talk on Millimeter Wave Transreceiver Chips With Antenna in Package by Prof. Quan Xue (South China University of Technology)	22-04-2024	25

9. Selected Publications of AY 2023-24 in the field of CoE

1. **Sharma, S**., & Kumar, M. (2023). Design and Analysis of a 4-Port MIMO Microstrip Patch Antenna for 5G Mid Band Applications. *Progress In Electromagnetics Research C*, *129*, 231-243.

2. Sarabjeet Singh Sethi, Dinesh Kumar, **Lalit Kumar Lata**. An Assessment on the State of Art of Internet of Things (IoT).”in SKIT Research Journal, Vol 13, Issue 1 (2023).

3. **Lata, L**. K., & Jain, P. K. (2023). Bipolar resistive switching behavior and endurance in RF-sputtered bilayer HfO2/ZrO2 resistive random access memory. Emergent Materials, 6(6), 1979-1989.

4. **Harshal Nigam** ,**Abhinandan Jain**,(2023).Alamouti Space Time Coding for 2X2 MIMO Wireless Channels using PSK Modulation Technique,International Journal of Research Publication and Reviews Vol 4, no 4, pp 1829-1835.

5. **Abhinandan Jain**, **Praveen Kumar Jain**, **Neeraj Jain**. Switching Characteristics of a-ITZO Based Thin Film Transistor.” in SKIT Research Journal, Vol 13 ,Issue 1 (2023).

6. **Shubhi Jain**." Prospects of Terahertz Technology –A Comprehensive Review." Journal of Propulsion Technology (2023): 1185-1196.

7. **Shubhi Jain**." Review on Terahertz Technology in Head and neck diseases: Advancement & Challenges.” in SKIT Research Journal, Vol.13,No.2,pp:30-33,October 2023.

8. **Shubhi Jain** ,Shivam Choudhary, **Mamta Jain**,(2023) .How to Combat COVID-19 with Wireless Networks,International Journal of Innovative Research in Science, Engineering and Technology Vol 12, Issue 5.

9. **Shubhi Jain**, Priyanka Jain,(2023).Review on Exploring Innovative Applications for Online Learning,International Journal of Scientific Research in Engineering and Management,Vol7, Issue: 06.

10. **Rawal** and S. Rawat. "A frequency and polarization reconfigurable L-shaped patch antenna with defected ground structure."Transactions on Computer Science & Engineering and Electrical Engineering (D) (2023),Volume 30,(5), pp-1703-1713.

11. Uma Rathore, Jyoti Yadav, **Mukesh Arora**, **Harshal Nigam**, **Suman Sharma** .''A patch Antenna at 2.4 GHz Frequency for Bluetooth." in SKIT Research Journal, Vol 13 Special Issue 3 (2023).

12. **Nigam, H**., & **Mathur, M**. (2023). Design and analysis of multiple beams phased array microstrip antenna for 5G applications. *Engineering Research Express*, *5*(3), 035011.

13. **Shubhi Jain**, Priyanka Jain, Shivam Choudhry "Effects of parasitic elements in Microstrip Patch Antenna" Advancement in Smart Electronics Materials and Communication Technologies. ISBN-978-81-954233-1-6,2023.

14. Kurtulan, E., Mathur, V., Tyagi, P., Vyas, R., & **Sharma, S**. (2023). Bridged concentric circular microstrip patch antenna for C, X and Ku band applications. Materials Today: Proceedings, 74, 392-400.

15. **Rajni Idiwal**, **Harshal Nigam**, **Monika Mathur** . "A Comparative Analysis of Graphene Based Terahertz Reconfigurable Antennas: A Review". Journal of Polymer and Composites, International Conference on Advancements in Smart Electronics, Materials and Communication Technologies (ICASEMCT 2023),Volume 11,pp-44-45.

16. Mirdha V., Bhatnagar D., Saleem S., Sharma B., Jangid Krishan G.,(2023), Circularly Polarized Antenna with Metallic Reflector for High-Gain Satellite Communication; International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC); ISSN: 2321-8169 Volume: 11, Issue: 4, pp 91-97.

17. Mirdha V., Bhatnagar D., Saleem S., Jangid Krishan G., Sharma B. (2023), Circularly Polarized Microstrip Patch Antenna for L Band Satellite Application;; International Journal of Research in Engineering and Science (IJRES); ISSN (Online): 2320-9364, ISSN (Print): 2320-9356; Volume: 11, Issue: 5, pp 867-871.

18. Mirdha, V., Bhatnagar, D., Saxena, V. K., Sharma B., (2023), Circularly Polarized Patch Antenna with Gain Enhancement using Reflector; Proceedings of International Conference on "Advances in Smart Electronics, Materials and Communication Technologies" (ICASEMCT-2023); ISBN : 978-81-954233-1-6; pp 89-91.

10. Selected student Projects in the related field

1. Title of the Project: 5G Innovation

   Students Names: 1. Swati Agarwal, Umang Sharma, Suraj Singh, Utkarsh Khandelwal

   Supervisor: Dr. Neeraj jain

2. Title of the Project: Compact triple band microstrip patch antenna for wireless communication

   Student Name: Nitin Nagar

   Supervisor: Dr. Suman Sharma

3. Title of the Project: X band microstrip patch antenna

   Student Name: Saxam Dixit

   Supervisor: Dr. Suman Sharma

11. FUTURE PLANS

1. External R&D funding
2. Enhance consultancy projects
3. Conduct advanced training on RF design and testing facility for researchers
4. Provide Internship for UG students in designing and testing antenna and RF devices
5. Enhance Research Publications and Patents