Project index

Faculty	No. of project floated	No. of student willing to take	Project number and title
Ashish Misra	1	1	**Project 1:** Microbial metabolic engineering
Prashant Mishra	2	1	**Project 2:** Fabrication of bioactive peptide loaded multifunctional mesoporous silica nanoparticles for cancer treatment
			Project 3: Biomarker based noninvasive method for detection of oral cancer using nanosensor**.**
Preeti Srivastava	2	1	**Project 4:** Asphaltene biodesulfurization and its application for bioremediation of crude oil
			Project 5: Deciphering the mechanism of regulation of the *dsz* operon for biodesulfurization of organosulfurs
Ritu Kulshreshtha	2	2	**Project 6:** Investigating the regulatory network of the key genes and non-coding RNAs in glioblastoma
			Project 7: Investigating the role of long non-coding RNAs in meningioma pathogenesis
Ravi Elangovan	2	2	**Project 8:** Molecular source tracking of AMR pathogens based on Whole Genome Sequencing
			Project 9: Optimization of light sheet microscopy for large clinical specimen analysis
Total	**9**	**7**	

Project no. 1

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Microbial metabolic engineering
Project description	**Background**: The use of microbes as hosts for the production of valuable compounds is of great interest to the scientific community. However, the redirection of microbial metabolism toward desired compounds remains a great challenge. Computational tools from metabolic analyses provide strategies for guiding genetic interventions - this project aims to use such metabolic flux and pathway analyses techniques for performing genetic interventions to improve product yields in microbial host(s). **Specific objectives and methodologies**: (i) In silico pathway analyses for exploring metabolic landscape of organism. (ii) Genetic intervention strategies for modifying selected microbial host and adaptive evolution for improving host properties.
Instruments required	Workstation, PCR machine, Shaker Incubator, HPLC, Gel electrophoresis
Any other comments	

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Ashish Misra	DBEB	ashishmisra@dbeb.iitd.ac.in

Skills required	
Qualification	Bachelors/Masters in Chemical/Biochemical Engineering or Biotechnology
Skills	Programming language like MATLAB or PYTHON; Analytical techniques like HPLC; Basic molecular biology techniques like PCR and cloning.

References
A Misra, MF Conway, J Johnnie, TM Qureshi, B Lige, AM Derrick, EC Agbo, G Sriram, 'Metabolic Analyses Elucidate Non-Trivial Gene Targets for Amplifying Dihydroartemisinic Acid Production in Yeast', Frontiers in Microbiology 4:200 (2013) S Nargund, A Misra, X Zhang, GD Coleman, G Sriram, 'Flux and Reflux: Metabolite Reflux in Plant Suspension Cells and its Implications on Isotope-Assisted Metabolic Flux Analysis', Molecular BioSystems DOI: 10.1039/C3MB70348G (2013)

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

Project no. 2

PhD project

Project details	
Project title	**Fabrication of bioactive peptide loaded multifunctional mesoporous silica nanoparticles for cancer treatment**
Project description	**Objectives:** 1. To synthesis mesoporous silica nanoparticles (MSNs) 2. To fabricate gate/ homing for silica nanoparticles for delivery peptide drugs 3. Testing these nanoparticles for their in vitro efficacy 4. To have dual drug loading and delivery strategies for MSNs **Background:** The current global crisis of people suffering from cancer and long term treatment burden is rising and hence sustainable nanoparticle based drug delivery systems are being developed. In this proposal, a novel strategy to design a mesoporous silica nanoparticle (MSNs) based nano-carrier (NC) system with iron as the core is planned. The MS have well-ordered internal mesopores, larger pore volume and surface area, tunable size and shape, robustness make them an ideal platform to design multifunctional nanosystems. Their high drug loading capacity can deliver the effective concentration of drug to the target cell and released smartly via external stimuli such as change in pH, wherein tumors (pH~6.5) and endosomes and lysosomes (pH~5–6). It is anticipated that precisely engineered nanoparticles will emerge as the next-generation platform for cancer therapy. The gated NPs will provide additional tool for sustainable delivery. **Methodology** Well established protocols developed in lab will be used

Instruments required	All equipment required are available with me at Nano Research Facility as Principal Investigator.
Any other comments	**For detailed publication see:** **http://scholar.google.co.in/citations?user=pCOEvOIAAAAJ** **http://web.iitd.ac.in/~pmishra/**

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Prashant Mishra	DBEB	pmishra@dbeb.iitd.ac.in

Skills required	
Qualification	B.Tech /MSc/M.Tech Biotechnology/Biochemistry/Microbiology/Life sciences
Skills	Background in Life Sciences/Biotechnology

References

Thymoquinone loaded mesoporous silica nanoparticles retard cell invasion and enhance in vitro cytotoxicity due to ROS mediated apoptosis in HeLa and MCF-7 cell lines
Goel S, **Mishra P**
Materials Science & Engineering C (2019) 109881 **IF 4.959**

Surface Molecularly-Imprinted Biomimetic Magnetic Nanoparticles for Enantioseparation
Goyal G, Bhakta S, **Mishra P**
ACS Applied Nano Materials 2 (2019) 6747-6756.

Asparaginase conjugated magnetic nanoparticles used for reducing acrylamide formation in food model system

Alam S, Ahmad R, Kumar P, **Mishra P** and Khare SK
Bioresource Technology 269, 121-126 (2018) **IF 6.669**

Co-delivery of curcumin and serratiopeptidase in HeLa and MCF cells through nanoparticles show improved cancer activity
Jaiswal S and **Mishra P**
Material Science and Engineering C 92, 673-684 (2018) **IF 4.959**

Thymoquinone inhibits biofilm formation and has selective antibacterial activity due to ROS generation
Goel S and **Mishra P**
Applied Microbiology and Biotechnology 102, 1955–1967 (2018) **IF 3.67**

Antimicrobial and antibiofilm activity of curcumin-silver nanoparticles with improved stability and selective toxicity to bacteria over mammalian cells
Jaiswal S and **Mishra P**
Med Microbiol Immunol 207, 39-53 (2018) **IF 2.96**

Permeation behavior of lysozyme-loaded poly(lactic-co-glycolic acid) nanoparticle through procine oesophageal mucosa and its microscopic studies.
Shankarayan R and **Mishra P**
J Nanopharmaceutics Drug Delivery 3: 85-96 (2016)

Modulation of toxic assembly of human gelsolin amyloids by emetine and curcumin-conjugated PLGA-nanoparticles.
Srivastava A, Arya P**,** Goel S, Kundu B, **Mishra P** and Ashish FNU
PLoS One 10 (5)e0127011 **(**2015**) IF 2.766**

Differential permeation of piroxicam- loaded PLGA micro/nanoparticles and their in vitro enhancement
Shankarayan R, Kumar S and **Mishra P**
J Nanopart Res 15 1496-1502 (2013) **IF 2.009**

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

Project no. 3

PhD project

Project details	
Project title	**Biomarker based noninvasive method for detection of oral cancer using nanosensor.**
Project description	Oral cancers are part of a group of cancers commonly referred to as head and neck cancers. One of the most common oral cancer, oral squamous cell carcinoma (OSCC) is a threat to the public health across the globe due to increasing rate of mortality. Recently, occurrence of oral cancer has also been attributed due to HPV16 in non-tobacco consuming young population. In early stage oral cancer is not noticed by patients, grows without pain and is asymptomatic. Hence, often, it is discovered when cancer is at a late stage of metastasis to another location such as lymph node of the neck. Thus early diagnosis is key to reduce the rate of mortality. Diagnosis of oral squamous cell carcinoma (OSCC) is mainly based on clinical examination, histopathology of biopsy and various microscopic methods. Since these methods are invasive, requires time, labour and expertise, an alternative diagnostic tool is needed. In this regards, biosensors offer a reliable, patient friendly and quick method of diagnosis. A number of biomarkers are known to be elevated in oral cancer in serum, tissue samples and saliva. Due to localization of oral cancer in oral cavity, saliva becomes obvious choice of biological fluid. In addition, collection of saliva is noninvasive, efficient and cost effective. A number of biomarkers are known to be elevated in saliva during oral cancer. Most common biomarkers of oral cancer are specific cytokines such as IL-8, IL-6, tumor necrosis factor (TNF-a), vascular endothelial growth factor (VEGF), epidermal growth factor receptor (EGFR). In addition, CYFRA-21-1 is a water-soluble proteinaceous biomarker representing 40 kDa cytokeratin and found in elevated concentration in saliva in oral cancer patients.In the present proposal, it is planned to design and develop novel biosensing element for detection of biomarkers using either impedance based or FET based point of care nanosensor.
Instruments required	All the facilities are available in my lab.
Any other comments	No comments

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Prashant Mishra	DBEB	pmishra@dbeb.iitd.ac.in

Skills required	
Qualification	M.Sc. / B.Tech/ M.Tech (other than chemical engineering graduates)
Skills	Biochemistry/Microbiology/Biotechnology/Molecular Biology

References

Gahlaut SK, Savargaonkar D, Sharan C, Yadav S, **Mishra P,** Singh JP. SERS platform for dengue diagnosis from clinical samples employing hand held Raman spectrometer. **Analytical Chemistry 92, 2527-2534** (2020) IF 6.35

Singh S, Moudgil A, Mishra N, Das S, **Mishra P.** Vancomycin functionalized WO_3 thin film-based impedance sensor for efficient capture and highly selective detection of Gram-positive bacteria. **Biosensors and Bioelectronics** 136, 23-30 (2019) IF 9.518.

Gahlaut SK, Kalyan N, Sharan C, **Mishra P**, Singh JP. Smartphone based dual mode in situ detection of viability of bacteria using Ag nanorods array. **Biosensors and Bioelectronics** 126, 478-484 (2019) IF 9.518

Moudgil A, Kalyani N, **Mishra P**, Das S. Azurin-TiO 2 hybrid nanostructure field effect transistor for efficient ultraviolet detection. **Nanotechnology** 30 (2019) 495205 IF 3.399

Moudgil A, Singh S, Mishra N, **Mishra P**, Das S. MoS_2/TiO_2 Hybrid Nanostructure-Based Field- Effect Transistor for Highly Sensitive, Selective, and Rapid Detection of Gram-Positive Bacteria. **Advanced Materials Technologies**(2019) 1900615 IF:5.395

Moudgil A, Kalyani N, Sinsinbar G, Das S and **Mishra P**. S-Layer Protein for Resistive Switching and Flexible Nonvolatile Memory Device. **ACS Applied Materials and Interfaces** 10 (5), 4866– 4873 (2018) IF 8.456

Kalyani N, Moudgil A, Das S and **Mishra P.** Metalloprotein based scalable field effect transistor with enhanced switching behaviour. **Sensors and Actuators B** 246: 363–369 (2017). IF 6.393

Indian Institute of technology Delhi

Project no. 4

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Asphaltene biodesulfurization and its application for bioremediation of crude oil
Type of project	PhD project
Project description	Heavy crude oil contains saturates, aromatics, resins and asphaltenes. While there are several reports on microorganisms which can degrade saturates and aromatics, there are only limited reports on asphaltene degradation. Asphaltenes contain heteroatoms including sulfur, nitrogen and heavy metals. Asphaltene degradation takes long time and the process is not very efficient. Here we propose asphaltene biotransformation for improved bioremediation. We hypothesize that asphaltene biotransformation is likely to result in smaller metabolites which can be easily degraded by native microbial community. The objectives are: a) Isolation and characterization of asphaltene biodesulfurizing microorganisms b) Characterization of metabolites and identification of genes for biodesulfurization c) Application of the isolated microorganisms in crude oil bioremediation There are no reports on microorganisms capable of biodesulfurizing asphaltenes. The project will lead to isolation of asphaltene biodesulfurizing microorganisms and their characterization. The microorganisms will be immobilized on different supports for their application in field.
Instruments required	GC-MS, FT-IR, NMR
Any other comments	

PhD/MSR supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Preeti Srivastava	DBEB	preeti@dbeb.iitd.ac.in

Skills required	
Qualification	M. Tech Biotechnology
Skills	Microbiology, Molecular biology

References

Indian Institute of technology Delhi

Project no. 5

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Deciphering the mechanism of regulation of the *dsz* operon for biodesulfurization of organosulfurs
Project description	Research on biodesulfurization of petroleum fractions began in the year 1993 and since then several research papers have been published. Several microorganisms were isolated for biodesulfurization and their genes were characterized. There was one thing common amongst all the microorganisms; all the microorganisms showed repression of biodesulfurization activity in the presence of inorganic sulfur. This severely affects the overall process of biodesulfurization. The mechanism of this repression is not known. We have recently isolated a transcription regulator belonging to TetR family and named it as DszR as it could specifically activate the *dsz* operon at low concentrations. At high concentrations it repressed the operon. The site of activation was found to be located at upstream region between -385 to -305bp with respect to the translation start site. The underlying mechanism for this long-distance activation is not known. Thus, the broad aim of the study is to determine the mechanism of regulation of *dsz* operon. We hypothesize that the binding of the DszR to the promoter region and its interaction with RNA polymerase requires other proteins. In the present study we aim to isolate and identify the DszR interacting proteins, which together with DszR are responsible for the activation or repression of biodesulfurization operon.
Instruments required	They are available in RNA I lab
Any other comments	

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Preeti Srivastava	DBEB	preeti@dbeb.iitd.ac.in

Skills required	
Qualification	M.Sc in Life Sciences/Biochemistry/Biotechnology or M.Tech in Biotechnology
Skills	Molecular biology

References
1. Pooja Murarka (2019) Isolation and characterization of proteins involved in regulation of dsz operon for biodesulfurization of organosulfurs . PhD thesis

Project no. 6

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Investigating the regulatory network of the key genes and non-coding RNAs in glioblastoma
Type of project	PhD project
Project description	Glioblastoma multiforme (GBM) is the most aggressive form of malignant glioma that still remains incurable. The estimated median survival of affected patients is less than 1 year. Identification of new therapeutic targets and strategies to improve the efficacy of existing forms of therapy are therefore urgently needed. Non-coding RNAs have been shown to play an important role in various cancers, however their role in GBM pathogenesis remains incompletely understood. This project is an effort to identify and understand the role of key ncRNAs in GBM and design ncRNA based therapeutic strategy. Objective: 1. Identify the genes and ncRNAs involved in GBM pathogenesis 2. Identification of functional relevance of ncRNA: gene regulatory network 3. Design delivery strategy of key gene/ncRNAs for GBM treatment
Instruments required	Mammalian Cell Culture Facility (Biosafety Hood, CO_2 incubator etc), PCR, Molecular biology related equipments (Gel Running Apparatus, PCR, Real-time PCR etc.)
Any other comments	None

PhD/MSR supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Dr. Ritu Kulshreshtha	DBEB	ritu@dbeb.iitd.ac.in

Skills required	
Qualification	MSc/MTech in any field of Life Science

Skills	Experience in Basic Mammalian Cell Culture and Molecular Biology Experiments

References

1. Krichevsky AM, Uhlmann EJ. Oligonucleotide Therapeutics as a New Class of Drugs for Malignant Brain Tumors: Targeting mRNAs, Regulatory RNAs, Mutations, Combinations, and Beyond. Neurotherapeutics. 2019 Apr;16(2):319-347.

2. Anthiya S, Griveau A, Loussouarn C, Baril P, Garnett M, Issartel JP, Garcion E. MicroRNA-Based Drugs for Brain Tumors. Trends Cancer. 2018 Mar;4(3):222-238.

3. Ahir BK, Ozer H, Engelhard HH, Lakka SS. MicroRNAs in glioblastoma pathogenesis and therapy: A comprehensive review. Crit Rev Oncol Hematol. 2017.

Indian Institute of technology Delhi

Project no. 7

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Investigating the role of long non-coding RNAs in meningioma pathogenesis
Type of project	PhD project
Project description	Meningiomas are the most common benign intracranial tumor with ~ 20% of patients showing aggressive phenotype with significant patient morbidity and mortality. However, there are no molecular markers for meningioma grading which currently relies solely on histology. Surgery and radiation are the mainstays of meningioma treatment but are insufficient to control 40%–75% of high-grade tumours. There are no curative therapies or effective molecular treatments for aggressive meningiomas.The recent development in the field of RNA biology shows the importance of long non-coding RNAs (lncRNAs) in carcinogenesis. However, the role of lncRNAs in meningiomas remains little studied. Therefore, transcriptomic profiling of meningiomas would be an efficient route to improved understanding of meningioma tumorigenesis, and will lead to development of newer prognostic biomarkers and rational therapeutic agents. The proposed study involves 1) Identification of differentially expressed lncRNAs 2) Analysis of lncRNA-miRNA-mRNA regulatory network and 3) Functional studies to identify the role of top deregulated lncRNA in meningioma pathogenesis.
Instruments required	Mammalian Cell Culture Facility (Biosafety Hood, CO_2 incubator etc), PCR, Molecular biology related equipments (Gel Running Apparatus, PCR, Real-time PCR etc.)
Any other comments	None

PhD/~~MSR~~ supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Dr. Ritu Kulshreshtha	DBEB	ritu@dbeb.iitd.ac.in

Skills required	
Qualification	MSc/MTech in any field of Life Science
Skills	Experinence in Basic Mammalian Cell Culture and Molecular Biology Experiments

References

1. Suppiah S, Nassiri F, Bi WL, Dunn IF, Hanemann CO, Horbinski CM, Hashizume R, James CD, Mawrin C, Noushmehr H, Perry A, Sahm F, Sloan A, Von Deimling A, Wen PY, Aldape K, Zadeh G; International Consortium on Meningiomas . Molecular and translational advances in meningiomas. Neuro Oncol. 2019 Jan 14;21: i4-i17.
2. Watson MA, Gutmann DH, Peterson K, Chicoine MR, Kleinschmidt-DeMasters BK, Brown HG, Perry A. Molecular characterization of human meningiomas by gene expression profiling using high-density oligonucleotide microarrays. Am J Pathol. 2002 Aug;161(2):665-72.
3. Vo JN, Cieslik M, Zhang Y, Shukla S, Xiao L, Zhang Y, Wu YM, Dhanasekaran SM, Engelke CG, Cao X, Robinson DR, Nesvizhskii AI, Chinnaiyan AM. The Landscape of Circular RNA in Cancer. Cell. 2019 Feb 7, 176(4):869-881.

Project no. 8

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	Molecular source tracking of AMR pathogens based on Whole Genome Sequencing
Project description	Background: Antibiotic resistance has been reported as one of the greatest threats to global health and food security today by World Health Organization (WHO). It has been indicated that new resistance mechanisms are emerging and spreading globally, threatening the ability to treat common infectious diseases. Use of antibiotics has become a major cause of water pollution in aquaculture as this is changing the structure of the environmental microbiota due to the accumulation of antibiotics in water environments. Project plan: With the rapid development of the global aquaculture industry, the presence of antibiotics and ARGs in aquaculture environment is of increasing concern. Therefore, in recent years, much attention has been paid to ARGs in farming processes, which are regarded as one of the main human activities that contributes to the selection and dissemination of ARGs (Durso LM et al., 2014). To our knowledge, few studies have evaluated the diversity and abundance of ARGs in aquaculture environment. Moreover, the mechanisms by which ARGs are transferred among fish, shrimp guts, the sediment and pond water of their aquatic environment remain unknown. Therefore, understanding the molecular mechanisms of antimicrobial resistance prevalent in aquaculture environment is important to design effective disease treatment strategies, to prioritize the use and registration of antimicrobials for aquaculture use, and to assess and minimize potential risks to public health. Due to the large-scale, high-density use of antibiotics in Indian aquaculture, we deemed it necessary to conduct an extensive investigation of the main aquaculture areas in India in order to understand the levels of antibiotics being used in Indian aquaculture. Objectives: 1) To investigate the comprehensive profiles of ART populations associated with different types of samples acquired from the aquaculture farm 2) Identification of a new resistant variant from domestic aquaculture products. Methodology: DNA extraction and library preparation :Samples will be concentrated by filtering through a 0.22 µm membrane, and then the bacteria will be suspended in 10 ml of 0.1% peptone water using a vortex mixer. All samples will be subjected to total DNA extraction (Ref.). Extracted DNA of samples from different sources/ponds will be subjected to NGS assessment. Illumina shotgun DNA library construction will be prepared. High-throughput metagenomic sequencing and data analysis High-throughput sequencing on a Miseq 2000 sequencer (Illumina, San Diego, CA, USA) will be done. The generated quality-filtered reads will be aligned using

	the basic local alignment search tool (BLASTx) with databases downloaded for ARGs (from the Antibiotic Resistance Genes Database (ARDB), http://ardb.cbcb.umd.edu/index.html), MGEs and integrons (from INTEGRALL, http://integrall.bio.ua.pt/), insertion sequences (ISs) (from IS Finder, https://www-is.biotoul.fr/) and plasmids (from the NCBI RefSeq database; 2408 plasmid genome sequences).
Instruments required	High-throughput sequencing on a Miseq 2000 sequencer (Illumina, San Diego, CA, USA
Any other comments	

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Ravikrishnan Elangovan	DBEB	elangovan@dbeb.iitd.ac.in

Skills required	
Qualification	

Skills	

References

Project no. 9

Indian Institute of technology Delhi

Department of Biochemical Engineering and Biotechnology

PhD project

Project details	
Project title	
Project description	Background: Histopathological examination of tissues remains as current gold standard in Cancer diagnostics. Current histopathological techniques are based on paraffin embedded thinly cut tissues sections for microscopy evaluations. This is due to limitation in the current microscopy methods to visualize thick samples. Current thin section based histopathology has many limitations, i.e., tumor hetrogenity across the volume of tissue sample can not be identified; sample is lost due to thin section processing; with limited volume imaging there is high error rate in the results. Project plan: Light sheet microscopy is recent technique that illuminate samples at an orthogonal angle. Sample is immersed with refractive index matching liquid to clear the sample for deep penetration. In this project, we propose to develop and optimize sample preparation methods for large clinical specimen clearing and imaging with light sheet microscopy. Objectives: 1. Develop tissue clearing protocol for large clinical samples 2. Develop sample labeling protocol for large clinical samples 3. Develop 3D rendering of images of large volume samples Methodology: 1. Development of tissue clearing protocol: Small tissue samples from poultry chicken will be used to optimize tissue clearing protocol optimization. Samples will be immersed in PBS with triton X for 6 hours, following with treatment with eoysin Y and DRAQ5. Finally appropriate amount of 2,2'-thiodiethanol will be added to match the refractive index. 2. Samples will be labelled for nucleic acid stains and additional immune-labelling will be decided on the type of clinical sample processed. 3. Large 3D data set needs to be rendered to visualize and extract feature information.
Instruments required	
Any other comments	

PhD supervisors			
Role	**Faculty**	**Academic unit at IITD**	**E-mail**
Supervisor	Ravikrishnan Elangovan	DBEB	elangovan@dbeb.iitd.ac.in

Skills required	
Qualification	
Skills	

References