**DEPARTMENT OF BIOTECHNOLOGY, JIIT, NOIDA**

# Plant and Microbial Biotechnology

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**Research Group**

## Vision

Create a wealth of scientifically verified information
On natural resources
Including plants and microbes

## Mission

To provide biotechnology driven solutions

For abetting developmental concerns

In Environment, Agriculture & Industrial sectors

**PLANT AND MICROBIAL BIOTECHNOLOGY**
**Department of Biotechnology, JIIT, NOIDA**

**Research Focus:**

New advances in biotechnology are providing great insights in to the workings of nature, presenting interesting opportunities to apply principles of biology to different fields of science. Sustainable solutions are emerging to address the concerns on improving crop productivity, depleting natural resources, environmental pollution, safety of food and agricultural products etc.. Concurrently, there is an increasing demand for natural bio-products of therapeutic and industrial importance (in the areas of healthcare, environmental remediation, agriculture biotechnology). This has provided an impetus for research on plants and microorganisms that produce novel bio-products with variable properties and understanding their mechanisms of action at molecular level. Hence research activities of the Plant and Microbial Biotechnology group at Department of Biotechnology are comprehensively focused up on major sectors *viz*., bioresources, biorefining, bioremediation of organic and inorganic pollutants, enzymes for environment, food, industrial applications, Biofertilizer, biocontrol agents for agriculture improvement and natural products for healthcare applications. The group has garnered extra mural funding to the tune of **Rs. 238.41 Lakhs** through research grants from Department of Biotechnology (DBT), Department of Science & Technology (DST) & Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Govt. of India.

# PLANT AND MICROBIAL BIOTECHNOLOGY

**A brief over view of research in the group**:

Ability of native plant growth promoting microorganisms (PGPMs) are being evaluated to offer holistic plant growth benefits (providing nutritional benefits along with resistance to soil pathogens, and help reclaim agriculture soils containing residual pesticides). A consortium of PGPM is developed that can be used as bioinoculant (biofertilisers, biopesticides) to improve agriculture productivity. Ability of select PGPM to remediate organic pollutants in agriculture soils is also being explored.

Biorefining, involving biocatalysts in the form of whole cell microbes or enzymes derived from native sources is being experimented with, to remove nitrogen and sulfur/aromatic content present in fossil fuels. Research comprises isolation of microorganisms capable of expressing genes involved in the degradation of contaminants present in fossil fuels.

Microbes (bacteria/actinomycetes) are being screened from niche habitats (desert/hydrocarbon-polluted soil) for isolating antibiotics, biosurfactants, enzymes and are also being characterized to study taxonomic diversity. Industrial enzymes being studied to obtain improved properties for technical applications are: phytase (phosphate utilisation properties for fish/poultry feed), tannase (treatment of industrial effluents), protease, keratinase (feather degradation property for solid waste management), tannase (for tea processing, effluent treatment, juice processing) and amylase (starch desizing in textile industry).

Research groups in the department are actively working on certain other important bio-products viz. food flavours (vanillin), biopolymers (resistant starch from elephant foot and chitosan from fungi, bacterial cellulose), antibiotics and other by-products (gallic acid). Probiotic formulations are being developed using novel microorganisms and those exhibiting resistance to gastric digestion.

New structurally diverse natural products of industrial importance (healthcare - drugs, and environmental remediation- enzymes, biosurfactants) are being studied to address the need for newer molecules with better target profiles. Natural products from plants are being evaluated for respiratory diseases and as immune boosters for asthma and diabetic conditions as well as for neurological conditions and for anti-oxidative activity.

Isolation and identification of microorganism for the bioremediation of sites contaminated with poly-aromatic compounds is being studied. Microbial (ex. *Pseudomonas putida*) ability for tertiary treatment of paper mill effluent has been studied by applying sequential treatment composed of two-step chemical precipitation in order to meet discharge limits for various environmental contaminants. Project related to bacterial surface display of outer membrane protein in *E. coli* to harvest metal ions from the environment is in progress.

**PLANT AND MICROBIAL BIOTECHNOLOGY**
**Facilities / Infrastructure**

| S.No. | **Name of equipments& numbers** | **Make/company** |
|---|---|---|
| **1** | BOD Incubator | Hicon |
| **2** | Cold room | Blue star |
| **3** | Spectronic( 20d+ ) | Thermospectronic |
| **4** | Monocular microscope | Olympus |
| **5** | Autoclave | Hicon, Atlantis |
| **6** | Laminar flow (horizontal) | S.m. international |
| **7** | Micropippetes | Eppendorf |
| **8** | Centrifuge (refrigerated) -3k30 | Sigma |
| **9** | Gel documentation system | Bio-rad |
| **10** | Gel drying system | Bio rad |
| **11** | Elisa reader model -benchmark | Bio-rad |
| **12** | Water bath | Gfl, germany |
| **13** | Incubator shaker | Kuhner |
| **14** | Thermal cycle (PCR) | Bio rad |
| **15** | Electronic analy. Balance | Denver |
| **16** | Conductivity meter model - 145a+ | thermo orion |
| **17** | pH meter model - 420a+ | thermo orion |
| **18** | Comprehensive plant tissue culture lab | Vista biocell |
| **19** | pH meter digital | Elico |
| **20** | Fermentor (7 ltrs) | Bioage |
| **21** | Deep freezer -80 model - u410+ | New brunswick |
| **22** | Lyophilizer model - alpha 1-2ld | Christ |
| **23** | HPLC model- water -2996 | Waters |
| **24** | BOD incubator | Narang sci. System |
| **25** | Binocular microscope ch20i | Olympus |
| **26** | Digital incubator orbital shaker | Macflow |
| **27** | Digital circular chillar bath | Macflow |
| **28** | Digital water bath with incubator shaker | Macflow |
| **29** | High precision balance - cy510c | Citizen |
| **30** | Balance model - ctg 602 | Macflow |
| **31** | Binocular microscope with photo interface -bx51 | Olympus |
| **32** | Magnus zoom trinocular microscope model- msz- | Olympus |
| **33** | Olympus zoom binocular microscope model- sz51- | Olympus |
| **34** | Magnus zoom binocular microscope model-msz | Olympus |
| **35** | Thermal cycler (PCR) model- peltier | Bio-rad |
| **36** | Incubator shaker model -lab thermlt-x | Kuhner |
| **37** | Laminar flow | Atlantis |
| **38** | Biosafety hood | Atlantis india |
| **39** | Refrigerator- (sanyo ) | Sanyo |
| **40** | Universal frequency counter,power supply | Bharti electronics |
| **41** | Premium upright freezer, model no -u410 | New brunswick |
| **42** | Chemical storage cabinet (model-csc-pp-40-24-87) 45 | Atlantis india |
| **43** | Laminar flow vertical -model v-42 | Atlantis india |
| **44** | Remi cooling microfuge -cm-12 -, microcentrifuge -1020 | Remi |
| **45** | UV-Vis spectrophotometer model UV-1800 | Shimadtzu |
| **46** | Gas chromatography | Thermo scientific |

# PLANT AND MICROBIAL BIOTECHNOLOGY

## Research Grants

Research efforts of the group reflects in sponsored research grants of **Rs. 238.41 Lakhs** from premier funding agencies of Govt. of India namely: Department of Biotechnology (DBT), Department of Science & Technology (DST) and Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH).

**Research projects:**

1. Formulation of Microbial consortia with parallel biofertilizer and biocontrol properties. (DBT): **PI: Krishna Sundari,** Co-PI: Dr Reena Singh (TERI). (2010-2014) Total grant value: 57.39, (**JIIT: 24.22 Lakhs**, TERI: 33.17 Lakhs). (Completed)
2. Scientific documentation (digitization) of the selected Indian Medicinal Plants used for antidiabetic and other activities" **AYUSH-NMPB-MHRD**,**Govt of India**, **PI: Dr Rachana,** (2008-2011) Grant Value: **Rs. 7 Lakhs.** (Completed)

3. Development of a biocatalyst for dearomatization of diesel. **(DBT)**, **PI: Nidhi Gupta**, Co-PI: Sanjay Gupta, Co-PI: D.K. Adhikari (Indian Institute of Petroleum, Dehradun) (2013-2014). Grant value: **6.92 Lakhs.** (Completed)

4. Ability of select PGPM strains to remediate organophosphate pesticides commonly used in agriculture **(DBT)PI: Prof. S Krishna Sundari** (2013-2014) Grant value: **Rs. 6.59 Lakhs.** (Completed)

5. Development of a biocatalyst for the removal of nitrogen and sulfur from diesel, (**DST**), **PI: Nidhi Gupta** (2013-2016). Grant value: **Rs. 27.5 Lakhs.** (Completed)

6. Potentially novel carbohydrases (cellulase and related enzymes) for waste management from cultivable bacteria and functional metagenomic library of North East India biodiversity hotspot (DBT-under Twinning Program for North-East). **PI** (JIIT)**: Dr. Indira P. Sarethy**, PI (CSIR-NEIST)Dr. Hari Prasanna Deka Boruah, (2017-2020). Grant value:**22.21 Lakhs** (JIIT), Co-PI: Prof. Sanjay Gupta, Dr. Ratul Saikia, Dr. Anil Kr. Singh Total grant value Rs. 55 lakhs (Ongoing)

7. Evaluation of the heavy metals content in market samples of plant raw drugs used in Ayurveda (AYUSH, GoI), PI: Dr.Pammi Gauba (2018-2021). Grant value: **Rs. 41.10 Lakhs.** (Ongoing).

8. Application of customized PGPM based formulations for reclamation of soil permeated with Organophosphate pesticide residues (**DBT**), PI: Prof. Krishna S. Sundari, Co-I: Dr. Sudha Srivastav (2017-2020). Grant value: **Rs. 62.10 Lakhs.** (Ongoing)

**Women Scientist Project (DST-WoS-A)**

Studies on production of therapeutically important saponins using *in-vitro* culture of *Bacopa monnieri*. (**DST**) PI: Pragya Bhardwaj (2014-2018); **Faculty mentors: Dr. Ashwani Mathur, Dr. Chakresh K Jain**. Grant value: **19.61** Lakhs. (Ongoing)

**Post Doctoral Research Associateship**

Screening of native microbes with tannase producing ability, production of tannase and gallic acid using alternate substrate. (**DBT**), **PI: Prof. S Krishna Sundari, Post-Doctoral Fellow: Dr. K E Nandini** (Jan 2012- Dec 2015). Grant value: **19.44 Lakhs.** (Completed)

**SPONSORED FELLOWSHIP**

1. Bioprospection of Microorganisms from Selected Niche Habitat(s) (Soil/ Rocks) for Antimicrobial Products. Indian Council of Medical Research. Fellowship holder: Nidhi Srivastava (ICMR fellowship No. [3/1/3JRF-2013/HRD-136 (30690), PhD Scholar, JIIT Noida), Duration: 2014-2019, **Mentor: Dr. Indira P. Sarethy.**
2. Bioprospection of Actinomycetes from Indian desert and antimicrobial activity of selected isolates: Department of Science and Technology- INSPIRE Program, Fellowship holder: A. Ibeyaima (IF120267, PhD Scholar, JIIT Noida), Duration: 2012-2017, **Mentor: Dr. Indira P. Sarethy.**

**Total research grant value: Rs. 238.41Lakhs**

**Inter Institutional Collaborations:**

Strategic partnerships and collaborations have been established with scientists from various institutions and research centres of repute that enable exchange of research reagents and protocols and sharing specialized expertise and facilities.

- Prof. Sanjay Rangnate Dhakate, Principle Scientist, Department of Materials Physics and Engineering, NPL, CSIR, New Delhi.
- Dr D.K Adhikari, Chief Scientist, Biofuels Division & HOA Biotechnology Conversion Area, Indian Institute of Petroleum, Mohkampur, Dehradun.
- Dr. Reena Singh, Area Convenor, CMR, TERI, Habitat place, Lodi road, New Delhi.
- Prof. Rup Lal, Department of Zoology, Delhi University, Delhi.
- Prof. Subhash Chand, Professor Emeritus, Department of Biochemical Engineering & Biotechnology, IIT Delhi.
- Prof. J.N Chakraborty, Department of Textile Technology, National Institute of Technology, Jalandhar.
- Prof S. P Singh, Department of Biochemistry, BHU, Varanasi, UP.

**Research Achievements:**

Some of the Research Achievements of the department in the thrust area Plant & microbial Biotechnology are:

- Isolated and characterised 13 plant growth promoting isolates to be developed as bioinoculants for crop improvement.
- A consortium of PGP microbes with dual biofertiliser and biocontrol abilities developed.
- Isolated and characterized four different microorganisms for the degradation of carbazole.
- Development of sequential tertiary treatment method using metal salt and microorganism for paper mill effluent.
- Production of bacterial cellulose, characterization and application in bioprocessing

- Production of fungal chitosan and preparation of blend membranes for industrial application.
- *In vitro* propagation of medicinal plants and evaluation of their therapeutic potential
- Monographs of medicinal plants of India.
- Submitted two 400 pages Monographs for medicinal plants of India AYUSH-NMPB, Govt of India.

- Enzyme Keratinase produced from soil isolate with proven applicability in imparting anti-shrink functionality to wool and works synergistically with other scale removing enzymes
- Novel actinomycete isolates have been obtained from niche habitats – desert, limestone rock and forest soil – showing production of bioactive compounds (antimicrobial, biosurfactant and antioxidant activity).

**Resource Development:**

The department contributes in the research training of undergraduate and graduate students through both vertical and horizontal integration of research projects in Ph.D, M.Tech and B.Tech programs. Degree has been awarded to PhD (4), M.Tech (55) and B.Tech (226) students who have pursued research in this thrust area. Presently the faculty in the area are actively involved in scientific engagements where research projects at post doctoral, doctoral training are presently ongoing: Post doc (1), PhD (12), M.Tech (20) and B.Tech (24).

Well-trained undergraduates and postgraduates students have gone for their MS or PhD degrees to Universities of National and International repute such as: University of Pennisylvania (Ashmita Saigal); Pennsylvania State University (Manmeet S Dayal); Yale (Anumeha Shah), University of southern California (Ambika ramrakhiani), North Carolina (Tanya Sabharwal), University of Cincinnati (Vikram Kapoor), New York University (Rohan Seth), Kent university (Aanchal Khadelwal), University College London (Radhika Chadda); NYU Polytechnic School of Engineering (Sneh Sharma), Center Ambedkar Centre for Biomedical Research (Manal Shakeel), IITs (Shivani Bisht, Richa Nigam, Sharadwata Pan), NITs (Sakshi), TERI-SAS (Rahul Singh, Anushka Jain), BITS (Neha Panjiar), ICT, Mumbai (rohan Chabbra). Some of the students secured employment / research position with reputed biotech/biopharma industries such as: U.S. Environmental Protection Agency (Vikram Kapoor), Memorial Sloan Kettering Cancer(Sneh Sharma), Novartis Health care pvt. Ltd.(Abhishek Neeraj), Zydus Cadila (Siddharth Bichpuria), Pall Life sciences (Prashant Kishore), Reddy labs (Siddharth Bichpuria), TERI (Madhusmita, Rahul), Panacea Biotec (Geetanjali Menia, Shambhavi Seth, Priyanka Gupta, Tanya Sabharwal), Premas Biotech (Priyo Kumar) Biocon (Rajat Goyal). Some students have taken up the path of entrepreneurship and established their own start ups: Gralit India Biotech Pvt. Ltd (Gaurav Kumar, Atul Kumar).

**PLANT & MICROBIAL BIOTECHNOLOGY**

**Group Members**

| Faculty | Area of Specialization |
|---|---|
| Dr. Neeraj Wadhwa | Enzyme technology |
| Dr. S Krishna Sundari | Bioactive products, Environmental, Agriculture Biotechnology |
| Dr. Pammi Gauba | Environmental Biotechnology |
| Dr. Indira P Sarethy | Bioresource, Natural products |
| Dr. Rachana | Natural products |
| Dr. Ashwani Mathur | Bioprocess Engineering, Natural products |
| Dr. Susinjan Bhattacharya | Microbial biotechnology |
| Dr. Smriti Gaur | Microbial Biotechnology |
| Dr. Garima Mathur | Environmental Biotechnology, Natural products |

**PLANT & MICROBIAL BIOTECHNOLOGY**
**Publications**

**International Journal:**

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2. Shaurya Singh., Sanjeev Agarwal, Sanghita Roy, Chaudhary and Pammi Gauba. The odd even experiment in Delhi. International Journal of Current Advanced Research2018,7;1, 9319-9322
3. I.Balwani, K. Chakravarty, S. Gaur, Role of phytase producing microorganisms towards agricultural sustainability, Biocatalysis and Agricultural Biotechnology, 12, 23-29, Oct 2017. (Indexed in scopus, SCI)
4. Singh, D Kaloni, S. Gaur, S. Kushwaha, and **G Mathur.** Current research and perspectives on microalgae-derived biodiesel. Biofuels, 2017,http://dx.doi.org/10.1080/17597269.2017.1278932.
5. M. Singh, R. Kaur, R. Rajput and **G. Mathur**. Evaluating the therapeutic efficiency and drug targeting ability of alkaloids present in *Rauwolfia serpentine*. International Journal of Green Pharmacy, Vol. 11, pp. 132-142, 2017.
6. N. Srivastava, A. Ibeyaima, **I.P. Sarethy** "Screening of microorganisms for antimicrobial property from the Lachhiwala Reserve Forest of Himalayas – a biodiversity hotspot", World Journal of Pharmaceutical Research, Volume 6, Issue 14, 424-442, 2017.
7. A. Verma and **S. Gaur** Microbiological analysis of street vended sugarcane juice in Noida city, India, Int J Pharm Bio Sci; 8(3): (B) 496 – 499, 2017
8. Bhardwaj P., **Jain C.K.**, Mishra P., **Mathur, A**. Comparative analysis of Bacoside-A yield in field acclimatized and in-vitro propagated Bacopa monnieri. International Journal of Pharmaceutical Sciences Review & Research, 44 (2); 168-175, 2017 [Indexed in SCOPUS]
9. Kapoor, P., and **Mathur, A**. Seabuckthorn juice: Nutritional therapeutic properties and economic consideration. International Journal of Pharmacognosy and Phytochemical Research, Vol. 9, pp. 880-884, 2017 [Indexed in SCOPUS]
10. **S. Gaur** and A. Verma, Evaluation of Probiotic Characteristics of Bacteria Isolated from Fermented Foods, Journal of Pharmacy Research,11(4),281-285,2017 (Indexed in scopus)
11. Parul Chauhan, Mahender Singh Rawat, Pammi Gauba"ROLE OF PLANTS IN INDOOR AIR REMEDIATION" International Journal of Engineering, Technology, Science and Research, 2017, 4 ; 9, 749-756
12. Swarna Shikha; Pammi Gauba Phytoremediation potential of three leguminous plants towards Chromium,Journal of Pharmacy Research, 11(4),2017,299-305
13. A. Khare, S. Singh, R. Maheshwari, M. Aggarwal and **S. Gaur**, Health beneficiary effects of β-glucan derived from barley, International journal of basic and applied biology, 3(3), 197-200, 2016.
14. R. Singh, **A Mathur**, N Goswami, **G Mathur**. Effect of carbon sources on physicochemical properties of bacterial cellulose produced from *Gluconacetobacter xylinus* MTCC 7795. e-Polymers, Vol. 16, pp. 331-336, 2016.
15. Sharma, P., Mathur, G., Dhakate S., Chand, S., Goswami, N., Sharma, S.K., **Mathur, A**. "Evaluation of physicochemical and biological properties of chitosan / poly (vinyl alcohol)

polymer blend membranes and their correlation for Vero cell growth". Carbohydrate Polymers, Vol. 137, pp. 576-583, 2016.[indexed in SCOPUS, IF: 4.8]

16. M Singh, R. Kaur, S. P Singh and **Rachana**, "Intranasal Drug Delivery- New Concept of Therapeutic Implications for Effective Treatment of CNS Disorders", *International Journal of Pharmaceutical Science,s* 8;8, Jan 2017, pp1000-1013
17. M. Singh, S. P. Singh and R. **Rachana**, "Development, Characterization and Cytotoxicity Evaluation of *Gingko biloba* extract (EGB761) loaded Microemulsion for Intranasal Application", *Journal of Applied Pharmaceutical Science*, 7,1, Jan 2017, pp024-034
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22. Prakash, R and Krishna Sundari, S (2017). Nanotechnology based solutions for control of agricultural pests. International Journal of Nanotechnology. 3(2): 7-13
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25. **Rachana**, M. Pant, S. Basu, A. Jain, N. Goel I wadi, "A review on herbal therapy for respiratory ailments", *International Journal of Life Sciences and PharmaRresearch*, vol 6, 2, pp11 -15, 2016
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29. J. Jain,S. Bajpai ; P Gauba "Adverse Health Effects Of Arsenic Toxicity"Journal of Civil Engineering and Environmental Technology:2016, 3 (8), 679-683
30. S .Shikha; P Gauba "Phytoextraction of Copper by Cicer Arientum" Int J Pharm Bio Sci 2016 Oct ; 7(4): (B) 161 – 166
31. Swarna Shikha and Pammi Gauba ,**Phytoremediation of pharmaceutical products,** Innovare Journal of Life Sciences, Vol 4, Issue 3, 2016, 14-17.

32. Yadav, P. and **Sundari, S. Krishna.** "Plant growth promoting rhizobacteria: An effective tool to remediate residual organophosphate pesticides applied principally in agriculture soils". Journal of Environmental Research and Development. Vol. 9(4), In print, 2015.

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41. A. Jain, N. Atale, S. Kohli, **S. Bhattacharya,**M. Sharma, V. Rani. "An assessment of norepinephrine mediated hypertrophy to apoptosis transition in cardiac cells: A signal for cell death", Chemico-Biological Interactions, vol. 225, pp. 54-62, 2015.

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48. Goyal, S., Prakash, A., Verma, A. and **Gauba P.** "Remediation of heavy Metals. Journal of Basic and Applied and Engineering Research. Vol. 2(9), pp. 727-729, 2015.

49. Basu, S, Pant, M. and **Rachana**. "Protective effect of *Salacia oblonga* against tobacco smoke-induced DNA damage and cellular changes in pancreatic â-cells". Pharmaceutical biology pp. 1-7, 2015.

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17. Sundari S K. Sachdeva S, Agarwal, P and Awasthi S (2018). Bioenergy: A Sustainable Energy option", In Proceedings of the MOL2NET, International Conference on Multidisciplinary Sciences, 15 January–15 December 2017; Sciforum Electronic Conference Series, Vol. 3, 2018 ; doi:10.3390/mol2net-03-05122 MOL2NET 3, pp. 1-5,.

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19. Nandini K.E and Sundari K.S., (2015). The Biological Solutions to treat industrial effluent using native isolates of Aspergillus carbonarius. The 56th Annual Conference of the Association of Microbiologists of India (AMI), JNU, New Delhi. December 7-10.

20. Singh A., **Wadhwa N.** Utilization of Jimikand Peels as a source of enzymes.:FAB-HEP-2014; International Conference on "Future Prospects of Advancements in Biological Sciences, Health Issues and Environmental Protection " at Indira Gandhi Pratishthan, Lucknow, India(7-8 Feb 2014) . **(Oral presentation).**
21. Singhal K, Mittal P, Rani M, Agarwal N and **Wadhwa N.** "Cyclic plant peptides as biopesticides."International Conference on "Bioproducts and the OMICS Revolution",Jaypee Institute of Information Technology,Noida,March , 2013
22. Singh A., **Wadhwa N**., "Antioxidative potential and Phytochemical analysis of Elephant foot peel (**Amorphophallus paeoniifolius** ) " **(Oral presentation)** at National Conference on "Energy, Environment & Biotechnology Research" NCEEBR-2013, 5th-6th October 2013 in the Mewar Institute of Management, Sec-4C, Vasundhara, Ghaziabad, U.P-201012
23. Shukla G, Gupta P, Singh A, **Wadhwa N**.; "Antidiabetic potential of natural plant α amylases inhibitors."International Conference on "Bioproducts and the OMICS Revolution",Jaypee Institute of Information technology, Noida,March , 2013
24. Asawa K**, Wadhwa N,** Agrahari S**, "**Resilient Back Propagation Based Yield Prediction of Keratinase from *Bacillus Megaterium* SN1" **(Oral presentation)** at Compbio 2010: Cambridge, 1-3 Nov. 2010.
25. Agrahari S, **Wadhwa N**, "Production of industrially important food and feed enzymes from *Bacillus thuringiensis* SN2 isolated from Ghazipur poultry waste site" **(Oral presentation)** at ICBFE 2010 : "International Conference on Biotechnology and Food Engineering" Singapore, 25th -27th August 2010.
26. Gaur S.**,** Gupta S. and **Wadhwa N.**, "Isolation of Protease and Keratinase From Microbes Isolated From Ghazipur Poultry Waste Site, Ghaziabad, Indi**a. (Oral Presentation),"** at SIM Annual Meeting and Exhibition Industrial Microbiology and Biotechnology, Toronto, Canada. July. 26–30, 2009
27. Gupta S, Gaur S and **Wadhwa N**, "Production of extracellularly secreted keratinase and protease from bacteria of poultry waste site" **(Oral presentation)** at International Conference on Emerging trends in Environmental Research (St Albert's College, Ernakulam) Kerala, 14th -16th August 2009.
28. Gupta S, Gupta P, Tyagi S, Gupta S, Gaur S and **Wadhwa N**, "Potential application of Protease from senesced leaves of banana (Musa paradisiaca) " (Poster presentation) at International conference on Emerging trends in Biotechnolgy (ETBT) and 6th annual convention of the Biotech Research Society India (BRSI) at Banaras Hindu University, Varanasi, 4th-6th Dec 2009.
29. Pandey, S., Gaur, S**., Wadhwa, N.,** and Vemuri, N., "Wheat glutenin as biopolymer : Potential in biodegradable food packaging and in cell culture technology, " National conference on potentials of biotechnology and microbiology , IAMR Ghaziabad, January, 2009

30. Gaur, S., and **Wadhwa, N.,** "Thermostability and antimicrobial properties of protease from senesced leaves of *Lantana camara,"* International Conference on Plant Genomics and Biotechnology: Challenges and Opportunities , IGAU Raipur, pp282283, Oct., 2005.

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2. **I.P. Sarethy,** N. Panjiar and R. Gabrani, "16S rDNA sequence of *Streptomyces* isolate PN-18, capable of producing biosurfactant on complex carbon substrates," GenBank Accession No. GQ856644, 2009.

3. **I.P. Sarethy,** N. Shanker, N. Vikram, A. Tyagi, and R. Gabrani, "16S rDNA sequence of *Streptomyces* isolate B-14, capable of growing on complex carbon substrates," GenBank Accession No. GQ426322, 2009.

4. S. Gaur and **N. Wadhwa, "**16S rDNA sequence of *Pseudomonas thermaerum* GW1," Genbank Accession No. GU951516, 2010.

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9. G.B. Singh, S. Srivastava, S. Gupta, **N. Gupta**, "*Pseudomonas* sp. enrichment culture clone GBS.5 16S ribosomal RNA gene, partial sequence," GenBank Accession No. JX193073, 2012.

10. **Sundari, S. K.** and Nandini, K.E., "*Aspergillus carbonarius*internal transcribed spacer 1, partial sequence; 5.8S ribosomal RNA gene and internal transcribed spacer 2, complete sequence; and 28S ribosomal RNA gene, partial sequence," GenBank Accession No. KM117230.1, 2014.

11. **Sundari, S.K.** and Nandini,S., "*Citrobacter frenduii*. 2.2 16S ribosomal RNA gene, partial sequence. GenBank Accession No. KM 117229.1, 2014.

12. Mishra,N., Shaheen,S. and **Sattiraju,K.S., "***Trichoderma harzianum.* Internal transcribed spacer 1, partial sequence; 5.8S ribosomal RNA gene, complete sequence; and internal transcribed spacer 2, partial sequence," GenBank Accession No. KP122935.1, 2014.

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14. **Mathur, A.**, Vanvari, R., Bhardwaj, P. and **Mathur, G**., *Bacillus clausii* strain BMH17 16S ribosomal RNA gene, partial sequence. (Accession MF350627), 2017
15. **A. Mathur**, R. Vanvari, P. Bhardwaj, **G. Mathur**, (2017), Brevibacillus panacihumi strain BMD16, 16S ribosomal RNA gene, partial sequence [Accession: MF350626]
16. **A. Mathur**, R. Vanvari, P. Bhardwaj, **G. Mathur**, (2017), Bacillus clausii strain BMH17, 16S ribosomal RNA gene, partial sequence [Accession: MF350627]

**Books Published**

1. Gupta V.K., Tuohy M., Sharma G.D., and **Gaur S.** Applications of Microbial Genes in Enzyme Technology. Nova Science Publishers, USA, 2013.

2. **Rachana,** Basu S, "Biochemistry (for BSc)"**, Punjab Technical University**: Published by Vikas publications, Noida, 2010.

3. **Rachana**, Sharma, S, Basu, S, "Human physiology and anatomy" (for MSc), **Punjab Technical University**: Published by Vikas publications, Noida,2010.

4. **Rachana**, S. Basu**, "**Basics of Zoology, (for BSc.), **Manonmaniam Sundaranar University** Tirunelveli, Vikas publications, Noida.

**Mono Graphs submitted:** to AYUSH, NMPB, Ministry of Health, Govt. of India

1. Monograph for the Indian medicinal plant *Salacia reticulata*
2. Monograph for the Indian medicinal *Andrographis panicualta*
3. Rachana and Sujata Basu Monograph for the Indian medicinal plant *Salacia reticulata*
4. Rachana and Sujata Basu Monograph for the Indian medicinal *Andrographis panicualta*

**Chapter Publications**

1. K. Chakravarty and **S. Gaur**, Fungal endophytes as novel sources of anticancer compounds In: Anticancer Plants: Natural Products and Biotechnological Implements (Eds. M K Swamy, S Akhtar), Springer, 2018(In press)

2. A.Mathew, and **S. Gaur,** Potential application of the enzymes of lactic acid bacteria in food industry In: Microbial Catalyst, Nova Publisher, 2018, In press

3. **Indira P Sarethy**, Sharadwata Pan. "Designer Foods: Scope for Enrichment With Microbe-Sourced Antioxidants" Chapter 14 in Microbial Production of Food Ingredients and Additives, Vol. 5, (Ed. Alexandru Grumezescu Alina Maria Holban), pp 423-449, 2017, eBook ISBN: 9780128111994, Print ISBN: 9780128115206, Academic Press
4. Govind Kumar Gnasegaran, Dominic Agyei, Sharadwata Pan, **Indira P. Sarethy**, Caleb Acquah, Michael K. Danquah "Process Development for Bioactive Peptide Production", chapter in Food Bioactives: Extraction and Biotechnology Applications, (Ed.: Munish Puri), pp 91-110, 2017, ISBN: 978-3-319-51637-0 (Print) 978-3-319-51639-4 (Online), DOI: 10.1007/978-3-319-51639-4_4
5. Krishna Sundari Sattiraju and Srishti Kotiyal (2016). Endurance to Stress: An Insight into Innate Stress Management Mechanisms in Plants. In "Microbes for Plant Stress Management", Editors: D.J. Bagyaraj and Jamaluddin, New India Publishing Agency, New Delhi, India pp 67-103.
6. **S. Gaur**, Natural weapons from bacteria against cancer In: Microbial Resources. (Eds. V.K. Gupta, D. Thangdurai, G.D. Sharma) CAB International Publishers, UK, pp 204-210, 2016.
7. **Gaur S.**, "Natural weapons from bacteria against cancer" in *Microbial Resources*. (Eds. V.K. Gupta, D. Thangdurai, G.D. Sharma) CAB International Publishers, UK, In press, 2015.
8. Agyei D., Danquah M. K., **Sarethy I.P.,** Pan S., Antioxidative peptides derived from food protein, in *Free Radicals in Human Health & Diseases* Rani, V and Yadav, U. C. (Eds.), Springer Publications,2015, Chapter 26, pp 417-430, 2015 ISBN 978-81-322-2035-0.
9. Vandana Gupta, **Indira P. Sarethy** and Sanjay Gupta, E- Lesson- 'General Characteristics of Different Types of Acellular Microorganisms' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. http://vle.du.ac.in/file.php/596/General_Characteristics_of_Different_Types_of_Acellular_Microorganisms/ Acellular_Microorganisms.pdf
10. Vandana Gupta, **Indira P Sarethy** and Sanjay Gupta, E- Lesson- 'General Characteristics of Different Types of Cellular Microorganisms: Bacteria, Fungi and Algae' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. https://drive.google.com/file/d/0B0Izh6GcIA_DcDlXQmRFMTNkbVk/view
11. **Indira P. Sarethy**, Sanjay Gupta and Vandana Gupta E- Lesson- 'Bacterial Systematics' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. http://vle.du.ac.in/mod/resource/view.php?id=10937
12. Vandana Gupta, **Indira P. Sarethy** and Sanjay Gupta, E- Lesson- 'General Characteristics of Different Types of Acellular Microorganisms' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. http://vle.du.ac.in/file.php/596/General_Characteristics_of_Different_Types_of_Acellular_Microorganisms/ Acellular_Microorganisms.pdf
13. Vandana Gupta, **Indira P Sarethy** and Sanjay Gupta, E- Lesson- 'General Characteristics of Different Types of Cellular Microorganisms: Bacteria, Fungi and Algae' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. https://drive.google.com/file/d/0B0Izh6GcIA_DcDlXQmRFMTNkbVk/view

14. **Indira P. Sarethy**, Sanjay Gupta and Vandana Gupta E- Lesson- 'Bacterial Systematics' for Institute of LifeLong Learning, University of Delhi, Virtual learning Environment, September 2015. http://vle.du.ac.in/mod/resource/view.php?id=10937
15. M. Singh, S. Malik, **G. Mathur**. Comparative analysis of Antimicrobial and antioxidant potential of *Ginkgo biloba* (EGb 761) microemulsions and *Ginkgo biloba* extract (EGb 761). In "Industrial, medical and environmental applications of microorganisms: current status and trends. Wageningen Academic Publishers, vol. 37, issue 8, pp. 517-520, 2014.
16. **Mathur A**., Sharma P., **Goswami N**., Sahai A., Dua A., Das A.R., Kaur H., Kukal S., Dayal M.S., Arora S., Mishra P., Jain V. and **Mathur G**. Comparative studies on production of bacterial cellulose from *Acetobacter* sp. and application as carrier for cell culturing. Industrial, Medical and Environmental Applications of Microorganisms: Current Status and Trends, Wageningen Academic Publishers, 2014, Vol. 37, issue 8, pp. 403-407.
17. **Mathur A.,** Chhabra R., Sachdeva A., Sharma P. and **Mathur G**.. Fungal chitosan: a suitable biomaterial for cell culturing. Industrial, Medical and Environmental Applications of Microorganisms: Current Status and Trends, Wageningen Academic Publishers, 2014, Vol. 37, issue 8, pp. 436-440,
18. S. Bhattacharya. 'Reactive Oxygen Species and Cellular Defense System' in Free Radicals in Human Health & Diseases (Eds. V. Rani and UCS Yadav). Published by Springer, 2014.
19. **Rachana**, S.Thakur, S.Basu on "Oxidative stress and diabetes in Free Radicals in Human Health & Diseases", publication: Springer, 2014
20. **S. Krishna Sundari** (2014). Impact of biotic, abiotic stressors: Biotechnologies for alleviating plant stress. In "Use of Microbes for the alleviation of salt stress". M. Miransari (Ed). Springer Science+Business Media New York, DOI: 10.1007/978-1-4939-0721-2_6, Chapter 6. pp.87-120.
21. A.K. Gupta, R. Chaddha, R. Shah, **S. Krishna Sundari**. "Methods to Study Diversity in Soil Metagenome and it's Significance for Sustainable Soil Management", In *"Soil Microbiology & Biotechnology"* M. Miransari. Ed. Houstan, Texas: Studium Press LLC, 2013, Chapter 1.
22. **S. Krishna Sundari** and N. Mishra. "Contribution of Plant Growth Promoting Microorganisms for sustainable agricultural and forestry management practice". In *Soil Microbiology and Biotechnology* Ed. M. Miransari. Houstan, Texas: Studium Press LLC, 2013, Chapter 12.
23. **S. Krishna Sundari** and K. E. Nandini. **"**A systematic study of advances in Plant-stress biotechnology, processes involved and approaches for countering stress". *Biotechnological Techniques of Stress Tolerance in Plants.* Studium Press LLC, Houstan, Texas 2013, Chapter 4.
24. Rana R., Punyani K., Gupta V.K., **Gaur S.** Biotechnological Attributes of Phytases: An Overview In: Applications of Microbial Genes in Enzyme Technology (Eds. V.K. Gupta, M. G. Tuohy, G.D. Sharma, and S. Gaur) Nova Science Publishers, USA,.2013.
25. **Indira P. Sarethy** and Kailash Paliwal (2013) "Evaluating phytoremediation using *in vitro* plant cultures" in *Modern Biotechnology and its Applications*, Part-I, (ed. K. Behera) New India Publication Agency, India, 2013, Chapter 3, pp 57-87.
26. **S Krishna Sundari**. (2012). Organic pollutants in agricultural soils, risks involved and options for remediation. In "*Environmental Biotechnology-Recent Perspectives: Application and New Horizons of Environmental Biotechnology*". Eds. N. Joshi, K.C.

Sharma, M. Sharma. Lambert academic Publishing, Gmbh & Co., KG., 2012. pp. 194-232, . ISBN: 978-3-8484-2515-0

27. **Gaur, S.**and V K Gupta., "Biotechnological Perspective of Bacterial Proteases: An Overview"in *Biotechnology of Microbial Enzymes*, Nova Science Publishers, USA 2012, pp 69-79.
28. Kushagr P, Shuchi A, **Vibha R**. "Metagenomics: A new tool to explore the uncultured microbes in their natural habitats" in *RecentAdvances in Environmental Biotechnology*, Lambert Academic Publishing, Germany. 2011
29. **Vibha, R.,Indira**, **P.S.,** Diksha, G., Karthikeya, T., Mayank, C., and Neha, S. (2011) 'Defense signaling pathways in *Arabidopsis thaliana*: a model host plant to study plant pathogen interactions"- 'Advancement of Biotechnology', International Book Distributing Co., Lucknow, India
30. **Gaur**, **S.**, Ahmad, N. and Maheshwari, S., "Impact of fungal phytases in biotechnology: present and future perspectives. In: Fungal Biochemistry and Biotechnology, (Eds. Gupta, V.K., Tuohy, M.G. and Gaur,R.K.) Lambert Academic Publishing, Germany. (ISBN No. 978-3-8433-5800-2), pp 20-34, 2010.
31. Vandana Gupta and **Sanjay Gupta**, Diversity of Microbial World: General Microbiology (chapter in e-book for first year undergraduate students), Council of Scientific and Industrial Research (CSIR), Government of India, 2008.

**PLANT & MICROBIAL BIOTECHNOLOGY**

**List of Doctoral students**

**Ongoing**

| S.No | Year of Registration | Name | Title | Supervisor |
|---|---|---|---|---|
| **1** | 2009 | Sujata Basu | Preventive effects of *Salacia* extract in oxidatively stressed condition | Rachana |
| **2** | 2009 | Nivedita Mishra | Developing microbial consortia with abilities for plant growth promotion and remediation of residual pesticides | Krishna Sunadri |
| **3** | 2009 | Mamta Pant | To study the preventive role of *Adhatodavasica* in oxidatively stressed condition | Rachana |
| **4** | 2011 | Anuradha | A study on Value added products from Aroid (*Amorphophallus paeoniifolius*) | Neeraj Wadhwa<br>Susinjan Bhattacharya |
| **5** | 2011 | Parul Sharma | Biopolymeric membrane for animal cell culture | Ashwani Mathur<br>Pros. S Chand |
| **6** | 2012 | Sonam Shaheen | Mass Production ofPGPR for making microbial consortium and testing their ability to remediate organophoshphate pesticides | Krishna Sundari |
| **7** | 2012 | Ibeyaima | Bioprospection of actinomycetes from Indian Desert for antimicrobial activity and other natural products of industrial importance | Indira P Sarethy<br>Prof. S. Sharma<br>Prof. R. Lal |

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|---|---|---|---|---|
| **8** | 2014 | Swarna Shikha | Phytoremediation | Pammi Gauba |
| **9** | 2014 | Samiya Khan | Development of a biocatalyst for refining diesel | Nidhi Gupta |
| **10** | 2014 | Nidhi Srivastava | Bioprospection of niche habitat(s) for anti-microbial products | Indira P Sarethy |
| **11** | 2014 | Pragya Bhardwaj | Studies on production of therapeutically important saponins using in-vitro culture of *Bacopa monnieri* | Ashwani Mathur<br>Chakresh KJain |
| **12** | 2014 | Pratibha Yadav | Remediation of organophosphate pesticides using PGPM | Krishna Sundari |
| **13** | 2016 | Kashyapi chakravarty | Probiotics and their health benefits | Smriti Gaur |
| **14** | 2010 | Manisha Singh | Development of *Ginkgo biloba* microemulsion system against Alzeimer's diesase for intranasal applications | Dr Rachana<br>Prof. S. P. Singh |
| **15** | 2017 | Shashank Awasthi | Therapeutic uses of common Indian plant for treatment of brain tumor | Dr Rachana |
| **16** | 2017 | Sonia Sharma | Phytoconstituent screening, characterization and application of endophytes from *Amorphophallus paeoniifolius* | Neeraj Wadhwa |
| **17** | 2017 | Shalini Tyagi | Therapeutic potential of commercial Indian medicinal plants | Garima Mathur |

**PLANT & MICROBIAL BIOTECHNOLOGY**
**List of Doctoral students**

**Completed**

| S.No. | Name | Title | Supervisor | Degree Awarded |
|---|---|---|---|---|
| **1** | Smriti Gaur | Studies of Proteases from Biological Sources | Neeraj Wadhwa | 2010 |
| **2** | Sarita Agrahari | Production of enzymes and degradation of feathers by soil microbes | Neeraj Wadhwa | 2011 |
| **3** | N. Kumara Swamy | Paper mill effluent: Decolorisation and detoxification studies using chemical and microbial methods | Indira P Sarethy | 2012 |
| **4** | Gajendra Bahadur Singh | Microbial screening and expression of gene involved in carbazole degradation | Nidhi Gupta | 2011 |
| | Sujata Basu | Preventive effects of *Salacia* extract in oxidatively stressed condition | Rachana | 2016 |
| | Mamta Pant | To study the preventive role of *Adhatodavasica* in oxidatively stressed condition | Rachana | 2015 |
| **5.** | Anuradha Singh | Phytoconstituent characterization and application of *Amorphophallus paeoniifolius* in development of food products" | Neeraj Wadhwa | 2015 |
| 6. | Parul Sharma | Evaluating the properties of casted and electrospun chitosan blend membranes as alternative surface for Vero cell culture | Ashwani Mathur, Prof. S Chand | Ph.D defence in 2017 |

**PLANT & MICROBIAL BIOTECHNOLOGY**
**Dual degree B.Tech/M.Tech projects**

| **Completed Projects** | | | | |
|---|---|---|---|---|
| **S.No.** | **Enrl No.** | **Name** | **Project Title** | **Faculty** |
| 1 | 20002 | Sharadwata Pan | Expression of Metal binding Proteins/peptides in bacterial cells (*E.coli*) | Dr. Susinjan |
| 2 | 20008 | Dushyant Pandey | Pegylation, a novel concept in protein modification | Dr. Indira |
| 3 | 20098 | Varun Roy | Effect of fungal protease on levels of proteases, gliadin, glutenin in developing wheat grains | Dr. Neeraj |
| 4 | 20045 | Raghuraj Singh Dangi | Cloning and expression of mosquito larvicidal cry 4a protein of *Bacillus thuringiensis subsp.serovar israelensis* in E.coli HB101 | Dr. Krishna |
| 5 | 20053 | Sonal Nangalia | Antibacterial properties of allicin from garli+c3c extract: a potential for clinical trials | Dr. Reema |
| 6 | 20070 | Prashant Kishore | Bioproduct characterization and analytical method validation | Dr. Indira |
| 7 | 20084 | Shashank Shekhar Singh | Media scouting for optimization of growth of adherent cell line | Dr. Indira |
| 8 | 20069 | Sunil Kumar | Production of cellulase enzyme from *Agaricus bisporus* by solid state fermentation | Dr. Krishna |
| 9 | 20081 | Shree Prakash | Expression of spermidine-binding protein PotD in *Escherichia coli* | Dr. Susinjan |
| 10 | 6101060 | Anjali Sharma | Development and characterization of topical microemulsion system for *Camellia sinensis* extract | Dr. Reema |
| 11 | 6501805 | Bharti Sharma | Investigating the effect of plant metabolites on yeast cells subjected to oxidative stress | Dr. Krishna |
| 13 | 6501829 | Swati Chabbra | Investigating the effect of fungal metabolites on yeast cells subjected to oxidative stress | Dr. Krishna |
| 14 | 6501825 | V. Divya Sai | Developing mutants with increased PHA production on alternate substrates | Dr. Krishna |
| 15 | 6501826 | Yashi Saxena | Amylase production and characterization from alkaliphilic isolates | Dr. Indira |
| 16 | 6501827 | Varun Kohli | Substrate and process optimization for maximising PHA production on alternate substrates | Dr. Krishna |
| 17 | 7501821 | Prakhar Sachdeo | Generation of metal binding *E.coli* through surface display of engineered outer membrane protein | Dr. Susinjan |
| 18 | 7501823 | Atul kumar | Dehydration and image analysis of *Vitis vinifera* | Dr. Neeraj |
| 19 | 7501824 | Aarushi Kashyap | In vitro propagation of the medicinal plant *Solanum nigrum* in liquid media and evaluation of its antioxidant property | Dr. Indira |
| 20 | 7501825 | Purva Chopra | Production and Extraction of Biosurfactant from *Streptomyces* sp. PN-18 | Dr. Indira |

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| 21 | 7501828 | Nitin Goel | An Investigation of the possible preventive role of apocynin on smoke induced cell death, in vitro | Dr. Rachna |
| 22 | 7501829 | Harsha Rohatgi | Production of Resistant Starch from Plant Sources | Dr. Neeraj |
| 23 | 7501830 | Vartika Mahajan | Isolation, Purification and Characterization of Protease from Vegetable Waste | Dr. Neeraj |
| 24 | 7501834 | Ayushi Jain | An Investigation of possible preventive role of *Tinospora cordifolia* on Smoke induced cell death: Yeast Model | Dr. Rachna |
| 25 | 7501835 | Aishvarya | Bioprospecting For Actinomycetes In Arid Desert | Dr. Indira |
| 26 | 7501806 | Uday Bahal | In-vitro propagation of the medicinal plant *Bacopa monnieri* in liquid culture and effect on asiaticoside production | Dr. Indira |
| 27 | 7501816 | Jai Surabhi Verma | Production Of Proteolytic Enzyme Keratinase By Free And Immobilized Cells Of *Bacillus* Species | Dr. Neeraj |
| 28 | 7501819 | Gaurav Kumar | Wheat gluten and puroindoline as edible food coating | Dr. Neeraj |
| 29 | 07501811 | Deepika | Antiapoptotic activity of bioactive compounds from selected fungi | Dr. Krishna |
| 30 | 7501832 | Sanchit Srivastava | Decomposition of *Lycopersicon esculentum* (tomato) and *Citrus limonium* (lemon) leaf litters under Laboratory conditions | Dr. Neeraj |
| 31 | 7501807 | Ishan Wadi | Studying the interactions of active ingredients from *salacia reticulata* with Aldose reductase: in silico approach | Dr. Rachna |
| 32 | 8101013 | Yashi Bhatnagar | Degradation of carbazole by entrapped and encapsulated *Pseudomas sp.* | Dr. Nidhi |
| 33 | 8512003 | Deepak Kumar Bharti | Bacteriological and physicochemical quality of drinking water in West Delhi, India | Dr. Smriti |
| 34 | 7501830 | Vartika Mahajan | Isolation, Purification and Characterization of Protease from Vegetable Waste | Dr. Neeraj |
| 36 | 9101059 | Mansi Sehgal | Profiling of *Bacopa monnieri* , from different geographical habitat, for phytochemicals of therapeutic importance | Dr. Ashwani |
| 37 | 9501810 | Akansha Sachdeva | Development of non-dairy probiotic | |
| 38 | 9501803 | Rohan Chhabra | Fungal chitosan: carrier material for animal cell culturing | |
| 39 | 9101064 | Mitika Gupta | Characterization of selected actinomycete isolates from dune ecosystem | Dr. Indira |
| 40 | 9501801 | Vandana Yadav | Characterization of selected actinomycete isolates from arid desert | |
| 41 | 9501806 | Gaurav Shukla | Properties of edible coatings from native and modified aroid starches | Dr. Neeraj |
| 42 | 9501822 | Mahima Malik | Effect of gluten coating enriched with bioactive compound to improve the quality of fresh-cut fruits and vegetables | |
| 43 | 9501807 | Apoorva Gaur | Production and purification of tannase from SSF, merits of co-culture for increased yield | Dr. Krishna |

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| 44 | 9501827 | Pratima Mishra | Bioprocess parameter optimization for in vitro propagation of medicinal plants | Dr. Garima |
| 45 | 9501828 | Ravish Rana | Screening and isolation of vanillin producing microorganisms | |
| 46 | 9501824 | Anukriti Verma | Evaluation of probiotic characteristics of bacteria isolated from fermented foods. | Dr. Smriti |
| 47 | 9501816 | Abhishek Rathore | Removal of azo dye by bacterial isolate | |
| 48 | 10101020 | Niyanta Bhatia | Characterization of endophytic microorganisms for bioactivity | Dr. Indira |
| 49 | 10501830 | Taru Gupta | Antimicrobial activity of an endophytic streptomyces from *Phyllanthus niruri* | Dr. Indira |
| 50 | 10501818 | Kirti Chauhan | Screening of Indian medicinal herbs for cell death | Dr Rachana |
| 51 | 10501823 | Akanksha Mohindra | Biodegradation of phenols | Dr Neeraj |
| 52 | 10501831 | Harleen Kaur | Biodegradation of Crude oil hydrocarbons | Dr Nidhi |
| 53 | 10101014 | Aalapti Singh | Application of phytoremediation technology in remediation | Dr.Pammi |
| 54 | 10101023 | Prachi | Fungal chitosan and its membranes: preparation, characterization and application in | Dr. Ashwani |
| 55 | 10501817 | Sukriti | A study exploring effect of organophosphate pesticides on oxidative stress metabolism in | Dr. Krishna |
| 56 | 6501815 | Nikhil Kathuria | Study of interaction of Apocynin and related compunds with MPO and like peroxidase | Dr Rachana |
| 57 | 6501828 | Vaibhav Gandhi | To investigate the possible mechanism of inhibition by Apocynin towards NADPH | Dr Rachana Dr Chakresh |
| 58 | 6501823 | Sonam Saluja | Investigation of vascicine as a potent inhibitor of myeloperoxidase | Dr Rachana Dr Chakresh |
| 59 | 6501816 | Priyanka Manoj | Possible Mechanism of Vascine as a potential antioxidant | Dr Rachana Dr Chakresh |
| 56 | 14301320 | Rushali Singh | Production of bacterial cellulose and its composites | Dr. Garima |
| 57 | 12501812 | Manmeet Kaur Sethi | Food enzymes in the united states | Dr. Garima |
| 58 | 12501809 | Vipin Kumar | Laccase production and application in textile dye decolorization | Dr. Garima |
| 56 | 14301317 | Akanksha Aggarwal | Saponin Production in Micropropagated Bacopa monnieri: In-vitro Culture Conditions | Dr. Ashwani |
| 57 | 12501820 | Himanshu kumar | Role of abiotic parameters in regulating saponin yield in *Bacopa monnieri* | Dr. Ashwani |
| 58 | 12501822 | Anshul Bindal | Role of culture conditions in regulating total carbohyrate yield in microalgal biomass and | Dr. Ashwani |

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| 59 | 12501823 | Rythm Vanvari | Role of biotic parameters in regulating saponin biosynthesis in *Bacopa monnieri* | Dr. Ashwani |

**PLANT & MICROBIAL BIOTECHNOLOGY**

## B.TECH PROJECTS

| Completed Projects | | | | |
|---|---|---|---|---|
| S.No. | Enrl. No. | Name | Project Title | Faculty |
| 1 | 20019 | Greta Kasliwal | Establishment of an optimal micropropagation technique for mass propagation at *Jatropha curcas* L | Dr. Neeraj |
| 2 | 20072 | Neha Gupta | | |
| 3 | 20099 | Jiwateshwar Singh | | |
| 4 | 20015 | Vipul Jain | Designing fuel cell using halophiles and Hydrogen metabolisers | Dr. Krishna |
| 5 | 20030 | Swatantra Kumar | | |
| 6 | 20039 | Nitesh Raut | | |
| 7 | 20002 | Sharadwata Pan | Tissue culture and micropropagation studies on the living fossil *Cycas* sps. for potential commercial application | Dr. Indira |
| 8 | 20029 | Abhishek Neeraj | | |
| 9 | 20033 | Kumar Shivam Shrivastava | | |
| 10 | 20070 | Prashant Kishore | | |
| 11 | 20014 | Sumanth Alla | Cost-effective protocols for rapid micropropagation of rare succulents | |
| 12 | 20007 | Piyush Gupta | Study of the antagonistic microorganisms against milk protein and fat degradative microorganism | Dr. Susinjan |
| 13 | 20042 | Anurag Sharma | | |
| 14 | 20078 | Amit Pramod Aggarwal | | |
| 15 | 20109 | Kapil Mishra | | |
| 16 | 30025 | Abhishek Tyagi | Isolation, identification and characterization of *Streptomyces* isolates from India for potential production of anti-cancer metabolites | Dr. Indira |
| 17 | 30040 | Nikhil Shanker | | |
| 18 | 30036 | Nitin Vikram | | |
| 19 | 30003 | Anmol Grover | Isolation of eDNA and biodiversity study of metal metabolizing microbes | Dr. Krishna |
| 20 | 30010 | Harish Sharma | | |
| 21 | 30084 | Hemant Jethwani | Bioplastic Production | |
| 22 | 30081 | Mansi Varma | | |
| 23 | 40003 | Neha Panjiar | Isolation, identification and characterization of *Streptomyces* isolates having potential petrol and diesel degrading properties. | Dr. Indira |
| 24 | 40005 | Praveshika Katiyar | | |
| 25 | 40018 | Tishya Tripathi | Isolation of a protease inhibitor from leaves of neem (*Azadirachta indica*) | Dr. Neeraj |
| 26 | 40004 | Vritika M Gaur | | |
| 27 | 5101022 | Akshay Banga | Screening of dibenzothiophene | Dr. Nidhi |

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|---|---|---|---|---|
| 28 | 5101026 | Anuj Garg | desulfurizing microbes from soil and quantification of dibenzothiophene utilization | |
| 29 | 5101028 | Yashika Khanna | | |
| 30 | 5101080 | Pratyush Banga | | |
| 31 | 5101021 | Shabnam Sourav | Novel Enzymes from alkaliphilic bacteria | Dr. Sanjay<br>Dr. Indira |
| 32 | 5101024 | Prerna Kumari | | |
| 33 | 5101040 | Neha Arora | | |
| 34 | 5101100 | Suyashi | | |
| 35 | 5101007 | Shubham Tyagi | Protease extraction from senesced leaves and its potential commercial | Dr. Neeraj |
| 36 | 5101018 | Pranjal Gupta | | |
| 37 | 5101019 | Parul Gupta | | |
| 38 | 5101032 | Nishika Malhotra | Study exploring bioremediating abilities of plant growth promoting microorganisms | Dr. Krishna |
| 39 | 5101036 | Divyanshu Jain | | |
| 40 | 5101043 | Kumar Siddhartho Talukdar | | |
| 41 | 5101044 | Meha Saxena | | |
| 42 | 601010 | Neha Ansal | Protease extraction from senesced leaves and its application in food industry | Dr. Neeraj |
| 43 | 601024 | Swati Aggarwal | | |
| 44 | 601830 | Apoorva Gupta | | |
| 45 | 601014 | Padmini Munukutla | Use of Glutenin coating in the storage of apple slices | |
| 46 | 6101032 | Akanksha Gupta | | |
| 47 | 6101046 | Nisha Agarwal | | |
| 48 | 6101031 | Arushi Goel | | |
| 49 | 601025 | Tushar Agarwal | Phytochemical Screening. Purification and Characterization of cellulase from germinating garlic | |
| 50 | 601038 | Esha Batra | | |
| 51 | 601011 | Neha Juneja | | |
| 52 | 601048 | Pavni Kaushiva | | |
| 53 | 601055 | Sumit Lamba | Isolation and characterization of new proteases from plant seeds | Dr. Neeraj |
| 54 | 601061 | Vipul Jain | | |
| 55 | 6101026 | Varun Gupta | Anti-oxidant and anti apoptotic activity *Picrorhiza kurroa* : LPS induced model" | Dr. Rachna |
| 56 | 6501815 | Nikhil Kathuria | | |
| 57 | 6501828 | Vaibhav Gandhi | | |
| 58 | 6101015 | Prateek Goel | Design of portable microbial fuel cell that meets small power requirements | Dr. Krishna |
| 59 | 6101016 | Prateek Roy | | |
| 60 | 6101037 | Dhananjai Sinha | | |
| 61 | 6101058 | Vikram Kapoor | | |
| 62 | 6501825 | Divya Sai | Microbial bioplastic production using oil cakes as alternate substrate | |
| 63 | 6501827 | Varun Kohli | | |
| 64 | 6101034 | Amumeha Shah | Developing consortium of plant growth promoting microorganisms for remediation of agricultural soils | |
| 65 | 6101040 | Jyoti chauhan | | |
| 66 | 6101041 | Kanika Sharma | | |
| 67 | 6501805 | Bharti Sharma | Biochemical analyses of anti oxidative | |

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|---|---|---|---|---|
| 68 | 6501829 | Swati Chhabra | compounds in mycelia culture of ectomycorrhizal fungi | |
| 69 | 6101002 | Akanksha | Screening of dibenzothiophene or carbazole utilizing microbes and quantifying the extent of utilization | Dr. Nidhi |
| 70 | 6101003 | Ashmita Saigal | | |
| 71 | 6101020 | Sakshi Aggarwal | | |
| 72 | 6101022 | Shivani Bisht | | |
| 73 | 7101001 | Sneh Sharma | Oxidative stress linked antiapoptotic activity of secondary metabolities (polysacharrides) and enzyme (SOD) from fungi | Dr. Krishna |
| 74 | 7101036 | Aakriti Goel | | |
| 75 | 7101023 | Ridhie Bajaj | | |
| 76 | 7501811 | Deepika | | |
| 77 | 7101028 | Anubhuti Bansal | To study the ability of plant growth promoting microorganisms to remediate carbofuran and chromium | |
| 78 | 7101034 | Megha Sarawgi | | |
| 79 | 7101058 | Neha Goswamy | | |
| 80 | 7101064 | Amit Chawla | Design and optimization of a portable microbial fuel cell that meets small power requirements | |
| 81 | 7101012 | Anant Aggarwal | | |
| 82 | 7501806 | Uday Bahal | Microrhizome production from black turmeric and its characterization | Dr. Indira |
| 83 | 7501824 | Aarushi Kashyap | | |
| 84 | 7501831 | Nidhi Sejwal | | |
| 85 | 7501835 | Aishvarya | Molecular characterization of Streptomyces isolates | |
| 86 | 7501801 | Megha Garg | | |
| 87 | 7501825 | Purva Chopra | | |
| 88 | 7501812 | Vidhi | | |
| 89 | 7501819 | Gaurav kumar | Optimization studies for keratinase production | Dr. Neeraj |
| 90 | 7501823 | Atul kumar | | |
| 91 | 7501832 | Sanchit Srivastava | | |
| 92 | 7101047 | Mayank Singh | | |
| 93 | 7501816 | Jai Surabhi Verma | Identification of prebiotics from plants | |
| 94 | 7501829 | Harsha Rohatgi | | |
| 95 | 7501830 | Vartika Mahajan | | |
| 96 | 7101006 | Akanksha Gulia | Selection of native isolates with optimal tannase activity on alternative substrates | Dr. Rachna |
| 97 | 7101035 | Swaran Nandini | | |
| 98 | 7101005 | Parul Mehrotra | | |
| 99 | 7501807 | Ishan Wadi | Potential role of Apocynin in preventing Apoptosis: yeast model | Dr. Rachna |
| 100 | 7501828 | Nitin Goel | | |
| 101 | 7501834 | Ayushi Jain | | |
| 102 | 7101063 | Akash Mathew | Screening, Isolation and identification of microbes producing phytate degrading enzymes (phytase). | Dr. Smriti |
| 103 | 7101056 | Nidhi Magoo | | |
| 104 | 7101057 | Srishti Rawal | | |
| 105 | 7101060 | Gaurav Shah | Expression of metal binding peptides in *Escherichia coli* | Dr. Susinjan |
| 106 | 7501821 | Prakhar sachdeo | | |
| 107 | 7101041 | Shainkee Chauhan | | |
| 108 | 8101001 | Manal Shakeel | Developing mass production strategies for PGPMs | Dr. Krishna |
| 109 | 8101011 | Shivesh Ghura | | |
| 110 | 8101035 | Anushka Jain | Exploring the plant growth promoting | |

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|---|---|---|---|---|
| 111 | 8101057 | Ambika Ramrakhiani | and bioremediating activities of PGP bacteria | |
| 112 | 8101031 | Poorva Mehndiratta | Carbazole degradation carbazole degradation by immobilized cells | Dr. Nidhi |
| 113 | 8101025 | Arushi Jain | | |
| 114 | 8101044 | Tanya Pahwa | | |
| 115 | 8101013 | Yashi Bhatnagar | | |
| 116 | 8501801 | Sakshi Goel | Studying the biocontrol properties and benzopyrene degrading abilities of | Dr. Krishna Dr Sujata |
| 117 | 8101034 | Akshara Rawat | Optimization Studies for phytase Production | Dr.Smriti |
| 118 | 8101055 | Rashi Bhutani | | |
| 119 | 8101038 | Manmeet Singh Dayal | Production of bacterial cellulose from *Acetobacter* sp | Dr. Ashwani |
| 120 | 8101045 | Vibhor Jain | | |
| 121 | 8101047 | Rohan Seth | Purification and properties of alkaline amylase from alkaliphilic bacteria | Dr. Indira |
| 122 | 8101053 | Harsh Sharma | | |
| 123 | 8501803 | Sangey Dorji | | |
| 124 | 8101058 | Harsh Tandon | Optimization of phytase production by response surface methodology | Dr. Pammi |
| 125 | 9101011 | Chandni Verma | Cytoprotective role of *Andrographis paniculata* on Nicotine induced toxicity in yeast cells | Dr. Rachna |
| 126 | 9101057 | Shreya Ahuja | | |
| 127 | 9501813 | Nidhi Dogra | | |
| 128 | 9101039 | Gautam Kapoor | Interaction of 11 hydroxy mustakone from Tinospora with biological | Dr. Rachna |
| 129 | 9501804 | Preeti Mishra | Production of phytate degrading enzyme by soil isolate | Dr.Smriti |
| 130 | 9501816 | Abhishek Rathore | | |
| 131 | 9101035 | Sakshi Monga | | |
| 132 | 9101042 | Devyani Shukla | | |
| 133 | 9101019 | Shreya Mahajan | Exploring the ability of native microbes to produce tannase from alternative sources | Dr. Krishna |
| 134 | 9501807 | Apoorva Gaur | | |
| 135 | 9101052 | Iram Hasan | Study of phosphate solubilising bacteria | Dr. Krishna |
| 136 | 9101034 | Kencho Wangdi | *In vitro* propagation of *Bacopa monnieri* in liquid culture | Dr. Indira |
| 137 | 9101051 | Priya Gaur | Diversity of Actinomycetes in desert ecosystem | Dr. Indira |
| 138 | 9512001 | Swati Sharma | | |
| 139 | 9101009 | Abhishek Sahu | Phytoremediation for heavy metals | Dr. Pammi |
| 140 | 9101055 | Deepika | | |
| 141 | 9501808 | Ashutosh K Mishra | | |
| 142 | 9512005 | Akanksha Singh | | |
| 143 | 9101001 | Ashutosh Sharma | Screening and identification of microorganisms degrading 7-ketocholesterol | Dr. Nidhi |
| 144 | 9101018 | Deepika Singhal | | |
| 145 | 9101036 | Soni Dayal | | |
| 146 | 9101064 | Mitika Gupta | | |
| 147 | 9101013 | Shikha Arora | Process Parameters Optimization for | Dr. Ashwani |

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|---|---|---|---|---|
| 148 | 9501827 | Pratima Mishra | Cellulose production from *Acetobacter* sp. | |
| 149 | 9501803 | Rohan Chhabra | Bioprocess Parameters Optimization for Chitosan production from soil fungal isolates | |
| 150 | 9501810 | Akansha Sachdeva | | |
| 151 | 9101020 | Chhavi Kumar | Process parameter optimization for laccase production in solid state fermentation | Dr. Garima |
| 152 | 9101065 | Anushree Jaiswal | | |
| 153 | 9101066 | Richa Nigam | | |
| 154 | 9501809 | Medhavi Vishnoi | | |
| 155 | 9512008 | Nidhija Roy | Evaluation of antimicrobial potential of | |
| 156 | 9101038 | Kshitiz Chandrika Srivastava | Therapeutic potential of *Amorphophallus paeoniifolius* | Dr. Neeraj |
| 157 | 9101047 | Anwesa Banerjee | | |
| 158 | 9501806 | Gaurav Shukla | Purification and application of enzymes from *Amorphophallus paeoniifolius* | |
| 159 | 9512002 | Parag Gupta | | |
| 160 | 10101055 | Ayushi Jain | Bioprocess parameters optimization for in-vitro propagation of Mentha sp | Dr. Ashwani |
| 161 | 10101065 | Saloni Rao | | |
| 162 | 10101066 | Shweta Agrawal | | |
| 163 | 10101098 | Ritika Jain | | |
| 164 | 10101035 | Aarushi Dua | Production and characterization of microbial cellulose | Dr. Garima |
| 165 | 10101096 | Anushuya Raj Das | | |
| 166 | 10501801 | Samiksha Kukal | | |
| 167 | 10501831 | Harleen Kaur | | |
| 168 | 10101020 | Niyanta Bhatia | Study of endophytic bacteria from selected medicinal and non-medicinal plants. | Dr. Indira |
| 169 | 10101031 | Deeksha Gupta | | |
| 170 | 10501802 | Bhavika Sharma | | |
| 171 | 10501830 | Taru Gupta | | |
| 172 | 10101045 | Nikhita Agarwal | Investigating the role of PGPMsin assisting plant growth under abiotic conditions | Dr. krishna |
| 173 | 10101075 | Kriti Shukla | | |
| 174 | 10101081 | Srishti Dangayach | | |
| 175 | 10501817 | Sukriti | | |
| 176 | 10101006 | Abhisarika Patnaik | Screening of plant poly phenol oxidase for its decolourisation and detoxification potentia | Dr. Neeraj |
| 177 | 10101016 | Nabeel Zaman | | |
| 178 | 10101037 | Aditi Bhatnagar | | |
| 179 | 10101039 | Garima Naswa | | |
| 180 | 10101004 | Sonal Gahlawat | Phytoremediation for PPCPs | Dr. Pammi |
| 181 | 10101017 | Shubha Valsangkar | | |
| 182 | 10101059 | Manvi Makhijani | | |
| 183 | 10501818 | Kirti Chauhan | | |
| 184 | 10101056 | Jasveen Kaur | Cytotoxicity caused by environmental pollutants obtained from different fuel sources and protective effect of berberine from *Tinospora cordifolia Tinospora cordifolia* | Dr. Rachna |
| 185 | 10101062 | Neha Choudhary | | |
| 186 | 10101001 | Sukrati Srivastava | | |
| 187 | 10101092 | Kritika Sharma | | |
| 188 | 10101050 | Shruti Garg | Escherichia coli surface display using outer membrane protein C | Dr. Susinjan |
| 189 | 10501809 | Shilpa Mishra | | |

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| 190 | 10501810 | Vandana Sharma | | |
| 191 | 10501828 | Kopal Jalan | | |
| 192 | 10101043 | Monika Rani | Optimization of culture conditions for the production of phytase from soil bacteria | Dr. Smriti |
| 193 | 10101063 | Sanchita Agarwal | | |
| 194 | 10101078 | Sakshi Madan | | |
| 195 | 10501823 | Akanksha | | |
| 196 | 10101090 | Pranav Sood | Isolation of microorganism degrading Napthalene | Dr. Nidhi |
| 197 | 10101072 | Farah Siddiqui | | |
| 198 | 10101074 | Ishan Shekhar | | |
| 192 | 11501822 | Suramya Asthana | | Dr. Neeraj |
| 193 | 11501817 | Mohit Vadehra | | |
| 194 | 11101027 | Meenakshi Sarpal | | |
| 195 | 11101013 | Astha Upadhyay | Bacterial cloning of CspD | Dr Susinjan |
| 196 | 11101049 | Shruti Thakur | | |
| 197 | 11101055 | Stuti Mahajan | | |
| 198 | 11101017 | Divya Tiwari | Effect of Biosurfactant on carbazole degradation | Dr Nidhi |
| 199 | 11101025 | Kuldeep Nigam | | |
| 200 | 11101038 | Pranjul Rai | | |
| 201 | 11101019 | Farhein Akmal | Cloning of gene involved in petroleum refining | Dr Nidhi |
| 202 | 11501807 | Deepshikha | | |
| 203 | 11501818 | Mridul Trehan | | |
| 204 | 11501805 | Avantika Rawat | Role of *Tinospora cordifoila* on yeast cell death induced by carbon soot | Dr Rachana |
| 205 | 11501813 | Jahnavi Sharma | | |
| 206 | 11101054 | Srishti Singh | | |
| 207 | 11101014 | Bharti Sharma | Diversity of endophytes in the aquatic plant *Nelumbo nucifera* | Dr Indira |
| 208 | 11101058 | Tanuja Ijarwal | | |
| 209 | 11101018 | Faiza Khan | | |
| 210 | 11101006 | Anchal Sachdeva | | |
| 211 | 11101033 | Nishtha Grover | Therapeutic potential of Probiotic Seabuckthorne Juice | Dr Ashwani |
| 212 | 11101001 | Aanchal Budhraj | | |
| 213 | 11101031 | Nikita Gupta | | |
| 214 | 11101053 | Srishti Kotiyal | Biopesticides from plant sources | Dr Krishna |
| 215 | 11101037 | Poorva Singhai | | |
| 216 | 11101032 | Nilanshu Gupta | | |
| 217 | 11101047 | Shefali Goyal | Phytoremediation of Pollutants in soil | Dr Pammi |
| 218 | 11101008 | Anjali Verma | | |
| 219 | 11101009 | Ankita Prakash | | |
| 220 | 11501816 | Meghna Srivastava | Bacterial expression of metal binding peptides | Dr Susinjan |
| 221 | 11501812 | Ira Thapa | | |
| 222 | 11101060 | Vrinda | | |
| 223 | 11101041 | Raveesha Malhotra | Production of exopolysaccharide from lactic acid bacteria | Dr. Smriti |
| 224 | 11101005 | Ananya Singh | | |
| 225 | 11101021 | Gauri Mittal | | |
| 226 | 11101050 | Siddhant Sharma | | |
| 227 | 12101005<br>12501820<br>12501822 | Shivam Arora<br>Himanshu Kumar<br>Anshul Bindal | Monitoring the effect of mangiferin against cytotoxicity induced by tobacco products | Dr Rachana |

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| 228 | 13101031,<br>13101036, | Shipra Garg<br>Neelanjan<br>Mili Garg | Effect of some Indian herbs on the growth of yeast | Dr Rachana |
| 228 | 12101026<br>12101037<br>12501806 | Paresh Sharma<br>Bhawna Bhatt<br>Shivangi Gupta | Characterization of fungal isolates from Thar Desert | Dr Indira |
| 229 | 13101034<br>13501831<br>13101032 | Abhishek Negi<br>Harshit Saini<br>Soumya Singh<br>Parul Singh | Diversity of microorganisms in selected monuments of Delhi | Dr Indira |
| **227** | 12101015<br>12501812 | Manmeet Kaur Sethi | Microbial Production of Vanillin | Dr. Garima |
| **228** | 13101049<br>13501849<br>13101011 | Muskan Agarwal<br>Twinkle Wahi<br>Sukriti Srivastav | Bacterial cellulose production | Dr. Garima |
| 227 | 13101004<br>13101006<br>13101019<br>13101027<br>13101020 | Avantika Mishra<br>Stuti Agarwal<br>Saru<br>Aarushi Tandon<br>Kriti Vasdev | Isolation and characterization of microalgae from fresh water river and lakes of Delhi NCR for alcohol production | Dr. Ashwani |

**PLANT & MICROBIAL BIOTECHNOLOGY**
**Relevant Courses conducted**

**Microbiology (10B11BT313)**

History and scope of microbiology; Broad classification and taxonomy of microorganisms; Growth and physiology; Methods of microbial enumeration; Microbial control; Microbial metabolism, photosynthesis, fermentation, anaerobic respiration; Pathogenic microorganisms (bacteria, fungi, protozoa, and viruses, etc), host-pathogen interactions; Microbial genetics; Extremophiles; Microbes in industry.

**Cell Culture Technology (10B11BT412)**

Cell culture materials and tools, growth conditions and other requirements for establishment and maintenance of plant and animal cells, cell lines and tissues; *in vitro* conservation, protoplast, triploid & haploid culture, micropropagation; Animal cell cultivation: primary culture, growth kinetics, biology and characterization of cultured cells, Large scale production of biologicals in plant and animal cells.

**Genetic Engineering (10B11BT513)**

Concepts in Genetic Engineering, Enzymes in Genetic Engineering, Cloning Vehicles, BAC / YAC vectors, Construction & screening of genomic libraries, gene cloning strategies, DNA sequencing & mutagenesis, Cloning & expression of transgenes in Prokaryotic & Eukaryotic systems, PCR technologies, gene transfer in plant and animals, molecular markers, Applications and impact of rDNA technology, Ethical issues and biosafety regulation.

**Food and Agricultural Biotechnology (10B11BT612)**

Food chemistry, microbiology of fermented food products, food spoilage and food borne diseases, Food processing and preservation, Current status of Indian processed food industry, Use of enzymes in food industry, nutraceuticals and functional foods, Single Cell Proteins, Probiotics, Biotechnological approaches in production of therapeutics & industrial products in animals and plants, Production of value added products (biofuel, bioplastics, etc) from agricultural waste, traditional crop improvement vs biotechnological interventions.

**Fermentation Technology and Downstream Processing(10B11BT614)**

Introduction to fermentation processes, Isolation, preservation and improvement of industrially important microorganisms, Media optimization, Bioprocess Considerations for animal & plant cell cultures, Downstream Processing : Filtration, centrifugation, Separation of insoluble products – Cell disruption : Physical methods, Chemical methods, Separation of soluble products- liquid-liquid extraction: solvent recovery, two phase aqueous extraction, Chromatography, Process design of Industrial Bio-products : Anaerobic bioprocesses – Ethanol and lactic acid production, Aerobic bioprocesses – Citric acid and penicillin production

**Enzymes in Food Processing (10B1NBT735)**

Principles of enzyme assay and kinetic studies, enzyme units, Carbohydrate Hydrolyzing Enzymes– amylases, cellulase, Hemicellulases, Isomerase, Pectin degradation Fat hydrolyzing enzymes Lipases, Phospholipases Application in Beverage, Juice and Wine making Industry, Enzymes in Dairy Industry, cheese making and ripening aroma and flavor production, cold sterilization, Enzymes in product modification. Debittering, Hydrolysis of Soy protein, fish protein, Milk protein, collagen, Blood protein Tailoring enzyme structure and function Alteration of technical properties, Increasing yields, Raw matter utilization, Improving preservation, flavors.

**Molecular Ecology (11B1NBT831)**

Molecular genetics in ecology, Understanding molecular markers, modes of inheritance, co-dominant and dominant markers, Genetic analysis of single population, Genetic analysis of multiple population, Molecular markers in phylogeography, molecular clocks, distribution of genetic lineages, Molecular approaches to behavioral ecology, Applications of molecular ecology in wildlife forensics, agriculture and fishing.

**Process Engineering (10B11BT512)**

Microbial process development: Introduction to Upstream and Downstream processes, batch, Fed Batch and Continuous culture, Cell growth kinetics; Bioreactor systems including utilities: Types of bioreactor and their applications, cardinal rules of bioreactor design, utilities of bioreactors; Fluid flow and mixing – Rheological properties – Newtonian and Non-Netonian fluids, Flow behavior, mixing, power consumption and shear properties of rushton turbine, helical, anchor, bubble column, external loop, airlift etc; Heat transfer – different modes of heat transfer, Mass transfer in microbial processes: Mass transfer correlation for air solubility; Sterilization : Thermal death of micro-organisms, Batch and continuous sterilization of media, Design of sterilization equipment; Bioreactor analysis – Ideal and non-ideal reactor: immobilized enzyme and cell reactors, multiphase bioreactors, Operational measurements and control in fermentation: Bioreactor sensor characteristics; Case studies related applications in various biotech and biopharma industries.

**Bioremediation (10M11BT212)**

Environment pollution vis-a-vis bioremediation, Nature and fate of environmental pollutants, Methods and strategies of bio-remediation (ex situ & in situ), Biochemical pathways of degradation, monitoring of bioremediation, use of microorganisms in oil spill degradation, oil refining and oil recovery, Remediation of gaseous effluents, Aerobic and anaerobic methods for sewage treatment, Metal bioremediation, Phytoremediation, GMO's for bio-remediation.

**IPR and Bioethics (10B1NBT833)**

Different forms of Intellectual Property Rights, their Relevance to Biotechnology Industry & Academia; Overview of International conventions & Trade agreements: WTO, TRIPS, WIPO, Implication for developing countries; Process involved in Patenting, Patent Search; IPR in Agriculture, Farmer's Rights, UPOV &Traditional Knowledge; Need of bioethics, Bioethics & GMO's: Issues of Genetically modified foods; Bioethics in Medicine gene therapy, Organ transplantation, ethics in patient care; Bioethics & Cloning: Human cloning, Stem cell research, Use of animals in research, human volunteers for Clinical trials; Ethics in Profession

**Metagenomics (12M1NBT331)**

Molecular Diversity and Metagenomics: Concept of e-DNA (environmental DNA), and introduction to Metagenomics, Diversity of Microbes in different environments; Conventional methods to study diversity, Understanding the ecosystem level functions of Microbial Communities;Human microbiome projects by NIH, India and EU;Significance of Bioinformatics in understanding and analysis of Genomic Data, Databases and Software available for analysis of Metagenomic Data; Metagenomics & Bioprospecting, Applications in Medicine, Cancer metagenome; applications in Environmental Biotechnology, Acid Mine Drainage project, Sargasso Sea Metagenomic Metagenomics & Applications in Agriculture, The Soil Resistome project

**Bioprocess and Industrial Biotechnology(14M11BT211)**

Basic kinetic models of cell growth kinetics, media and air sterilization, Cell death kinetics, metabolic quotient, $O_2$ transfer and uptake, mass transfer and heat transfer, liquid rheology, Batch / fed batch and continuous cultivation, yield and productivity, Types of bioreactor, Ideal and non-ldeal reactors, Optimization of bioprocess operation (OVAT and statistical design), Operative measurement and control of fermentation, Bioreactor scale-up criteria, Cell growth kinetics of bacteria and fungi in non-ideal reactors: submerged and Solid state fermentation, types of reactor for solid state fermentation, recombinant bacterial cell stability and growth kinetics, Animal cell fermentation (Animal cell metabolism: basic understanding of substrate and byproduct stoichiometry, Growth characteristics and kinetics, micro-carrier attached growth kinetics, biomaterial properties for anchorage dependent cell lines, cell culture in perfusion and hollow fiber reactor, 2D and 3D cell culturing, bioreactor design considerations), plant cell fermentation (Importance of plant cell cultivation, Plant cell / hairy root cultivation, callus and shoot propagation, kinetics of cell growth and product formation, plant cell / hairy root reactors – types of rectors, comparison of reactor performance, immobilized plant cell reactors), Algal derived metabolites, methods of studying growth kinetics of chemotropic and phototropic algae, types of bioreactors: lab scale and large scale photo-bioreactor / pond reactors, Isolation, preservation and propagation of microbial cultures, Process technology for production of Organic acids, Amino acids, alcohols, antibiotics, Vitamins, nucleotides, steroids & flavours,

Production of enzymes: protease, cellulose, amylase, lipase; Enzyme inhibitors: inhibitors of cholesterol synthesis; biopesticides; biofertilizers; biopreservatives; biopolymers; single cell proteins; monoclonal antibodies; phytochemicals of commercial / therapeutic importance : flavanoids, saponins.

**Nutraceuticals (14M1NBT235)**

Historical perspective, Classification, scope & future prospects. Bioactive Carbohydrates Bioactive Lipids, Bioactive Peptides, Polyphenols, Nutraceuticals of plant origin, Nutraceuticals of animal origin, Microbial and algal nutraceuticals, Nutraceuticlas and diseases, Product development and clinical trials, Nutraceutical Industry and Market information.

**Microbial Technology(14M1NBT238)**

Principles of Microbial Biotechnology and industrially important microbes; Food & Microbial biotechnology; Microbes in Medical biotechnology; Microbes and Environmental Biotechnology; Microbes and clean energy production; Regulatory and ethical issues involved in all of the above.

**Product development in Biotechnology(14M1NBT334)**

Production of commercially important primary and secondary metabolites like organic acids, amino acids,Antibiotics, Vitamins and Steroids, Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers, Biodiesel, Recombinant proteins having therapeutic and diagnostic applications, Modified and Artificial Enzymes , Catalytic antibodies, Bioprocess strategies in Plant Cell and Animal Cell culture, Regulatory compliance, Analytical product testing , Biomanufacturing and Biobusiness issues.

**Plant Diseases & Biotechnology (15B1NBT833)**

An Introduction about Global Agriculture productivity and how disease impact crop yield; Use of chemical pesticides, insecticides and their ill effects; Plant physiology, Genetic basis of Plant genes, plant signalling pathways (systemic acquired resistance); Principle groups of plant pathogens and diseases caused, Molecular basis of genetic modification and crop improvement; RNAi technology in plant disease control; developing genetically modified plants with improved disease resistance; Biocontrol methods applying antimicrobial proteins, Plantibodies, PGPR and their role in disease control.

**15B11BT414 Immunology (4 Credits) EVEN 2018 4$^{th}$ semester**

Basic immunology, Types of immunity, B-cells and T-cells, Antibody: structure, function and diversity, T-cell receptors, Cellular and molecular aspects of antigens, Antigen-antibody Reaction, Regulation of Immune response and immunological tolerance, Immune effector mechanisms: Complement system and Cytokines, Autoimmunity and Autoimmune disease, Hyper-Sensitivity, Tissue and organ transplantation, MHC and HLA, Hybridoma technology, Immunity against infectious diseases, Vaccines, Immunodeficiency diseases

Elective

**Innate Immunology, 17M12BT120/17M1NBT332, M Tech Biotechnology**

Introduction: Immunity, Antigens, Epitope, Primary vs. secondary immune response, immunization: active vs. passive, phases of an Immune response, immune memory Hemopoiesis. Organs and cells of the immune system; Types of immunity: Innate and acquired immunity; Innate mechanisms of immunity: Inflammation, Cytokines, Complement activation, Phagocytosis; Innate immune defenses and PRRs: TLRs Cytosolic PRRs, RLRs and other cytosolic nucleotide sensors, NLRs and the inflammasome, MMRs, Lung Collectins, And related pathways; Role of different cells: Mast cell modulation of the innate immune response to enterobacterial infection, The role of dendritic cells at the early stages of *Leishmania* infection, The Role of Natural Killer Cells; Mammalian host defences; Links between innate and adaptive immunity: Role of phagocytes, Cytokines, Compliment system, Antimicrobial Peptides, The Role of Mast Cells, CD1-Restricted T-Cells; Innate immunity components in cancer: Macrophage – recognized molecules of apoptotic cells, Sensitivity to macrophages decreases with tumor progression in the AKR lymphoma, Opposing effects of IL-1α and IL-1β on malignancy pattern; Medical implications: DNA-based vaccines: the role of dendritic cells in antigen presentation, Hereditary Periodic Fever Syndromes and Other Disorders of NLRs, Systemic Autoimmune Disorders, Therapeutic Implications, Glucocorticoids, NF-κB and p38 inhibitors, TLR agonists, TLR antagonists, Immune response to infectious diseases and tumor immunity

**Waste management (16B1NBT733)**

Introduction to waste management, waste generation aspects, Biological and chemical waste treatment technologies-landfill, pyrolysis, gasification, energy recovery system, aerobic and anaerobic digestion, composting, biogasification and mechanical biological treatment of wastes, plasma-based technologies, Waste to energy (WTE), Product recovery and biorefinery, Management and treatment of hazardous waste, Legal aspects and policy guidelines, Environmental and Economic considerations of waste management.

**Bioeconomics (16B1NBT631)**

Introduction to bioeconomics, Bio-economics- Concept, Development of Economics and Bioscience (Concept of resource economics for scarcity of biological resources), Bioresource elasticity, Evolution and Development of Economics and Biology (Charles Darwin and the evolutionary paradigm)bioeconomics and thermodynamics, Thermodynamic analysis and thermo economics, Exergy cost, Exergetic efficiency, Bioeconomics and sustainability, Benefits and challenges of knowledge-based bioeconomy, sustainable food security (Europe and African Perspective), Development of resource (agricultural) efficient bioeconomy, Social and economic challenges for bioeconomy, Bioeconomic Models- Dynamic resource harvesting model, Dynamic optimization model, Demand-limited bionomic equilibrium, Growth and aging- The cohert model, SWOT analysis of Bioeconomy, Generic bioeconomic mathematical models, ecological bioeconomics, bioeconomy for agriculture, fisheries bioeconomics and mathematical models.