

ANNUAL REPORT

2020

**Amity Science, Technology & Innovation
Foundation
(ASTIF)
&
Amity Directorate of Science & Innovation
(ADSI, AUUP)**

**A Journey towards
Research Excellence**

Message from Founder President



It brings me immense pleasure to see that my Universities are scaling newer heights in the research arena through undertaking projects, filing patents, making quality publications, developing and commercializing technologies/ products. These consistent and substantial efforts have led to our Universities being perceived as “Research & Innovation Driven” a dream that I have cherished and realised.

Amity Science, Technology & Innovation Foundation (ASTIF) and Amity Directorate of Science & Innovation (ADSI) are very close to my heart which have been established with the vision to augment, support and nurture the research and innovation initiatives undertaken at Amity. It gives me great pride and happiness to revisit the milestones achieved by my faculty members, scientists, and researchers in the last one year which have been brought out in the 5th Annual report prepared by ASTIF/ ADSI.

Looking into the success achieved in the arena of funded research projects, quality publications, patents filed and granted, I feel that “Innovation” now needs to be given a special thrust. Therefore, I given the mission to each Amitian to aim higher and achieve new milestones by contributing towards the scientific advancement and societal development. I feel immensely proud of all my Vice- Chancellors, Pro-VCs, HODs, HOIs, Faculty Members, Scientists and Researchers and every member of the team who is working day and night towards building meaningful collaborations and creating synergies for making my dream a reality. This year all of us have to increase our efforts multifold compared to previous years to achieve the targets set for ourselves at Individual, Institutional and University level and must strive to make our knowledge, technologies and products available to the society for meeting the industrial and societal needs.

I would appeal to you all to make this Innovation Year a memorable one and contribute in enhancing the share of Amity in National growth. My heartiest congratulations for moving in the right direction to achieve our goals and I am confident that with your concerted efforts and determination we can fulfil the Amity group motto of *“Together we can change the world.”*

Dr. Ashok K. Chauhan
Founder President
Ritnand Balved Education Foundation

Preface

With utmost pleasure, I would like to put forth the Fifth Annual Report of Amity Science, Technology & Innovation Foundation (ASTIF) & Amity Directorate of Science & Innovation (ADSI) which gives the glimpse of the major milestones achieved by Amity University in the field of research and innovation during the year 2020 (Jan- Dec). Our deepest gratitude and thanks to Honorable Founder President, Dr. Ashok K. Chauhan for his exemplary leadership coupled with great vision, constant motivation, guidance, support and blessings without which we would not have been able to achieve all these milestones.



I would also take this opportunity to thank Dr. Atul Chauhan, President RBEF, and Dr. Aseem Chauhan, Addl. President RBEF and the entire AKC family who have been the pillar of strength and acted as a force multiplier for Amitians in their endeavor of making Amity the best in the world through research and innovation. ASTIF and ADSI Team gratefully acknowledges the continuous guidance and blessings from all members of AKC Family.

My sincere appreciation and thanks to all the Vice Chancellors, Pro Vice Chancellors, for spearheading the mission and dream of Hon'ble Founder President in their respective campuses through praiseworthy leadership and untiring efforts towards periodic monitoring, continuous motivation and sustained efforts which have led to achieving exponential growth. I would also like to appreciate the efforts put forth by the all Deans, Heads of Institutions, Research coordinators, faculty members and researchers who are taking great strides towards strengthening the research and innovation initiatives. I would like to place on record my appreciation for Ms. Sneha Nair for preparing this report under the able guidance of Mr. S. N. Singh and bringing out the report in its present form with inputs from Dr. Smita Sahu, Dr. Goodwill Khokhar, Dr. Aman Bhatnagar, Ms. Parul Singh, Mr. Sanjai KV, Mr. Benny Thomas, Ms. Jiji Binu and Mr. Devendra Kumar.

Our faculty members and researchers were able to receive 71 projects sanctioned during the year amounting to Rs. 29.58 Crores bringing the number of ongoing projects to 246 in the year 2020. In addition, 5905 publications in journals of repute have been published and 215 patents have been filed in the year. The achievements of 2020 are appreciable as all Amity Universities have performed well under the unprecedented circumstances created in the country on account of wide lockdown due to COVID. I would like to compliment all achievers especially the ones who have worked towards fighting the situation through developing products and technologies.

ASTIF in consultation with all Universities has set a target of 8000+ research publications in Scopus and web of sciences indexed journals, 250 + funded research projects, 500+ patent filing, commercialization of at least 30+ technologies/ products developed by researchers for the year 2021.

All your contributions have made us proud. However, considering the task entrusted by Hon'ble Founder President to make Amity group the topmost contributor in the area of research and innovation, much more need to be achieved. I am sure that as a team we will leave no stone unturned to reach new pinnacles of success and making Amity the best in the world

My best wishes for success in all the future endeavors of Amity group.

Dr. W. Selvamurthy
President, ASTIF & Director General, ADSI

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Preamble

Amity Science, Technology & Innovation Foundation (ASTIF) is the umbrella body of the Amity Education Group for promoting and facilitating research and innovation in science, technology and innovation in all Amity Universities. It was founded by Dr. Ashok K. Chauhan, Hon'ble Founder President in the year 2008 with a vision of making Amity a Centre of Excellence in all Domains of Science & Technology at National and International level through an integrated research and academic endeavors to contribute to the National mission of India emerging as a Knowledge Superpower. Dr. W. Selvamurthy is now the President; Dr. Ajit Varma and Dr. S L Kothari are the Vice Presidents.

The primary objective is to create appropriate research ecosystem, enabling processes to nurture research culture and to undertake research in the frontier areas of Science & Technology leading to quality publications, patents, technology development and commercialization. To meet this objective, state of the Art research infrastructures have been created, both through National and International funds as well as through Amity resources to augment research. Centers of Excellence have been established in niche areas of Science & Technology. In addition, more than 12 research clusters in areas of great national and international importance are effectively functioning to act as force multiplier in Amity Group. ASTIF undertakes a wide spectrum of important activities, such as Talent search, providing Amity Research Fellowship for meritorious scholars, building collaborations, supporting accreditation, and ranking activities thereby creating an enabling ecosystem for research and innovation to blossom at Amity.

Further, Amity Directorate of Science & Innovation was created at Amity University Uttar Pradesh Noida to achieve the mission of placing Amity amongst the topmost global Universities in the field of Science & Technology. The Directorate facilitates and supports faculty members for achieving the targets in terms of Projects, Patents, Publications, Product development, Collaboration etc.

GLIMPSE OF ACHIEVEMENTS 2020

1. Projects:

- A total of 71 projects have been sanctioned/ approved with a funding of Rs. 29.58 Crores.
- **The total number of ongoing projects is 248 with a total funding of Rs. 128.40 Crores**
- **The average cost of the sanctioned projects during 2020 is 63.81 % higher than the average cost of sanctioned projects during previous four years.**

2. Publications: A total of 5905 have been done out of which 3019 are Scopus indexed & 1210 are indexed in Web of sciences. There has been an increase of 21% in publications over previous years.

3. Patents/Copyrights: A total of 215 patents have been filed & 30 patents have been granted. While 31 copyrights have been filed out of which 18 have been registered

4. Technologies Transferred : 6 technologies have been transferred, the details are as shared below:-

Name of the technology/ product	Details
Rootonic, Amity University Uttar Pradesh, Noida	SOM PhytoPharma (India) Limited.
An Antimicrobial Face-Mask Using Nano-particle Coating, Amity University Haryana	Idea for funding to nurture under TIDE 2.0 MeitY G3C
3D Manufacturing of N95 Mask having Inherent Antimicrobial Properties, Amity University Haryana	Idea for funding to nurture under TIDE 2.0 MeitY G3C
Penside Plate ELISA Paratuberculosis Diagnostic Kit, Amity University Rajasthan	Genomix Molecular Diagnostics Pvt. Ltd., Hyderabad
Rapid LFA Paratuberculosis Diagnostic Kit, Amity University Rajasthan	Genomix Molecular Diagnostics Pvt. Ltd., Hyderabad

LAMP coupled LFD Kit for Paratuberculosis Diagnosis, Amity University Rajasthan	Genomix Molecular Diagnostics Pvt. Ltd., Hyderabad
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- 49 National & 32 International MoUs were signed during the year.
- 23 Ramalingaswami re-entry, Ramanujan, DST-INSPIRE fellows are presently working at Amity.
- 142+ awards and 59 fellowships bestowed as the faculty members and researchers of Amity during the year 2020. 69 Amitians have been recognized for their outstanding research contributions. Some of the notable among them are Bet Outstanding Academic Leader National Award, INSA-Young Scientist Medal, ICMR Shakuntala Amir Chand Award, NESATech Green Technology Innovative Award-2020, Fellow of Royal Society of Chemistry, EMBO Fellowship, SERB- Teacher Associateship for Research Excellence.
- The group has organized more than 2482 webinars of global relevance during the year during the lockdown period for keeping its faculty members and researchers updated with recent technological advancement in their field of research.
- In addition to this, 40+ Conferences, Seminars and workshops as well as 193+ FDPs were organized using online mode.
- 9 Honorary Doctorates were awarded to eminent personalities while 33 eminent persons from across the globe were bestowed with Honorary Professorship.
- The research endeavors have been strengthened further through 43 research centers and 20 CoE established across Amity Universe in niche areas.
- Our brilliant and dynamic researchers have also developed technologies and products of great societal impact which includes Hydrogel nanotubes for diabetic wound healing, herbal packaging to reduce post-harvest losses, self-sustained system for generating electricity while remediating wastewater, Folic acid & curcumin conjugate for fighting cancer, POC device for on-spot chromium detection in water, drug delivery system for treating breast cancer, IoT based low-cost ventilator.
- Amitians have also contributed towards "FIGHTING CORONAVIRUS" through developing technologies such as CoronaX : A detection software, Nano based anti-microbial face mask, herbal hand sanitizer, nano herbal inhaler, portable ventilator, RT- PCR based diagnostic system, COVID -19 Kit etc.

- A total of 9 Research clusters have been initiated in areas of great national and international importance for bringing out synergy of ideas and thoughts for enhancing research productivity.
- Global Research Network on Novel Viruses, Amity Global Research Hub at USA, ASTIF German chapter, Amity Global Research Network on Neuro-spine has been established for providing impetus to research and innovation endeavours of the group.
- **Amity Dubai Satellite Ground Station** has been launched at Amity Dubai Campus. 4 cube Amity satellites are under development
- **Mars Amity Research Centre at Ladakh** for planetary research.
- **Four Amity University faculty members in top 2% of global researchers from India, in the list compiled by Stanford University, USA while 12 researchers from Amity University have found their place in the list who have proved their scientific brilliance through extraordinary research accomplishments in India.**

Chapter – 1

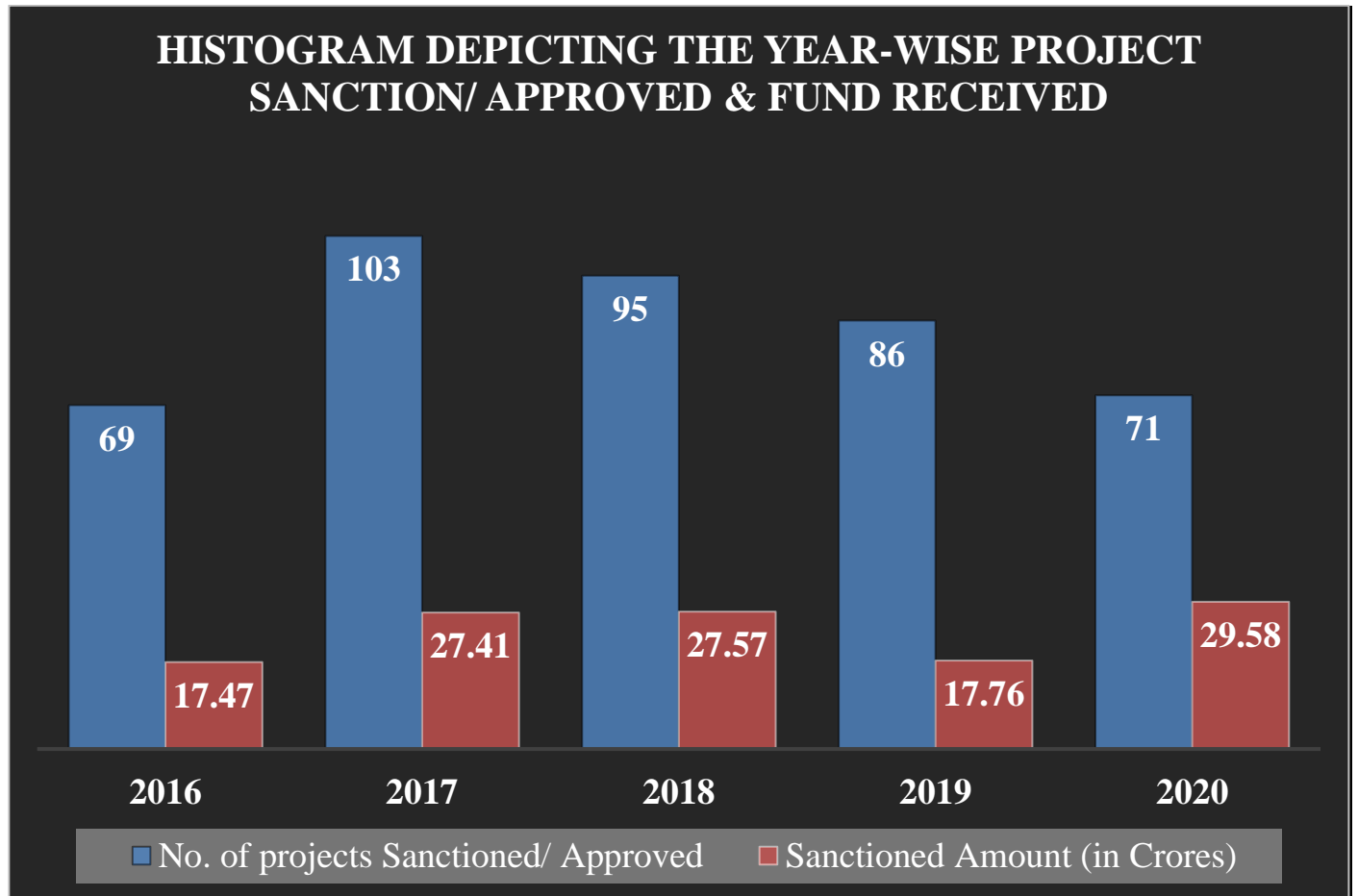
PROJECTS

• FUNDED PROJECTS

- 1.1. Amity University, being conscious of the fact that sponsored research projects play a pivotal role in building a strong research culture amongst the scientists and researchers, lays great emphasis on such funded research projects awarded by National and International organizations for generation and dissemination of knowledge for the benefit of the society.
- 1.2. Amity Foundation for Science, Technology & Innovation Alliances (AFSTIA), Amity Centre for Developmental Cooperation and Alliances (I & II) have been set up exclusively to accelerate the number of submissions of quality proposals through timely identifying funding opportunities and submission of quality proposals by the relevant faculty members; and monitoring formulation of quality research proposals as well as their technical implementation after approval.
- 1.3. Amity Directorate of Science & Innovation (ADSI) facilitates Administrative & Financial Management of sanctioned research projects through an in-house developed software on “Research Project Management System.”
- 1.4. **Despite the impact of Corona virus pandemic and financial restrictions, Amity Universities have been able to submit more than 400 project proposals against various schemes announced by National and International funding agencies and have achieved the distinction of getting 71 projects sanctioned/ approved during the year amounting to Rs. 29.58 Crores.**
- 1.5. **The average cost of the sanctioned projects during 2020 is 63.81 % higher than the average cost of sanctioned projects during previous four years. The total number of ongoing projects in Amity group is 248 amounting to Rs. 128.40 Crores.**

1.6 Funds received for Sanctioned/ Approved projects

	2016	2017	2018	2019	2020
Total No. of projects sanctioned/approved	69	103	95	86	71
Amount in Rupees (Crores)	17.47	27.41	27.57	17.76	29.58
Average budget per project (Lakhs)	25.32	26.61	29.02	25.40	41.63



1.7 The faculty members and researchers from across Amity Universe have made dedicated efforts towards finding solutions towards supporting the Nation in the “**FIGHT AGAINST COVID**” wherein they had submitted more than 200 proposals against various schemes on COVID-19. 9 projects have been sanctioned under the same by various funding agencies.

1.8 Amity has also contributed towards dissemination of knowledge and skill development by organizing training programmes for various organizations. In addition, based on expertise of faculty member, consultancy services have been provided during the year. The funds received by the University for undertaking Consultancy, Training and Skill Development programme for the year 2020 are as under:-

Type of project/ training	Total Number	Funds received in INR
Sanctioned Projects	71	29,58,11,032
Consultancy	31	42,46,473
Training/ Skill development	38	2,80,02,104
Total	140	32,80,59,609

1.9 A number of researchers who have been awarded prestigious fellowships such as Ramalingaswami re-entry fellowship, Ramanujan fellowship, DST-INSPIRE etc have been associated with amity in the past few years. The total number of such fellows working in Amity university campuses is as mentioned below:-

Type of Fellowship	Total
Ramalingaswami re-entry	15
Ramanujan	1
DST- INSPIRE FACULTY	7

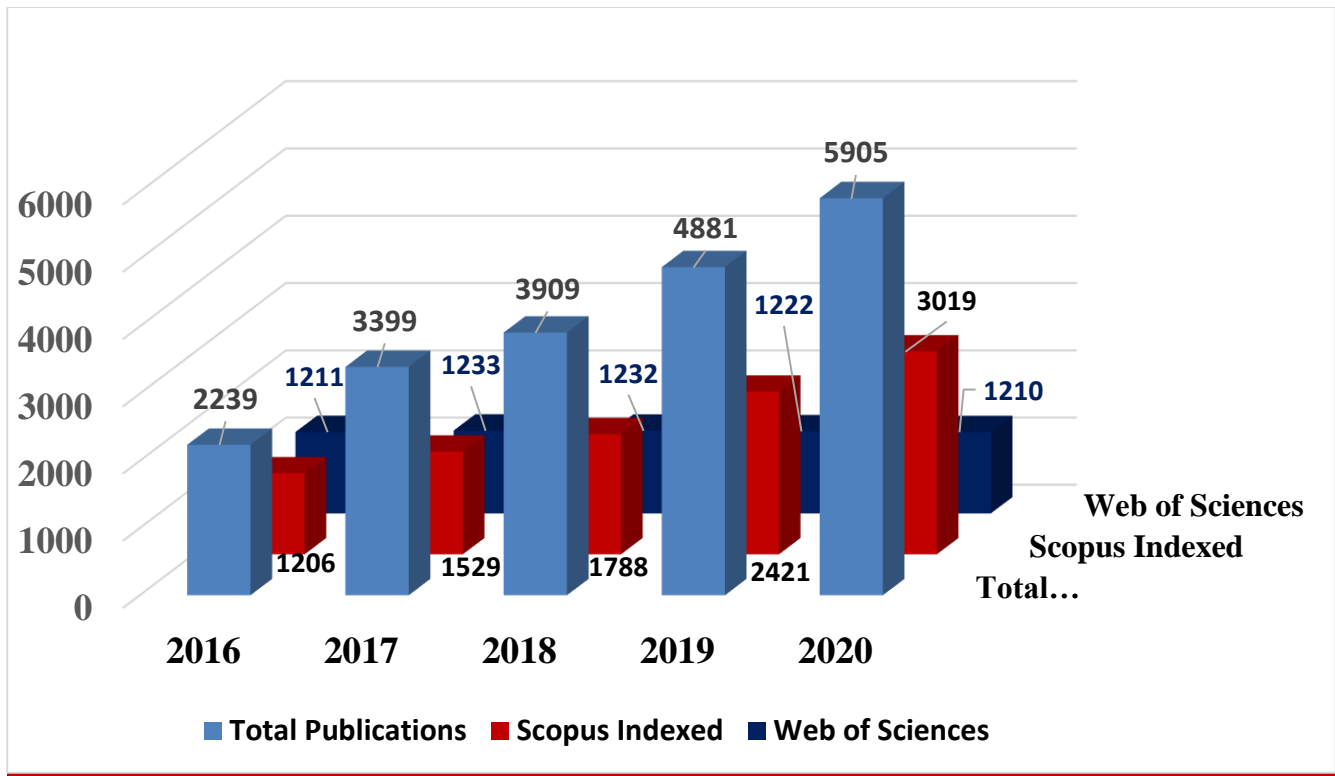
1.10 In addition, a total of 51 Fellows under various projects and fellowships have enrolled in Amity Universe during the year.

Chapter – 2

PUBLICATIONS

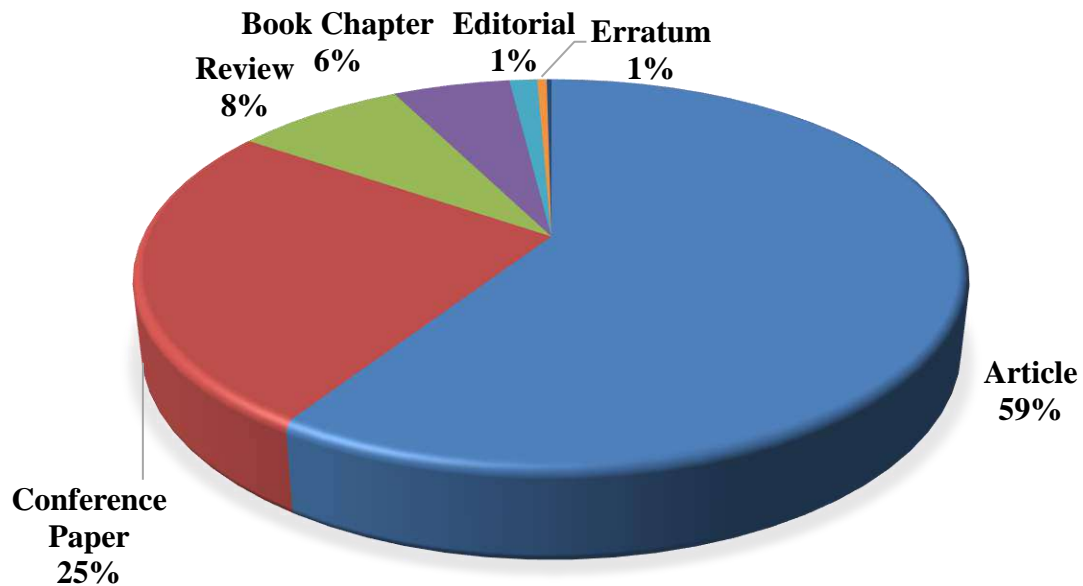
- 2.1 Publication, a mirror image of knowledge generation based on research and its dissemination for societal benefit has been at the core of scientists and researchers of Amity Universities who pursue research activities tirelessly, and publish their work in reputed, peer-reviewed refereed journals indexed in Scopus and web of sciences.
- 2.2 Our aim is to strengthen research and enhance the publications both qualitatively and quantitatively and contribute in strengthening the National position.
- 2.3 **This year a total of 5905 publication, an increase of 21% over previous years have been made, out of which over 160 are having an impact factor ranging from 6.0 to 61.0.**
- 2.4 **A Glimpse of data shared herein gives the summary of the number of Research Papers/ Books/ Book Chapters/ Papers in conference proceedings indicating the growth pattern in the Publication domain.**

	2016	2017	2018	2019	2020
Total No. of Publication	2239	3399	3909	4881	5905
Scopus Index	1206	1529	1788	2421	3019
Web of Science	1211	1233	1232	1222	1210



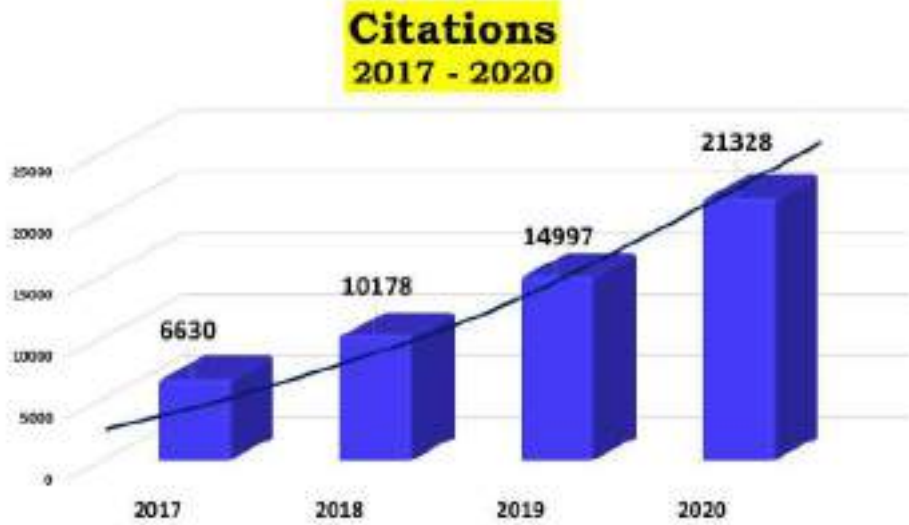
2.5 Analysis of Scopus indexed Publications for the year 2020

- The percentage of the publications document wise such as Articles, Conference papers etc. is given below:-



- The percentage of publications based on their subject is as given below:-

2.6 The citations of research publications by Amity faculty members/researchers as per Scopus for the last 4 years is depicted below:-



Chapter – 3

PATENTS & COPYRIGHTS FILED

3.1 Amity has been credited to be one of the largest patent filing Institution at National level with a **total of 1407 patents** till 31 December, 2020 of which **215 were filed in 2020** itself. Out of these filed patents, **80** have been **granted** so far out of which **30** were granted during **this year itself**. In addition, **31 copyrights** were **filed** out of which **18** have been **registered**.

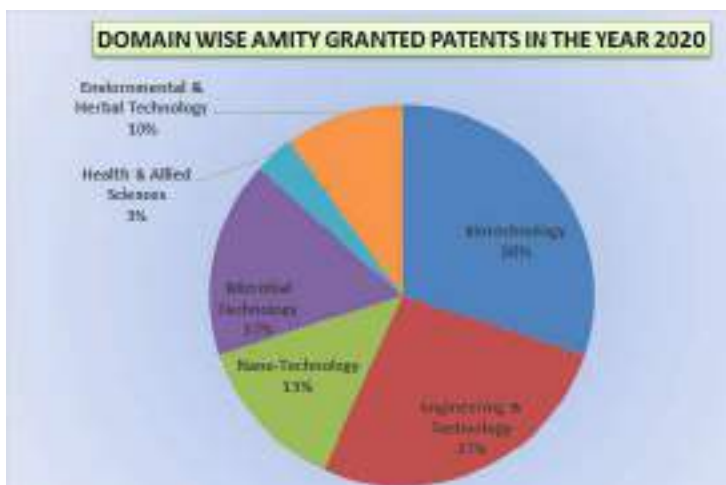
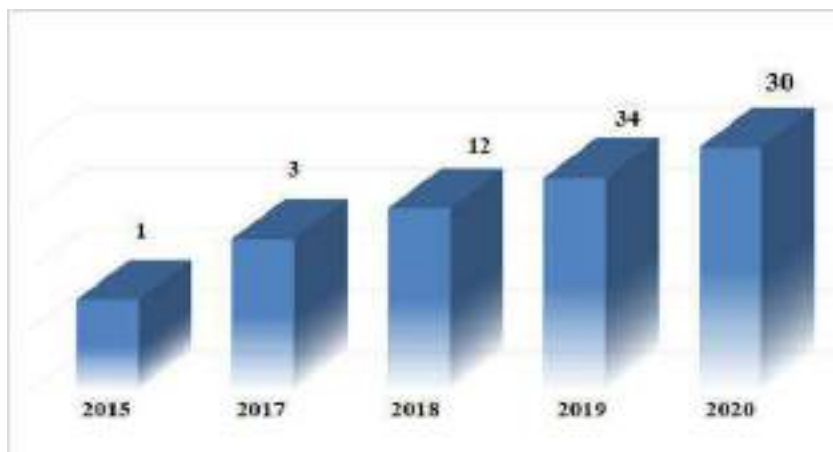
3.2 Graphical representation of Patents filed till date by Amity:-



3.3 The IP Analytics of the Group during the last year is shared below:-

Details	Figures for 2020
Number of Patent Application filed	215
Copyrights filed	31
Copyrights approved	18
Granted patents	30
CAP filed	117
Prior Art/Novelty Search Report	243
RFE's Filed	82
Response to FER	77
Hearing attended	29
NBA filed/Response filed to NBA queries/ NBA Approvals	286

3.6 PATENTS GRANTED: A total of 82 patents have been granted till 31st December 2020 out of which 30 have been granted in the year 2020.



LIST OF PATENTS GRANTED IN 2020 ATTACHED AS ANNEXURE - III

3.7 AMITY COPYRIGHT FILINGS

- **Total Copyrights filed – 65**
- **Total Copyrights registered – 43**
- **Copyrights filed in 2020 – 31**
- **Copyrights registered in 2020 - 18**

Chapter – 4

TECHNOLOGIES TRANSFERRED

In order to bridge the gap between research output of the University and the application of the same in industries, the Directorate of Innovation and Technology Transfer (DITT) has been created which functions as the Industry Interface of Amity University. The vision of DITT is to be an effective interface with the Industry to promote, develop, nurture and commercialize innovative technologies of Amity Universe for the mutual benefit.

4.1A total of 12 technologies have been transferred to the industries out of which the following **6 Technologies** have been transferred for commercialization in the year 2020:-

S.No	Name of the technology/ product	Name of University	Details
1	Rootonic	Amity University Uttar Pradesh, Noida	Technology transferred to SOM PhytoPharma (India) Limited.
2	An Antimicrobial Face-Mask Using Nano-particle Coating	Amity University Haryana	Idea for funding to nurture under TIDE 2.0 MeitY G3C
3	3D Manufacturing of N95 Mask having Inherent Antimicrobial Properties	Amity University Haryana	Idea for funding to nurture under TIDE 2.0 MeitY G3C
4	Penside Plate ELISA Paratuberculosis Diagnostic Kit	Amity University Rajasthan	Technology transferred under DBT-BIRAC project to Genomix Molecular Diagnostics Pvt. Ltd., Hyderabad. Technology under manufacturing scale validation at different Reference Laboratories.
5	Rapid LFA Paratuberculosis Diagnostic Kit	Amity University Rajasthan	Technology transferred under DBT-BIRAC project to Genomix Molecular Diagnostics Pvt. Ltd., Hyderabad. Technology under manufacturing scale validation at different Reference Laboratories

6	LAMP coupled LFD Kit for Paratuberculosis Diagnosis	Amity University Rajasthan	Technology transferred under DBT-BIRAC project to Genomix Molecular Technology under in-house industry validation.
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4.2 Some of the technologies which are in pipeline with high potential for commercialization are:

- Cement-Nano Composite coated pebbles-based water purification system for Microbial Decontamination
- Generation of electricity from industrial wastewater and self-cleaning of the same water without external power source
- Herbal Hand Sanitizer and Floor Disinfectant
- Portable Water Purification System
- Hybrid Cooling System for solar modules & panels
- A Portable Ventilator System with Varied Sensing Modes
- Smart Device for maintaining social distance
- Smart Hand Gloves
- Natural polymer-based gelatin free capsules
- A portable device for sewer worker
- Driver Identification System
- Biocompatible and biopolymer based herbal coating for enhancement of shelf life of perishable fruits
- Injection Mouldable Bio-plastic
- New Electronic Smart Device for Maintaining Social Distancing
- Remote identification of toxic gases
- A smart solid lipid nanocarriers loaded with n-Hexadecanoic acid, 9-12-Octadecadienoic acid, Levodopa and Sesame oil for the Treatment of Parkinson's Disease
- Paratuberculosis vaccine
- 4th generation-based dendrimer to combat leishmaniasis.
- Black Carrot based Probiotic Beverage.
- Bioactive Food Packaging Film
- Microbially Enhanced Rehabilitation of Mine Spoiled Land
- Detecting Nerve Agents with the touch of a Finger.
- Microneedle Sensor for Continuous Monitoring of Levodopa: Toward Parkinson Management
- Non-invasive chronic kidney disease nano sensor for point-of-care diagnosis
- Anti-aspergillus potential from quinazoline derivatives
- Anti-Freeze materials for domestic water system.

- Reusable catalyst from fruit waste material for organic transformations
- Monitoring of volatiles adsorbed inside polymer beads containing packets

4.2 To enable technologies to advance the maturity level in order to facilitate its transfer to industry for commercialization a **Technology Enabling Centre (DST-TEC) fully funded by DST has been established in AUUP Noida which is engaged fully in upgrade TRL Level of various technologies and to make them industry ready.**



Inauguration of TEC Office on July 25, 2019

4.4 The Technology Readiness Level (TRL) of the following technologies has been enhanced under this center during the year

S.No.	Title of the Technology
1	Natural polymer-based gelatin free capsules
2	Biocompatible and biopolymer based herbal coating for enhancement of shelf life of perishable fruits
3	Potable Safety Device for Sewer Worker
4	Driver Identification System
5	Injection mouldable Bioplastic
6	Novel endophyte for plant growth promotion

Chapter – 5

AWARDS & FELLOWSHIPS

5.1 Awards and competitive fellowship are reflective of third-party endorsement about the quality and achievements of individuals. Keeping this in view Amity, as a policy keeps encouraging its faculty/researchers and students to participate at National & International forums for research and Innovation as well as Academics.

5.2 In recognition of excellence and outstanding accomplishment in research and Academics, the brilliant and dynamic faculty members of Amity Education Group have been bestowed with more than **142 awards and 59 fellowships/Scholarships** in the year 2020. In addition, **a total of 20 students from Amity have been selected for prestigious BRICS Scholarship**

5.3 Over and above this, 69 faculty members have also been recognized for their outstanding work by various agencies such as, Department of Biotechnology (DBT), Canadian centre of science and education Indian Culinary Federation, International Centre for Excellence in Education and SPACE (India) {Society for Perpetuation of Art, Education Council of India Culture & Education), Indian Institute of Remote Sensing Asian society of Researchers, Hon'ble Editorial Board of the non-profit peer reviewed open access International Journal of Bio Sciences and Technology, Frontiers in Psychiatry - Psychological Therapies, RELO, U.S. Embassy, International Culinary Union (ICU), London UNIVERSITAS VARSOVIENSIS (Warsaw University), Poland etc..

5.4 University wise summary of details of Awards, fellowships and recognition are as under- (details are attached as annexure)

University	Awards	Fellowships/ Scholarship	Recognition
Amity University Noida	28	21	44
Amity University, Haryana	30	3	7
Amity University, Lucknow	23	12	4
Amity University, Madhya Pradesh	18	8	0
Amity University, Rajasthan	15	6	2
Amity University, Mumbai	6	3	2
Amity University, Kolkata	0	2	10
Amity University, Chhattisgarh	17	0	0
Amity University, Jharkhand	04	3	0
Amity University, Patna	1	1	0
Total	142	59	69

Chapter – 6

COLLABORATIONS

6.1 MEMORANDUM OF UNDERSTANDING (MoU) SIGNED

- Amity University has signed a total of **81 MoUs** with **49 National and 32 International** organizations during the year. MoU's signed by Amity Universities includes National Institute of Ayurveda (India), All India Institute of Ayurveda (India) , Institute of Acupuncture and Natural Medicine (India), Lakehead University (Canada), Northeastern University (USA), Arizona State University (USA), Northumbria University (UK) to name a few.
- The scope of all such collaborations sought through these MoUs encompasses collaborative research projects, joint publications, IPR generation, product/technology development, joint PhDs, student exchange/ dissertation/projects, award of Honorary Doctorates/ Professorships, supporting international visits of the faculty, International conference/Seminars/Workshops etc. which leads to synergic enhancement in research & innovation and added to the otherwise increasing visibility, identity, and diverse growth of the Amity Group.

6.2 EVENTS ORGANISED IN 2020

- Amity among various other initiatives for facilitation of cross-fertilization of ideas and thoughts, regularly organizes visits/ lectures for igniting the research acumen of its brilliant and dynamic faculty members/ researchers.
- Outbreak of COVID-19 and nationwide lockdown is a testing phase for all. However, Amity believe that learning never stops. Even during the lockdown period, apart from conducting online classes, the faculty has made great contributions by Webinars in an effort to increase the knowledge of fellow researchers and students as well as to keep them updated about the recent trends in Academia, research and industry. Amity Universities has organized more than **2482 webinars** during the lockdown period.

- In addition, **40+ conferences/ seminars/workshops and 193+ Faculty development programmes/ workshops** organized in the year 2020 for promoting cross fertilization of ideas as well as to build collaboration across Amity Universe.

6.3 HONORARY DOCTORATES/ PROFESSORSHIP

- Amity University has awarded **9 Honorary Doctorate** degree to distinguished achievers from various professions at National and International level for their outstanding research contributions and leadership. In addition, the University has also awarded 33 Honorary Professorship has been awarded to renowned Scientists, Industrialists, Technocrats in the year 2020.

Chapter – 7

RESEARCH INITIATIVES

7.1 Research Clusters:

- Amity to further its initiatives under “Mission Synergy” of bringing together brilliant scientific brains of a related areas of activity on a common platform had implemented a concept of setting up research clusters in the year 2019 wherein more than 50 frontier areas of global and societal relevance were identified with an aim of enhancing the scientific productivity.
- The objectives of these clusters are as follows:
 - a) To promote the connectivity among the experts in particular cluster.
 - b) To give force multiplier effect to the thoughts through interaction of various minds working in a specific area together in functional cluster mode.
 - c) To share latest updates on the cluster regarding the particular research area . Formulation of multidisciplinary integrated projects for submission to the funding agencies.
 - d) To have regular interactions on WhatsApp group specifically and separately created for each cluster.
 - e) To identify advisors from outside Amity for specific research sub clusters, who can interact with members of the clusters on various research activities.
 - f) The following 9 clusters which are socially relevant, national important and globally significant were initiated in the year 2020 for accelerating the expression of ideas and concept emanating in the minds of our faculty members/researchers.

7.2 RESEARCH CENTERS & CENTERS OF EXCELLANCE: Amity University has also established 43 research centers & 20 Centers of Excellence in niche areas. The campus wise list of such centers is shared below: -

Research centers at Amity

a) Amity University Uttar Pradesh Noida

- Amity Food & Agriculture Foundation
- Amity International Centre for Post-Harvest Technology & Cold Chain Management, (AICPHT& CCM)
- Amity Center for Bio Control & Plant Disease Management (ACBPDM)
- Amity Institute of Herbal Research & Studies (AIHRS)
- Amity Center for Extension Services (ACES) (Agriculture)
- Amity Center for Soil Sciences (ACSS)
- Amity Center for Carbohydrate Research (ACCR)
- Amity Center for Spintronic Materials (ACSM)
- Amity Center for Astronomy and Astrophysics (ACAA)
- Amity Society for Nuclear Security
- Sir Richard Robert Center for Genetically Modified Organism
- Amity Institute of Click Chemistry Research and Studies (AICCRS)
- Amity Institute of Water Technology and Management
- Amity Center for Antarctic Research & Studies
- Amity Center for Environmental Health and Sciences
- Amity Mega Center for Natural and Man-Made Calamities
- Amity Centre for Inter-Disciplinary Research (ACIDR)
- Amity CIMA Centre of Excellence
- Centre for VUCA Studies (CVS)
- Amity Centre for Yoga Education, Therapy and Research (ACYTER)
- Amity Centre for Cancer Epidemiology & Cancer Research
- Amity Institute of Indian System of Medicine (AIISM)

b) Amity University Haryana

- CENTRE for BRICS STUDIES
- AMITY University Haryana - Yunus Social Business Centre (AUH-YSBC)
- Amity Centre for Innovation In Education
- Amity Centre for Ocean Atmospheric Science and Technology ACOAST)
- Amity Centre for Air Pollution Control(ACAPC)
- Amity Centre for Big Data and Computational Biology
- Amity Centre for Linguistics Studies
- Nobel Laureate Kailash Satyarthi Centre for Child Rights & Development
- AYUSH-Amity Herbal Garden and Medicinal Plants Distribution Centre
- Centre for Drug Design and Discovery
- Kiran Majumdar Shah Centre of Affordable Innovation
- Amity Centre for Entrepreneurship

c) Amity University Rajasthan

- Amity Centre for Water Studies and Research
- Amity Centre for Ocean Atmospheric Science and Technology
- Amity Interdisciplinary Centre for Climate Research and Policy

d) Amity University Madhya Pradesh

- Centre for Environmental Conservation & Biodiversity Of Madhya Pradesh
- Centre for Detection of Fake News and Disinformation

e) AUUP LKO Campus

- Centre for Media Studies
- Centre for Cyber Forensics and information Security

f) Amity University Chhattisgarh

- Centre for Nanoscience & Nanotechnology

g) Amity University Mumbai

- Centre for Computational Biology & Translational Research (CCBTR)

Centres of Excellence

a) Amity University Uttar Pradesh Noida

- NRDC-Amity Innovation Facilitation Centre
- Amity Center for Entrepreneurship Development
- Quanser Qube Laboratory
- DST- Technology Enabling Center (TEC)

b) Amity University Haryana

- CoE for Stem Cell
- CoE for Financial Analytics
- CoE of Robotics & Artificial Intelligence
- CoE for Bio-Energy and Bio-Fuels
- CoE for Nano Science & Technology
- Centre of Excellence in Indic and Sanskrit Studies
- Amity-GE Health care Centre of Excellence

c) Amity University Madhya Pradesh

- Center of Excellence of Chemical Biological Radiological and nuclear (CBRN) Mitigation
- Centre of Excellence: Gwalior as a Smart City
- Centre of Excellence in Nanobiotechnology and Alternative Medicine

d) Amity University Lucknow campus

- Centre of Excellence For Research-Driven Media Activities
- in Financial Risk Management and Data Analytics
- Centre of Excellence for Photonics and optoelectronics

e) Amity University Chhattisgarh

- Centre of Excellence for Laws Relating to Intellectual Property Rights

f) Amity University Mumbai

- Amity Centre of Excellence in Astrobiology

Chapter – 8

RESEARCH HIGHLIGHTS

Amity University is transforming into “Cradle of Innovation” with a strong focus on development of products & technologies for the benefit of society and working together to transfer technology from “Lab to Land”. Some of the innovations from the portals of Amity are shared here: -

AMITY UNIVERSITY UTTAR PRADESH NOIDA

A) Enhancing agri productivity through Novel root endophyte (Amity Institute of Microbial Technology) – A Biofertiliser

Discovered and named as “ROOTONIC,” which is found to enhance agricultural productivity by strengthening a plant’s ability to withstand environmental challenges – a solution to address food security and thus aids in early seed germination, provides resistance against diseases, improves soil fertility and boosts the growth of the plant. The fungus act as an immune modulator, plant growth promoter, phyto-remediator, and enhances nutritive value, thereby enhancing agricultural yield in many crops including cereals, pulses, horticulture produce, sugarcane and medicinal plants. This technology has been transferred to four industries including a Taiwan based company.



Cultivated plants at high altitude after *ROOTONIC* treatment. Pronounced growth promotion was seen after application as compared to control

B) “DIP DIP” WATER PURIFIER (Amity Institute of Advanced Research Studies (Materials & Devices)

First of its kind, the green technology-based device is cost effective, reusable and easy-to-carry. The Eco-friendly purifier provides around 99% decontamination of microbial load in the treated water. The device has very good reusability and its efficacy remains the same even after 500 uses of the same pebbles within a time span of 6 months. The purifier can kill bacteria faster than conventional UV and filters without requirement of electricity. It can be reused to cleanse nearly 1000 liters of water in a time span of six months and has exhibited long-term antibacterial activity against pathogenic and non-pathogenic bacterial strains. The device is bio-fouling resistant and has been tested and Certified by NABL accredited labs.



C) Ecofriendly Biodegradable Plastic to reduce the environment woes (Amity Center for Carbohydrate Research)

Amity has developed a low cost 100% degradable plastics with Melt Flow Index (MFI) ranging from 8-18 and are durable at temperatures up to 150° C. The price is around Rs. 80/Kg which is equivalent to the petroleum-based plastics. Thickness and strength variation can be customized. An MoU has also been signed with a well-known multi-national company GXT Green Inc., Boston.



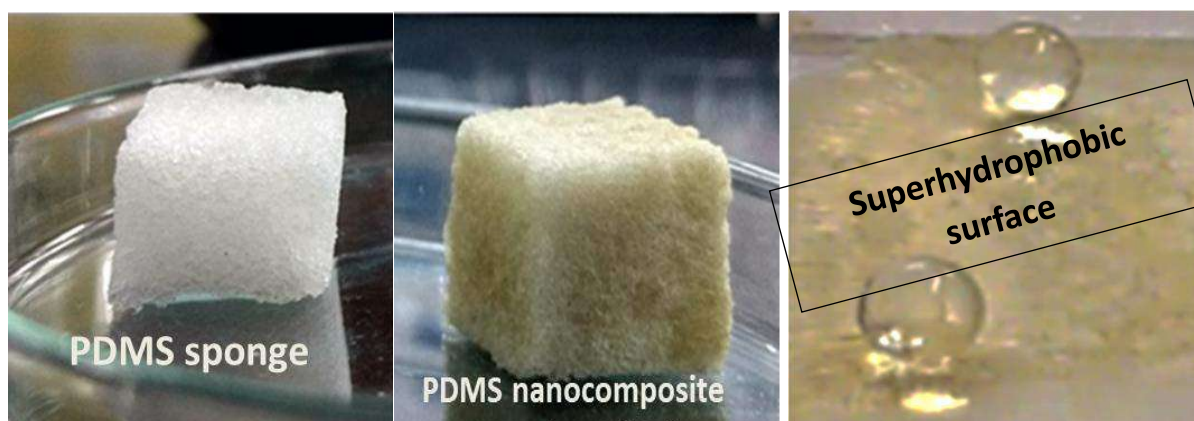
Plastic bags

Granules

Bottles

D) Smart sponges for cleaning of Industrial effluents and pathogens (Amity Institute of Nanotechnology)

A valuable technology for efficient removal of oil, organic pollutant and pathogens from industrial wastewater. The reusable sponges can be used 70 times for oil absorption without much loss in efficiency. The unique nanomaterials incorporated in the sponge to improve efficiency are available in nature abundantly, thus proving to be cost-effective method of manufacturing with long-term durability and reusability. The sponge can remove floating oil/hydrocarbon from water 6 to 13 times its own weight rapidly and efficiently. The product has been tested for removal of Petrol, Diesel, crude petroleum oil and organic pollutants like Benzene, Toluene, Xylene, hexane, etc.



E) Hydrogel nanotubes with ice helices as exotic nanostructures for diabetic wound healing (Amity Institute of Click Chemistry Research & Studies)

Hydrogel nanotubes containing ice in a helical structure have been found to accelerate diabetic wound healing by a multi-institutional team led by researchers from Amity University, Noida. Besides biocompatibility, the hydrogel nanotubes were found to facilitate quicker proliferation and migration of epithelial cells, fibroblasts and keratinocytes to the wound bed. This led to faster wound healing. The hydrogel nanotube can be used as a medicament which can control wound moisture, absorb inflammatory cytokines and dead cells from the wound and form a barrier to microbes. This is also the first report which mentions the existence of ice helix within hydrogel nanotubes. The researchers tested the hydrogel for sustained drug release. Nearly 90% of a drug (benzalkonium chloride) loaded in the hydrogel nanotubes was released over 22 hours.

F) WRAP-IT-UP! Herbal Packaging to reduce post-harvest losses (Amity Institute of Biotechnology)

It is a novel biopolymer based, biodegradable film to extend freshness of fruits and vegetables. It extends their shelf life without reducing the nutritive value. The film is soluble in water and can be easily removed from the surface of the fruits/ vegetables thereby reducing the waste generated from the packaging. This film is a superior substitute to the presently used plastic based cling film or saranwrap for wrapping fruits. This film has been found to enhance the shelf life of banana fruit up to 14 days at room temperature. The physical properties were found excellent as compared to the control (non-coated) banana and nutritive values of coated banana was highly preserved.”



Packing of fruits and vegetables

G) Self -sustained system for Generating electricity while wastewater remediation (Amity Institute of Advanced Research & Studies (Material & Devices)



An innovative technology having huge potential to be used anywhere to clean Industrial wastewater while generating electric power without using any external source or material. The user has to dip two specially designed electrodes made from different materials in the dark coloured industrial wastewater which in turn generates electric power and cleans the water, simultaneously. It is an electrochemical process where cleaning of water is done by its own generated electricity.

H) Fighting Cancer using Folic acid & Curcumin Conjugate (Amity Institute of Molecular Medicine & Stem Cell Research)

Scientists of Amity are working on a triple conjugate bio composition comprising curcumin and anticancer drug conjugated through heterobifunctional linkers that are delivered via the folate receptor to target specifically cancer and cancer stem cells which are responsible for drug resistance and cancer relapse to have maximum therapeutic efficacy.

The method for the synthesis of bioconjugate constitute folic acid –Curcumin – anticancer drug that has been conjugated using acid labile linkers such as Thioimaleamic acid, N-ethoxy benzylimidazole (NEBI), amide, hydrazone linkage etc. involves the conjugation of monoalkyne derivative of curcumin to heterobifunctional PEG such as N3PEG-COOH.

I) Digital Fabrication of Printed Circuit Boards using Inkjet Printing for Industry 4.0 (Amity School of Engineering & Technology)

Scientists from Amity have designed a new PCB prototyping machine, which will be faster and more efficient than both the technologies. Further, it will be more environmental friendly and convenient to use. It replaces the mask lithography process by directly printing the circuit on Copper clad boards through inkjet printing technology. It uses digital inkjet piezo-electric technology (Mask-less) with Drop-On-Demand feature.

The Microfab drop-on-demand print-head is designed for dispensing ink materials at temperatures up to 150°C, which is a unique facility in India. Three national patents have been filed under this project so far:



J) Solar Photovoltaic Panels and Agriculture for Optimizing Land Use (Amity Institute of Advanced Research Studies (Materials & Devices) & Amity Institute of Organic Agriculture, Noida)

Scientists from Amity have conducted extensive research on this Novel application of “AgriVoltaic” Technology which can significantly enhance the economic development of our farmers particularly small and marginal farmers. The research was conducted in a very systematic manner keeping in mind aspects such as optimization of space between two poles of photovoltaic, implementation of pressure at which the water sprinkler has to work, movement of shadows on land, economics of net income which farmers can generate through implementation of Agri-Voltaic system if a farmer possesses one or more acres of land etc. The concept has been selected on priority as one of the two major innovations at the apex level. The team has designed and developed Agri-photovoltaic technology by combining cultivation of food crops and installation of solar photovoltaic panels on the same field. An optimized design of 10KW & 2KW solar power plants on the agricultural land has been developed and tested. This technology can make significant impact on farmers particularly small and marginal farmers who are in large numbers in our country by generating additional income through solar power generated which could be used by farmers for farming as well as own personal domestic use. The rest of the power can be put on grid generating a fixed income every month.



Farm for Agri Voltaic experiments established in AUUP Noida campus

K) E-Nose for rapid detection of toxic gases in manholes (Amity Institute of Advance Research Studies (Materials & Devices))

Amity has developed a low cost, easy to use portable sensor array capable of detecting the poisonous gases like carbon monoxide, hydrogen sulfide, and explosive gas like methane in few minutes. Our complete electronic integrated system shows presence of toxic gases using LEDs and alarms. It also provides information of gases which are present beyond the threshold limit. The innovative system has an in built camera with position tracking system which gives the position and condition of the worker working inside the manhole. The whole device is mounted on the head of the worker which will also provide online status of health and level of toxic gases.



The device helps in detecting the presence of hazardous gases in sewer-pipeline to offer safe access to sewer-pipeline workers so that the human fatalities, which occur due to the toxic exposure of sewer gas components, can be avoided.

L) A novel fluorescent biomarker for precise detection of cancer cells (Amity Institute of Biotechnology)

Cyanine dyes, used as fluorescent dyes belong to the polymethine group and are usually synthesized with reactive groups on either one or both of the nitrogen side chains so that they can be chemically linked to either nucleic acids or protein molecules. Labeling is done for visualization and quantification purposes.

A process has been developed by Scientists of Amity University for the synthesis of AA-dUTP-Cy3/Cy5 analogues from AA-dUTP and Cy3/Cy5-NHS ester. The product is a low cost fluorescent labeling agent and has application in fluorescent labelling of RNA samples and cDNA through incorporation of aa-dUTP during in vitro transcription, which allows sensitive detection of gene expression profiles on microarrays. The biomarker can also be used for precise detection of cancer cells.

M) Amelioration of Alzheimer's using a Novel formulation (Amity Institute of Biotechnology)

Researchers from Amity have developed a novel drug delivery system using rivastigmine-quercetin conjugates for the treatment of Alzheimer's disease. Zebrafish is a reliable model for the study of neurological disorders. The novel conjugate prepared by click chemistry proves to be more effective treating Alzheimer's and is prepared with a formulation which can control bioavailability of the drug increases the potency of the treatment.

N) Hybrid Cooling System for solar modules & panels using forced convection cooling and nano-porous material (Amity Institute for Advanced Research and Studies (Materials & Devices))



The scientists at Amity have recently developed a novel hybrid cooling system to dissipate excessive heat of solar modules / panels and lower the temperature of solar panels. Herein the hybrid cooling system comprises of primarily, the passive cooling using optimized nano-porous materials for thermal cooling in form of specially designed air duct channels, beneath the solar panel with the forced convection cooling system. The novel design herein is of low cost, easy to integrate and with high heat dissipating system. The ultimate heat dissipating layer will have the quality to at least reduce the working temperature of solar modules / panels, during summer session, in the range of about 20oC to even 30oC, which can in-turn increase the existing solar cell's efficiency of 10% to 15%, and may build a positive bench mark for all the PV plants, to work on its own standard efficiency, even in extreme summers.

O) Point of care device for on-spot detection of Chromium in water (Amity Institute for Advanced Research and Studies (Materials & Devices), Noida)

We have developed a colorimetric sensor for detection of chromium using nanotechnology in water and urine/serum samples of patients. The device is a small meter

of a size of mobile phone. It just takes few drops of water and gives the quantity of chromium in water. It is highly useful for an “**Instant detection of chromium**” in water samples.



P) Herbal Mosquito Repellent (Amity Institute of Herbal Research Studies, Noida)

A novel composition for herbal mosquito repellent having pleasant fragrance and long-lasting effect has been developed by Amity researchers. This technology has been licensed to leading manufacturers of incense sticks. The herbal mosquito repellent comprises extracts obtained from aerial parts of *Myxopyrum Smilacifolia* (Chaturamulla). The extracts are processed with suitable natural carrier base and can be used in the form of coils, incense sticks, lotion and ointments. The herbal mosquito repellent comprise base materials that contain herbal ingredients that are safe and effective, pleasantly perfumed, do not irritate the skin and effectively repel mosquitoes. This herbal mosquito repellent has no side effects and is suitable for external application.



PACKAGED PRODUCTS

Q) Herbal Colors (Amity Institute of Phytochemistry & Phytomedicine & Amity Center for Carbohydrate Research, Noida)

Amity Scientists have developed 100% pure, safe, ecofriendly and indigenous herbal colors with absolutely no synthetic or harmful additives, supporting the “Make in India” Campaign of Hon’ble Prime Minister of India. The herbal compositions contain colorants extracted from plants like rhizome of *Curcuma longa*, leaves of *Hibiscus rosasinensis* and seeds of

Bixa orellana and binding agents from Cassia tora, Cassia grandis and Sesbania bispinosa for use in food and cosmetic application. These herbal colors could be used in various Industries such as Cosmetics, Toys, Paints, Pharmaceuticals, Food and other edible items. This revolutionary technology of herbal colors was transferred to a Jaipur based Company- Shubhlaxmi Industries for the use of herbal colors in manufacturing of Gulal. The technology can be used as coloring agent for packaged food such as Meals Ready to Eat.

R) SENSOR FOR DETECTING NITROGEN DIOXIDE GAS

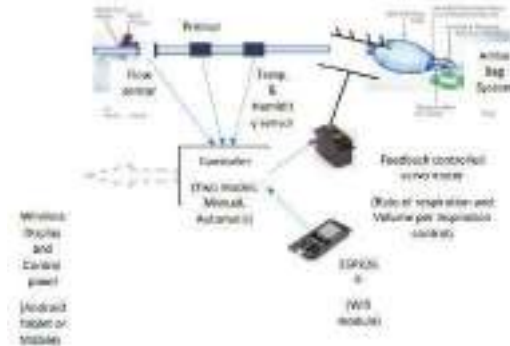
A novel nitrogen dioxide gas detecting film has been developed. The detecting film is based on light emitting conjugated polymer Poly [2-methoxy-5-(3',7' -dimethyloctyloxy) -1,4-phenylenevinylene (MDMO-PPV). **It has been demonstrated for the first time that a thin film of MDMO-PPV deposited on glass substrate or filter paper can be used to sense NO₂ gas by just change in color at room temperature.** It has been observed that the bright orange fluorescence of MDMO-PPV is quenched to yellow in color in the presence of NO₂ gas above 150 ppm level in few minutes. The quenching time is proportional to the concentration of the NO₂ gas. The quenching of the fluorescence of the detecting film after exposure to NO₂ is also studied by absorption and emission spectroscopy. The technology is patented by Amity University



Fig. 1 Photographs of the polymer solution (a), polymer film on glass substrate (b) and polymer film on filter paper (c) before and after exposure to NO₂ gas. In all the cases the original orange color is bleached to pale yellow on exposure to NO₂ gas.

AMITY UNIVERSITY HARYANA

A. *IoT based Low Cost Ventilator*



The ventilator design is customized, especially for the clinical requirement of Covid-19 subject. This ventilator can provide lifesaving oxygen at a rate set by doctor. It has capability to display respiration rate, oxygen moisture and temperature in real time on android display. It uses IoT technology hence can be used at home as well and display may be attached in hospital. Upgrade of this ventilator is under development in which fully automatic feature is being implemented with the help of real time feedback of patient lung parameters.

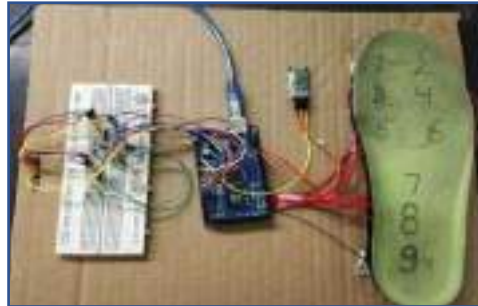
B) Skin Cream with UV-protective (SPF value 37), anti-microbial and skin rejuvenating properties: A team from Amity Institute of Stem cell research and Amity Institute of Pharmacy have developed an affordable, patented skin cream infused with nanoparticles synthesized by green synthesis by Green Chemistry, using Cucumber, that can provide protection from UV-rays of sun lights (with Sun Protective Factor (SPF) value of 37), has anti-microbial properties as well as skin rejuvenating properties

C) AmiPi-Humanoid Robot (Amity School of Engineering & Technology)



AmiPi is an autonomous social intelligent humanoid robot. It can interact with humans through conversation and touch screen. It is designed with human body proportions and developed with 3D printing technology. It is 80cm in height and 2.5kg in weight with 18 degrees of freedom for natural and expressive movements. It uses different machine learning algorithms and artificial intelligence techniques to learn, interact and adapt with humans and surroundings. AD-XL12A Dynamixel servo motors are used for each joint. Raspberry/Orange pi processor is used as a main micro-processing unit for the robot.

D) *Weight Sensing Foot sole* (Amity School of Engineering & Technology)



It provides information about Gait mechanics and has a wide range of applications, i.e. in clinical situations and in sports. Its aim is to help people recover from injury promoting a faster rehabilitation. Various pressure sensitive sensors placed throughout inside the sole, this means that some cross/relationship calculations has made between adjacent sensors. With the data it will be possible to create a real-time pressure map which is displayed to a mobile screen with help of Bluetooth for immediate diagnosis by doctor or/and recorded for later playback.

E) **AgRo-Bot**



Agro-Bot is an advance agriculture robot. The working of an autonomous robot is based on field parameters i.e. length and width. Prototype of an autonomous

Agro-Bot is designed for multitasking such as seed sowing, ploughing and harvesting. It is a four-wheeled vehicle which is controlled by ATMEGA328 microcontroller (Arduino) as master controller, power supply is provided by solar panel which is eco-friendly to the environment. It will also help in decreasing the use of non-renewable sources of energy and will not pollute the environment. Other accessories are slaves performing specific operations. Its working is based on the precision agriculture which enables efficient seed sowing at optimum depth and distances between crops and their rows.

E) Smart Medicine Box



The Smart Medicine Box is a utility box designed for both patients and nurses, it helps them keep track of medication and also reminds them when it is time to take medication or when to refill the empty medicine compartments. This should prove useful especially for patients with Alzheimer's disease or Dementia as they no longer have to keep track of when they have to take medication rather just take or refill medication when the buzzer reminds them to. The box is equipped with an IR sensor which allows the patient to turn off the alarm just by standing in front of the box rather than fiddling around with a button.

F) IoT based Smart Irrigation System

The objective of this work is the development of an **IOT** based Irrigation System. Irrigation system tailors watering schedules and run times automatically to meet specific landscape needs.

These controllers significantly improve outdoor water use efficiencies. Unlike traditional irrigation controllers that operate on a preset programmed schedule and timers, smart irrigation controllers monitor Temperature, Soil condition, Humidity and Rain fall to automatically adjust the watering schedule to actual conditions of the site.



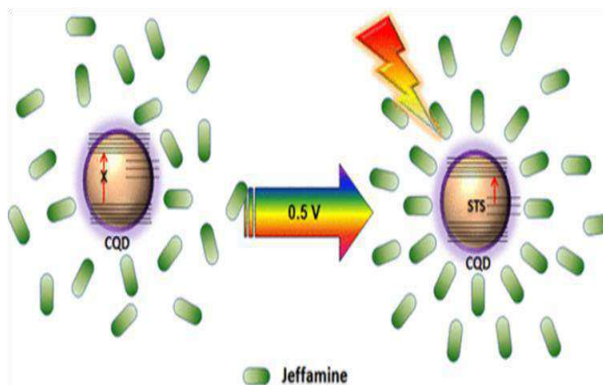
G) *IOT based Smart Parking System*



The IOT based Smart Parking System relies on IR sensors to detect whether a car is parked at a parking slot or not, and this information is updated onto a website/app which a user can access. User is also able to book the slot according to their choice. It provides the user information about the availability of parking slots in real time, and this system can greatly improve the quality of parking facilities as it makes the process easier and convenient for the people.

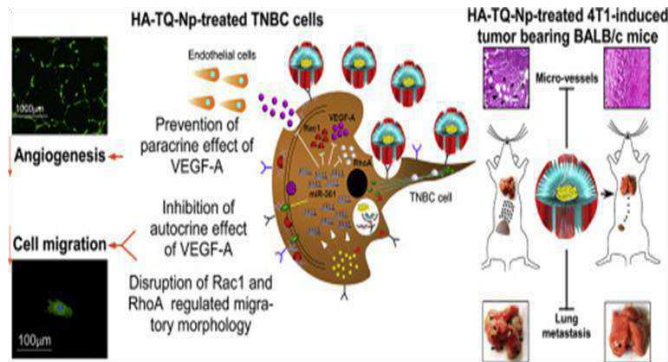
AMITY UNIVERSITY KOLKATA

A) Potential Technology for smart light-sensitive molecular switching devices using quantum dots



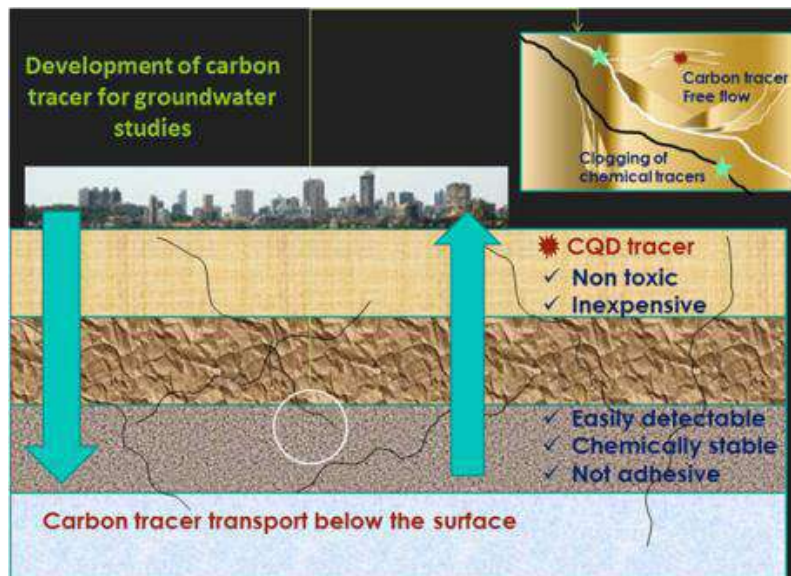
Researchers from Amity Institute of Nanotechnology, have reported the effect of induced polarization on the charge carrier dynamics of carbon-quantum-dot-based nano ionic materials (CQD-NIMs) under simulated solar radiation. The solventless liquid-like CQD-NIMs is composed of polystyrenesulfonate (PSS)-passivated CQD as the core-corona system with a polyetheramine (Jeffamine) forming the canopy. **The concept depicted may be further developed to design smart light-sensitive molecular switching devices.**

a. Drug Delivery system for treating breast cancer



researchers from Amity Institute of Biotechnology have developed thymoquinone (TQ)-loaded, hyaluronic acid (HA)-conjugated Pluronic® P123 and F127 copolymer nanoparticles (HA-TQ-Nps) as a selective drug-carrying vehicle to deliver anticancer phytochemical TQ to TNBC cells. The mean size of nanoparticles was around 19.3 ± 3.2 nm. and they were stable at room temperature up to 4 months. An innovative targeted nano-therapeutic approach is being established to reduce the tumor burden and inhibit metastasis and angiogenesis simultaneously for better

C) Emergence of robust carbon quantum dots as nano-tracer for groundwater studies

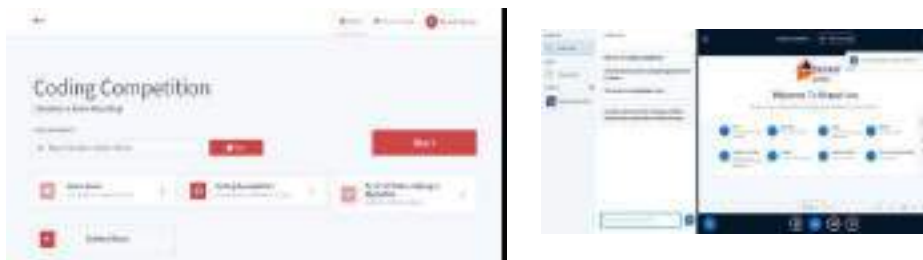


first ever large scale synthesis and testing of carbon quantum dots (CQDs) as hydrogeological tracers. CQDs, as they are now popularly termed, are a new class of environmentally friendly and highly fluorescent nanomaterial mainly used for bio-imaging and catalytic applications. Amity Institute of Nanotechnology have used fluorescence emission and surface functionalization of the CQDs as parameters to study flow of water in simulated laboratory columns and in field. The robustness of the CQDs towards environmental factors has been tested. Comparative tracer results suggested that CQDs may be envisaged as nano-tracers for future hydrogeological investigations.

AMITY UNIVERSITY MADHYA PRADESH

A) Bharat Live Web Conferencing System

Bharat live web conferencing system consists of all the features expected from a commercial application which includes real-time audio and video sharing, presentation of documents and other relevant papers, and screen sharing along with interactive tools like whiteboards accessible by multiple users, Polling system for votes, private as well as group chats to public group, emojis and emoticons and breakout rooms. This application also provides the feature of recording the on-going live sessions which could be viewed and reviewed later as and when the users want.



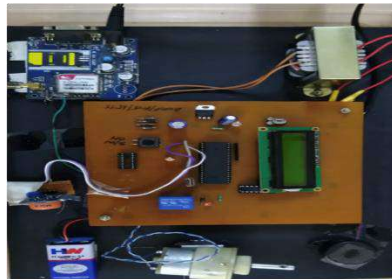
B) BRAKING SYSTEM USING SWIRL MECHANISM

This project introduces a swirl mechanism braking system to solve many problems such as thermal failure, wear and slow responses of the old vehicles braking system. The Mathematical model of the project built to measure the torque of swirl mechanism braking system and analyse the brake forces distribution in between the two types of the braking system. It can be operated easily and reliably with the help of swirl mechanism, to provide appropriate amount of brake orce in a quick response.



C) FACTORY WORKER ALCOHOL DETECTOR WITH MACHINE SHUTDOWN SYSTEM

A system that is intended to protect the factory worker, the machine and safeguard the huge investment of the owner by preventing accident in the factory. This system checks the workers condition regularly to know the drunk state, whether normal or drunk. If he is in drunken condition, then checks the range of drunken value. If it is above the permissible range then the machines will get automatically shut down to prevent any accident, and micro controller alerts the GSM module for sending a message to the person who is responsible for maintaining the particular department.



D) DESIGN AND FABRICATION OF FOLDABLE WASHING MACHINE

The project was developed in two parts i.e., first the use of foldable bellows which is mechanically attached with the sheet metal, the height of the washing machine can be altered by pressing the rubber bellows. Lastly, for covering the motor part up to a small height by using a sheet metal designed component. It will also comprise of the agitator to induce a swirl in the water and clothes for washing.



E) ADVANCED TRAFFIC CONTROL MANAGEMENT SYSTEM

Designed for the better management of the traffic on roads and to reduce the waiting time of vehicles by introducing a sensor network that will adapt to the changing density pattern of vehicles and switch the signals accordingly in real time. Advantages of Advanced Traffic Control Management System

- Reduced traffic on roads.
- Better time management.
- Reduction in environmental pollution.
- Better pedestrian safety.
- Less maintenance cost

F) BASE ISOLATION SYSTEM

- It is explained through an example building resting on frictionless rollers. When the ground shakes, the rollers freely roll, but the building above does not move. Thus, no force is transferred to the building due to shaking of the ground; simply, the building does not experience the earthquake.

Advantages of Base Isolation

- Reduced Floor Acceleration and Inter-storey Drift
 - Less (or no) Damage to Structural Members
 - Better Protection of Secondary Systems
- Prediction of Response is more Reliable and Economical.

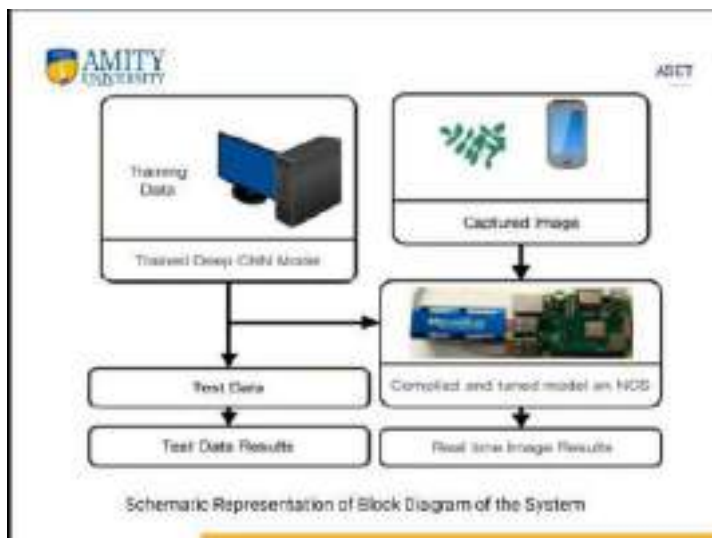
AMITY UNIVERSITY LUCKNOW CAMPUS

A) Computer Based Cognitive Intervention Of Stroke Patients Through PABLO Plus System

There is substantial evidence, till date, on post-stroke cognitive rehabilitation benefits for patients with stroke. Researcher have used PABLO plus system for computer based cognitive intervention as the design of PABLO device is patient friendly as it has position sensors and numerous accessories in place of mouse and key board which opens up incredible flexible therapeutic options in a safe environment for patients of all impairment levels. Till date PBLO plus system has been used only for upper limb exercises as occupational therapy device.

B) Detection and classification the plant diseases like potato in real time with a economical equipment and minimal human efforts. This model presents a real

time deep learning based model for identification and classification of major project diseases with an accuracy of 97.11%.



A.

C) Polyherbal nasal drop and nasal in situ gel for the treatment of allergic rhinitis. Extracts of two dried leaves of *Moringa olifera* and dried ripe fruits of *Embelia ribes* were used. These formulations provide enhanced local affect along with prolonged action.

D) Berberine chloride dihydrate- loaded ethosomal gel for dermatological disorders like dermatitis & psoriasis for transdermal application.

E) Poly-herbal antiaging gel containing extracts of fruits of *Kaitha (Limonia acidissima)*, *Amrakh (Averrhoa carambola)*, *Phalsa (Grewia asiatica)* and *Karaunda (Carissa carandus)* (1:1:1:1). The gel is rich in natural antioxidants like polyphenols and flavonoids.

AMITY UNIVERSITY BIHAR

A) NotesPro App



AMITY UNIVERSITY RAJASTHAN

A. Utilization of Crop Stubble as Alternate Source of Electricity Generation USING Microbial fuel cell

Researchers from Amity Institute of Biotechnology have shown an alternative use of crop stubble like utilization of rice straw for electricity generation through microbial fuel cell. In 10 days experimental set up, the MFC produced the maximum voltage of 0.002 V corresponding to the maximum current of 2.5 mA which results in power output of 0.05 mW.

The experiments results of the study accentuate the significance of biomass by utilizing the rice paddy straw for generating the electricity by means of microbial fuel cells. The electricity generated through crop stubble can be used as a sustainable source of energy in the remote areas. It is also focused on suggesting policies to the government so that air pollution can be minimized in affected areas. This system generates electricity in a very cost-effective manner by using microbial fuel cell (MFC) technology which will help in reducing air pollution and generating the electricity to be used to light the houses in the rural areas.

B. Point of Care Diagnostics (PoCD) for paratuberculosis

Researchers from Amity Institute of Biotechnology have developed Penside Plate ELISA Paratuberculosis Diagnostic Kit, LAMP coupled LFD Kit for Paratuberculosis Diagnosis, and Rapid LFA Paratuberculosis Diagnostic Kit. All these technologies were developed with the collaboration of Genomix Group of Industries.

C. LAMP-coupled lateral flow device (LFD) for rapid detection of paratuberculosis

LAMP primers with biotin and FITC end tags were designed for *IS900* gene specific for MAP. To determine sensitivity of LAMP assay, 10-fold serial dilutions were made from 10 ng/ μ l MAP stock DNA and were compared with PCR. The detection limits of LAMP-coupled LFD were defined and reactions were repeated for reproducibility. The specificity was evaluated using other infectious bacteria such as *M. bovis*, *M. tuberculosis*, *Brucella abortus*, *Leptospira interrogans*, *Yersinia enterocolitica*, *Salmonella typhimurium*, *Listeria monocytogens*, and *Staphylococcus aureus*. A total of 95 samples turned positive for

LAMP-coupled LFD out of 389 fecal samples. All the cultural-positive and PCR-positive samples showed positive in LAMP-coupled LFD. The overall sensitivity and specificity of the LAMP-coupled LFD assays were 100% and 97.02% respectively in comparison with the culture as the gold standard method. The sensitivity detection limit of developed assay was 10 fg/ μ l and specificity was 100%. This assay successfully detected MAP not only by using bacterial DNA but also in clinical fecal samples. The clear band formation at control and test positions was observed on LAMP-coupled LFD. The developed assay is a simple, rapid, easy to perform, and is very useful in early diagnosis of *Mycobacterium avium* subsp. *paratuberculosis* at point of care resource-limited areas.

D. Rapid LFA Paratuberculosis Diagnostic Kit

A simple, inexpensive, rapid and robust point of care (POC) lateral flow diagnostic test kit for serodiagnosis of paratuberculosis infection in bovine cattle and in small ruminant livestock species. We developed a rapid, pen-side lateral flow antibody (Ab) diagnostic test kit for onsite screening of paratuberculosis. The rapid kit detects infection in 20 minutes and can be used directly by a farmer without the requirement of an expert or equipment. 2,502 samples have been evaluated using lateral flow assay (LFA) which included 243 reference sera and 2,259 field samples. The results suggest that the sensitivity and the specificity of LFA were 91.01% and 98.94% respectively in comparison with the gold standard culture, polymerase chain reaction (PCR) and delayed-type hypersensitivity (DTH) methods. Thus, LFA aids to detect the MAP specific antibodies (Ab) in the collected samples at POC resource-limited areas and help the bovine and small ruminant livestock healthcare systems. This assay is well suited for the early diagnosis of MAP in less equipped laboratories and in resource limited POC settings suitable for the Indian environment.

AMITY UNIVERSITY CHHATISGARH

A) Hydrogen gas production by engineered Escherichia coli utilizing crude glycerol and lignocellulosic biomass

- The project is intended to develop zero- emission strategy for the production of green fuel (H₂).
- Waste biomass will be utilized to produce H₂ fuel.
- Low cost fuel production can reduce the cost of H₂ production up to 40-fold compared to present commercial value.
- Metabolic flux engineering technology intended to develop will have application in production of many industrially important chemicals.



B. Development of Electro Coagulation based low cost system for treating arsenic and fluoride containing groundwater in rural area of Chhattisgarh.



The aim of the project is to install a pilot plant in Ambagath block (Tehsil) of Chhattisgarh for removal of arsenic and fluoride from groundwater to provide safe drinking water for rural people.

- A low cost system for the treatment of arsenic and fluoride contaminated ground water
- Prototypes for small scale treatments in smaller societies.
- Bricks from sludge of the process for value addition
- LCA analysis of the whole process.

C. Designing and fabrication of facile molecular systems for synthesizing stable bioactive peptides/proteins with pharmaceutical significance derived from green algae and marine biota.

- Aims to identify novel bioactive peptides/proteins having pharmaceutical significance from marine biota.
- Genetic engineering technology for the synthesis of antimicrobial peptides will be developed.

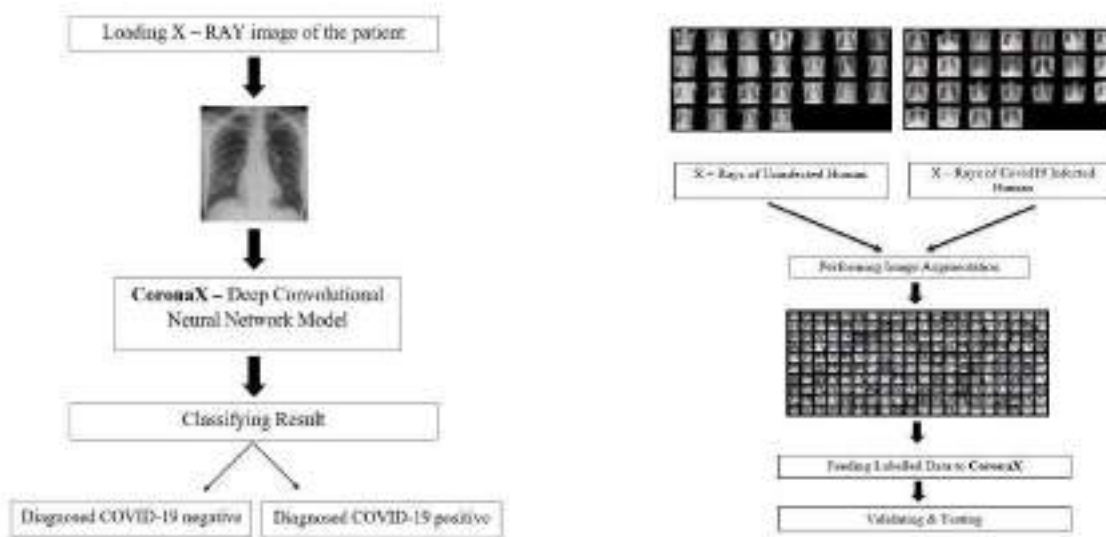
A technology for the development of stabilized peptides by backbone cyclization is proposed to develop in this study



PATENTED TECHNOLOGIES/ PRODUCTS DEVELOPED BY AMITY UNIVERSITY RELATING TO COVID-19

➤ **CoronaX - A Deep Convolutional Neural Network Model for Reliable Detection of SARS- Related Coronavirus (COVID-19)**

In the present scenario, Ms. Ishika Dhall and Mr. Shubham Vashisth (STUDENTS) of Computer Science Department, Amity University Noida under guidance of their faculty Dr Shipra Saraswat have developed a novel method of designing a real time system for efficiently diagnosing COVID-19 to keep a precise record of positive cases so that people who are diagnosed positive can be treated on time and can be prevented from being a carrier of the virus being transmitted to more people with a testing accuracy of more than 90%. The AI based method provides real time system for efficient and reliable detection method for efficiently diagnosing SARS-related coronavirus and keeps a precise record of positive cases so that people can be treated timely and community spread can be prevented



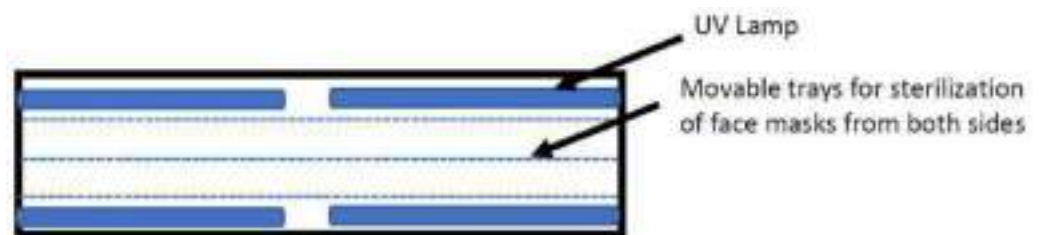
WORKING OF CORONA X

Construction of CoronaX

➤ **ANTIMICROBIAL FACE MASK USING NANOPARTICLE COATING**

Scientists from Amity University Haryana have designed a reusable, affordable, biodegradable, antimicrobial face mask, using nanoparticle coating provided with a portable sterilization unit. The mask is three layered face mask, having an anti-microbial nanoparticle coated cloth layer sandwiched between two untreated cotton cloth layers.

The face mask provides a reusable affordable solution for the masses. A UV chamber is provided for sterilization of these masks before distributing them to the users. **The mask** developed by Dr. Arvind Chhabra, Dr. Monika Vats, Amity University Haryana, Gurugram has replaceable middle layer that can be repurposed for different applications



➤ **Herbal Hand Sanitizer**

An effective and highly useful Hand sanitizer made from herbal extracts has been developed by Dr. Seema Bhatnagar & Dr. V. Pooja from Amity Institute of Biotechnology, Amity University Noida which has proven anti-microbial property and is safe for use in people of all age groups. The hand sanitizer is broad spectrum (effective against bacteria fungi, virus) comprising of herbal extracts having proven efficacy against a wide variety of opportunistic hospital/ airborne pathogens. These extracts have been tested against *Streptococcus* spps, *Staphylococcus aureus*, *E. coli*, *Bacillus subtilis*, *Pseudomonas* spps, *Candida albicans*, *Aspergillus niger* and *Cryptococcus neoformans*. The combined effect of herbal extracts formulated in water base provides broad spectrum anti-microbial potential to the sanitizer. The product has long term shelf life and retains its efficacy is suitable for patients, frontline health professionals as well as for general public.



Hand sanitizer developed by Amity

➤ **Nano based herbal inhaler**

Developed by Dr. Dhruv Kumar, Amity Institute of Molecular medicine and stem cell research, Amity University Noida. The anti-viral herbal inhaler comprising of Nano-gold based herbal nasal cream formulation has been prepared with the herbs known for their medicinal value, The inhaler effectively inhibits the infection and propagation of SARS-CoV-2 through nasal air flow.

➤ **PORTABLE VENTILATOR SYSTEM WITH VARIOUS SENSING MODES**



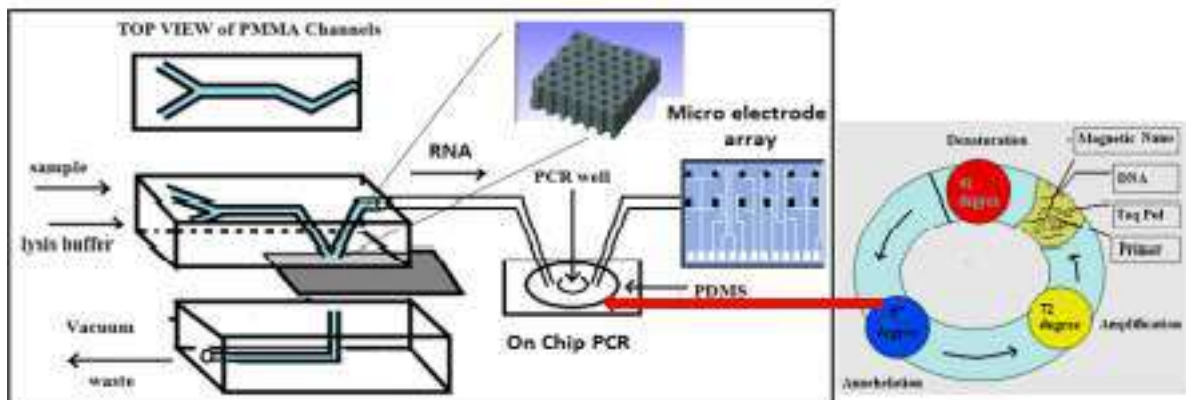
A portable ventilator system with various sensing modes have been designed by a team of brilliant researchers from Amity University Noida. The ventilator system can record all the parameters has an in-built IoT device which can send the data with information of date and time on the server continuously thereby providing real-time information of the patient's vital parameters. The salient features of the instrument includes:-

- Volume and pressure adjustment according to age: Automatic adjustment of breathing according to age.
- Can set number of Breathing per minute
- Can control volume, pressure, temperature, and humidity

- Auto mode to enable the feature for ideal situation.
- Auto mode with oximetry and heartbeat sensor
- Purification of Exhaled gases

➤ **DIAGNOSTIC SYSTEM AND METHOD FOR RAPID DETECTION OF PRESENCE OF ANTIGEN**

Dr. Ranjita Ghosh Moulick from Amity Institute of Integrative Sciences and Health, Amity University Haryana have developed a low cost portable microfluidics embedded on chip rRT-PCR and microelectrode array coupled point-of care optoelectronic device for large scale screening of emerging viral disease like SARS COV2. The electronic diagnostic system which rapidly detects the presence of antigen (analyte) in asymptomatic and presymptomatic persons' body fluid to combat the spread of virological diseases. Large numbers of contagious infected samples could be screened using the technique within a short time on the basis of electrochemical measurement as a result of binding of antigen to the antibody-nanoparticle complex. The diagnostic system does not require high end instrument or trained personnel and is an easier, label-free, cost-effective method to screen huge number of samples within a short time.



➤ **Next Gen diagnostic kit for infectious agents**

An innovative diagnostic kit against infectious diseases and chronic conditions has been developed by Dr. Arvind Chhabra from Amity Institute of Stem Cell, Amity University Haryana.

The kit traps infectious agent/ cells/ biomarker utilizing patient-derived human colvalescent plasma to detect infectious agents (e.g. viral particles) presence in patient samples, whereby

the convalescent plasma of infected patients, who have recovered from the disease, is used as a source of antibody to trap the infectious agents (e.g. viral particles). Pooled convalescent plasma are being used in the assay

➤ **Low cost nano-patterning of graphene to safeguard from viruses and bacteria in facemasks**

Dr. Brijesh Kumar from Amity University Gurugram assessed the antimicrobial activity of nanoparticles (consisting of a mixture of silver nitrate and titanium dioxide) and nanoparticle-coated facemasks to protect against infectious agents. The minimum inhibitory concentrations of the nanoparticles against Escherichia coli and Staphylococcus aureus were also studied. The antibacterial activity of nanoparticle-coated masks was quantified whereby a 100% reduction in viable E. coli and S. aureus was observed in the coated mask materials after 48 h of incubation. Skin irritation was not observed in any of the volunteers who wore the facemasks. Nanoparticles show promise when applied as a coating to the surface of protective clothing in reducing the risk of transmission of infectious agents.

➤ **A SYSTEM FOR DETECTION OF CORONAVIRUS AND THE LIKE BODY SYMPTOMS**

Prof. Ashish Mani from Amity School of Engineering & Technology has developed a device for disinfecting the currency, which is implemented for the perfect solution for the banks and high transaction places. The device includes a real-time screening of Covid19 patients using multi-factor sensing including X-Ray imaging, Thermal monitoring and Video Analysis. The suitably positioned X-Ray machine interfaced with Artificial Intelligent based interface screening system, which receives precise X-Ray images, Thermal Images and Videos in real time, processes and classifies in real-time with very high accuracy. It can be installed at entry points of places of Mass gatherings like Universities, Malls, Metro Stations and Airport etc. The system will allow entry to persons only if the multifactor sensing clears that individual on all factors and this is achieved with intelligent decision making. It would be equipped with facial recognition biometrics and card / mobile based identifier and will inform the condition on a centralized database for reporting to various stake holders about suspected cases.

➤ **.FLOOR DISINFECTANT**

Dr. Seema Bhatnagar & Dr. V.Pooja have developed a floor disinfectant that cleans and deodorize floor surface, removes dirt, disinfects, deodorizes and kills the pathogenic

microorganisms, removes greasy and tough stains on floors and tiles that keep away flies and insects. Floor disinfectant is suitable for wet mopping and restroom surface cleaning. However, with little variation in the dilutions of concentration of active ingredients according to the requirement/demand of disinfectant application. It is suitable for large area sanitization and sterilization for surfaces like glass, ceramic, wood, textile, etc.



In-vitro antimicrobial Test Results

➤ Covid-19 kit, with ‘smart’ gloves, wearables

To protect people from Covid-19, Dr. V.K Jain have led a team of students to come up with a handy low-cost and low-powered battery operated kit that contains an electronic smart device for maintaining social distancing, smart gloves with a self-sanitising system, and an electronic device to keep one’s hands away from the face. the kit would cost about Rs 500. The electronic smart device helps the user maintain a social distance of six feet from others. It has a buzzer and a light alarm and it warns the user if the six feet distance is breached. The radio frequency based device can be worn as a wrist band and has chargeable batteries.

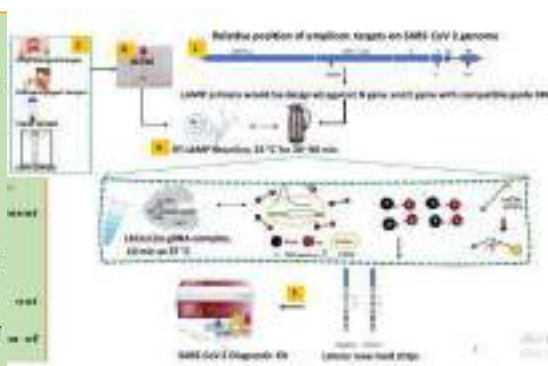
➤ **Identifying Multitargeted Agent Against SARS CoV-2: An integrated Computational Approach by Prof. Rajendra Prasad, Dr. Ravi Datta Sharma, Dr. Amresh at Amity University Haryana**

Spike glycoprotein, a class I fusion protein harboring the surface of SARS CoV-2 (SARS-CoV-2S), plays a seminal role in the viral infection starting from recognition of the host cell surface receptor, attachment to the fusion of the viral envelope with the host cells. Spike glycoprotein engages host Angiotensin-converting enzyme 2 (ACE2) receptors for entry into host cells, where the receptor recognition and attachment of spike glycoprotein to the ACE2 receptors is a prerequisite step and key determinant of the host cell and tissue tropism. Binding of spike glycoprotein to the ACE2 receptor triggers a cascade of structural transitions, including transition from a metastable pre-fusion to a postfusion form, thereby allowing membrane fusion and internalization of the virus. From ancient times people have relied on naturally occurring substances like phytochemicals to fight against diseases and infection. Among these phytochemicals, flavonoids and non flavonoids have been the

active sources of different anti-microbial agents. We performed molecular docking studies using 10 potential naturally occurring compounds (flavonoids/non-flavonoids) against the SARS-CoV-2 spike protein and compared their affinity with an FDA approved repurposed drug hydroxychloroquine (HCQ). Further, our molecular dynamics (MD) simulation and energy landscape studies with fisetin, quercetin, and kamferol revealed that these molecules bind with the hACE2-S complex with low binding free energy. The study provided an indication that these molecules might have the potential to perturb the binding of hACE2-S complex. In addition, ADME analysis also suggested that these molecules consist of drug-likeness property, which may be further explored as anti-SARS-CoV-2 agents.

➤ **On-spot diagnostic kit for COVID-19 based on RT-LAMP integrated CRISPR-CAS technique by Dr. Saif Hameed, Amity University Haryana**

- **Rapid:** The RT-LAMP and CRISPR-Cas12 reaction takes less than 1 hour.
- **Specific:** Because detection depends on the identification and subsequent cleavage of SARS-CoV-2 genomic sequences by the Cas12 enzyme.
- **Sensitive:** Because of the integration of two techniques.
- **Field-deployable:** No sophisticated equipment is required.
- **Easy to use:** The colorimetric reaction coupled to lateral flow read out facilitate easy visual inspection of the results.
- **Adaptability:** The developed method can be easily adjusted for detection of other emerging pathogens.



➤ **Data analytics (AI) Based Vaccine Discovery System by Prof. Kamal Rawal at Amity University Noida**

Human Infectious Diseases including COVID19; Several million deaths in 2020; Economic Cost- Several trillion dollars [WHO]. Vaccines helps in preventing infections. Computational Systems- specially Deep learning systems are playing major role in solving important problems in drug discovery.

A total of eight proteins were shortlisted using properties such as secretory/surface-exposed nature, low transmembrane helix (<2), essentiality, virulence, antigenic, and non-homology with host/gut flora proteins. Subsequently, highly antigenic & immunogenic MHC class I, MHC class II and B cell epitopes were extracted from top-ranking vaccine targets.

The designed vaccine construct (containing 24 epitopes, 3 adjuvants and 4 linkers) was analysed for physicochemical properties using different tools (including docking). Immunological simulation studies confirmed significant levels of T-helper, T-cytotoxic cells, and IgG1 upon the administration of such a multi-epitope vaccine construct.

The vaccine construct is predicted to be soluble, stable, non-allergenic, non-toxic, and offer cross-protection against related *Trypanosoma* species and strain

