IITP/ACAD/Ph.D/2022-23/02   Date: 27 /10/2022

<u>Ph.D. Admission – Jan 2023 (Spring Semester, AY-2022-23)</u>

Applications are invited for admission to the Doctor of Philosophy (Ph.D.) programme, starting in Jan 2023 in the following Departments. The areas of research in IIT Patna are as follows:

Department	Areas of Research
Chemical & Biochemical Engineering	Ambient pressure NH3 formation using heterogeneous catalysis Artificial Intelligence in Process system engineering Carbon foot printing Chemical Kinetics and Catalysis Continuous downstream processing CO2 conversion to Carbon nanotube Crystallization Data driven optimization Energy and Exergy management Food processing Process system engineering Ice-nucleation Microwave Assisted Material Processing Molecular Modeling and Simulation Modelling of viscoelastic flows Phase behaviour of confined fluid Phase change materials Photocatalyst for CO2 reduction and N2 fixation Photoelectrochemical processes for clean energy Pinch Analysis Plasma catalysis Process design and optimization Process Integration Production planning Reactive distillation Renewable energy integration Renewable Energy Sources and Their Applications plastic to fuel using renewable energy sources. Robust optimization Scheduling and optimization Separation processes Stochastic optimization Sustainable chemical processing Computational Fluid dynamics Treatment of Pharmaceutical Waste Thermal management of lithium-ion batteries Wastewater Treatment using Advanced Oxidation Processes Wetting and interfacial properties of Ionic Liquid and Deep Eutectic Solvent Ambient pressure NH3 formation using heterogeneous catalysis

	Artificial Intelligence in Process system engineering
Chemistry	*Organic, Inorganic, Physical, Theory, Biochemistry/Biomaterials, Polymer and Materials Chemistry*
Civil & Environmental Engineering	***Specialization: Structural Engineering*** *Smart Material for Vibration Control* *Structural Engineering* *Structural dynamics and earthquake engineering* *Structural stability* *Structural Fire engineering* *Multiscale Multiphysics Modeling and Mechanics of Materials* *Strengthening and retrofitting of structures* ***Specialization: Geotechnical Engineering*** *Ground Improvement* *Geoenvironmental Engineering and Biogeotechnics* *THMC behaviour of unsaturated soil* *Energy Geotechnics* *CO2 sequestration* *Rock Mechanics and Underground Excavations* *Geotechnical Earthquake Engineering* ***Specialization: Transportation Engineering*** *Pavement Analysis and Design* *Pavement Materials Engineering* *Railway Engineering* *Traffic Engineering* *Traffic flow Theory* *Intelligent Transportation Systems* ***Specialization: Environmental Engineering*** *Water and Wastewater Treatment* *Waste Treatment and Resource Recovery* *E-waste Management* *Removal of Micro-plastics and Emerging Contaminants from Aqueous Matrices* ***Specialization: Hydraulics and Water Resources Engineering*** *Open Channel Hydraulics* *Geoinformatics application in Water Resources* *Surface Water Hydrology* *Groundwater flow and contaminant transport*

Computer Science and Engineering	*All areas including (but not limited to)*
	802.11 Wireless Network
	Adhoc Networks and Sensor Networks
	Analog EDA
	Big Data Computing
	Bioinformatics
	Biomedical Imaging
	Bio-Text Mining
	Blockchain and Smart Contract
	CAD for VLSI
	Cloud Computing
	Cloud Security
	Complex Networks
	Computational biometrics and forensics
	Computer Vision
	Consensus in Blockchain
	Database & Data Mining Applications
	Deep learning
	Discrete Event Modeling
	Distributed Systems
	Empathetic Conversational Artificial Intelligence and Affective Computing
	Energy management & Intelligent transportation systems
	Fault-Tolerant Computing
	Federated Learning
	Formal Methods for Analysis and Verification
	Hardware Security
	Human-Computer Interaction
	Image Processing
	Information Extraction
	Information Systems Security
	IoT Security
	Machine Learning
	Machine learning Security
	Malware detection
	Medical image analysis
	Mobile Social Computing
	Modeling of social networks
	Multimodal Artificial Intelligence
	Multiobjective Optimization
	Natural Language Processing
	Online Algorithms
	Pattern Recognition
	Programming Languages
	Reinforcement learning
	Security & Privacy
	Service recommendation
	Social Networks
	Soft Computing
	Text Mining
	VLSI Design and Methodologies
	Wi-Fi Security, Wireless Networking
	Robotic Applications
	5G Network Slicing
	Swarm Drones

Electrical Engineering	Power Electronics
	Electric Drives
	Power Systems
	Smart Grid
	Power System Protection
	Power System Stability
	Control System
	Semiconductor Device and Circuits,
	Design and Fabrication
	Optoelectronic Devices
	Sensor
	Solar cell
	Photodetectors
	Semiconductor Device and Circuits for Low Power and Neuromorphic Computing
	VLSI and Embedded System
	Radio Frequency Integrated Circuits (RFIC)
	Analog Integrated Circuits (AIC)
	Wireless Sensor Networks
	Internet of Things (IoT)
	Molecular Communications
	Machine Learning
	Deep Learning
	Digital Signal Processing
	Digital Image Processing
	Digital Video Processing
	Video Surveillance
	Multimedia Communication
	Tele-medicine
	Biomedical Signal and Image Processing
	Neuroscience
	Neuro-congnition
	Wearable Healthcare Monitoring
	mm-Wave Antennas for 5G and Beyond
	High Gain Beam Scanning Metasurface Antennas
	Digital Metasurface and Applications in 5G and Beyond (IRS)
	Metamaterial Absorber for Stealth Application
	SDR Based Radar for Detection and Ranging
	Wireless Communication
	5G and Beyond
	6G and Signal Processing for Communication and Wireless Communication
	Optical Communication
	Photonics for Artificial Intelligence
	Optical Fiber based Sensing

Humanities and Social Sciences	**Economics** *Macroeconomic Reforms* *Trade and investment* *Microeconomics* *Labour Economics* *Development Economics* *English* *Gender Studies* *Indian English Fiction* *Migration and Diaspora Studies* *Digital Humanities* *South Asian Fiction* *Linguistics* *Sociolinguistics* *Cognitive Linguistics* *General LinguisticsForensic Linguistics* *Management* *Applied Psychology* *Human Resource Management* *Industrial and Organizational Psychology* *Organizational Behavior*
Metallurgical & Materials Engineering	*Plasma Spray Coating, Mechanical Properties of Materials, Friction stir processing and welding, Metal and Ceramic Matrix nano composites, Tribology of Materials, Process-structure-property Relationship, Solid State Chemistry, Materials Chemistry, Nanoparticles for Energy, Structural and Functional Applications, Structure- Property correlation of Dielectric, Ferroelectric, Multiferroic and other energy conversion Materials, Flash sintering of ceramics, Microstructure - property correlation in ceramics, Polymer blends and alloys, Polymer nanocomposites, Nanofillers, Hybrid nanofillers, Carbonaceous nanofillers like carbon dots and graphene*

Mathematics	*Reliability Estimation*
	Survival Analysis
	Estimation under Censored Data
	Statistical Inference
	Numerical Analysis
	Moving Mesh Methods
	Singular Perturbation
	A posteriori Error Estimates
	ordinary differential equation (ODE)
	partial differential equation (PDE)
	Integral Equations
	Fractional Order Equations
	Nonlinear Problems
	Black Scholes Equations
	Mathematical Finance
	Nonlinear Programming
	Vector Variational Inequalities; Differential Manifolds
	Rings and Modules
	Algebraic Coding Theory
	Algorithmic graph theory
	Theory of Inregral Transforms
	Monotone Iterative Techniques
	Non standard Finite difference techniques
	Existence and Uniqueness of Nonlinear Boundary Value Problems
	Biomathematics
	Mathematical sequence design
	Dynamical Systems
	Mathematical Control Theory, Optimal Control
	PolynomiaL identities on rings, Differential geometry

Mechanical Engineering	**Design:** *Computational Mechanics (FEM/XFEM)* *Condition Monitoring of Gear Box and Bearing* *Continuum Mechanics* *Cyclic Plasticity* *Fatigue and Fracture Mechanics* *Mechatronics* *Micro Electromechanical (MEMs) Devices* *Robotics* *Smart Materials and Devices* *Tribological Machine Element Design* *Vacuum Tribology* *Bio-Medical Device Design, Interfacial Rheology and Tribology* *molecular modelling* **Manufacturing:** *Additive Manufacturing* *Advanced Metallic Materials* *Cyber Physical Machine Tools* *Digital Manufacturing* *Finite Element Modeling of the Welding Processes* *Friction Stir Welding/Processing* *Green manufacturing* *In situ Analysis of Manufacturing Processes* *Mechanical Micromachining* *Non-traditional Micromachining* *Sheet Metal Forming* *Surface Engineering* **Thermal and Fluids:** *Artificial Intelligence and Machine Learning Tools for Heat Transfer Problems* *Biofluid Dynamics* *Biomicrofluidics* *Biophysical Aerodynamics* *Boiling Heat Transfer* *Bubble Acoustics* *Condensation Heat Transfer* *Computational Fluid Dynamics* *Energy* *Fluid-structure Interaction* *Hydrodynamic Stability* *Hypersonic* *Microfluidics and BIOMENS* *Micro-nanostructured Surface Fabrication* *Rarefied Gas Flows* *Solar Thermal*

Physics	*Optics and Photonics*: *Ultrafast Spectroscopy & Biophysics, Applied Optics (optical signal processing, information security), Digital Holography, Biophotonics, Nano-optics, Nanophotonics, Quantum Optics (Theory + Experiment)* *High Energy Physics*: *High Energy Physics Phenomenology* *Condensed Matter Physics*: *Multiferroics, Magnetic materials, Nanostructured materials, Magnetocaloric materials, Electrocaloric materials, Heusler alloys, Solid State Cooling, Nanomaterials for Energy and Sensing, High-Temperature Superconductors, Nanoscale device applications based on atomic switch technology, Renewable Energy Materials & Devices, EMI Shielding, Ferroelectrics & Dielectrics, Organic electronic devices, Nanoelectronics, Spintronics, 2D Materials* *Computational atomic Physics:* *e-scattering,* *photoionization* *electronic structure calculation* *strong field ionization*

Applicants having external fellowship from recognized Government funding agencies are encouraged to apply.

Research area under Visvesvaraya Scheme are as under:

Name of PhD Programme and Department	Research Areas
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (Full Time)	"Blockchain Technology", "Machine Learning and Artificial Intelligence in/for Blockchain", "Analysis and Verification of Blockchain Smart Contracts", "Safety and Security of Blockchain Smart Contracts", "Blockchain Technology for Critical Applications".
DEPARTMENT OF ELECTRICAL ENGINEERING (Full Time)	Intelligent electric vehicle propulsion system with battery health monitoring, diagnosis and quality identification using machine learning and artificial intelligence.

DEPARTMENT OF MECHANICAL ENGINEERING (Full Time)	Machine learning and Artificial Intelligence for electronic thermal management, AI Based monitoring and maintenance planning of machining systems, Image-based structural health monitoring using a flying robot (Open for both Mechanical and Electrical discipline); IoT Based Condition Monitoring of Gear Box (Open for both Mechanical and Electrical discipline), Heterogeneous Robotic Swarm (MAV-USV) for Inspection of Littoral Zones in Marine Surveillance (Open for both Mechanical and Electrical discipline), Novel Actuator and Mechanism for Robots

It is to be noted that, "The 'Visvesvaraya PhD scheme' is reserved for candidates who wish to do their work in Electronic System Design and Manufacturing (ESDM) and IT/IT enabled Services (ITES) research areas."

More details about the 'Visvesvaraya PhD scheme can be found at the following URL:
https://phd.digitalindiacorporation.in/assets/documents/Scheme-document-Phase-II.pdf

General Terms & Conditions:

Minimum Eligibility Criteria for Admission to Ph.D. Programme:

In all the disciplines, the upper **age limit is 28 years (B.Tech./B.E./M.Sc./MA/MCA/MBA) and 32 years (M.Tech./M.E./M.S./M.Phil.)** to be calculated as on the last date of application and is applicable **only** for candidates applying in Regular and Full time category, as institute fellow. For Research/ project fellows, age limit will be as per the funding agency norms. In absence of any age criteria, the Institute norms will be followed. Upper age limit is relaxed up to 05 years in case of candidate belonging to Schedule Castes/Schedule Tribes, Women, Physically Handicapped and OBC applicants.

A.1 Ph.D. in Engineering

For admission to the Ph.D. Programme in Engineering Department, a candidate must satisfy one of the following criteria:

A.1.1 Candidates having M.Tech./M.E. degree in a Engineering/Technology, with a minimum CPI of 6.5 or 60% of marks.

A.1.2 Bachelor's degree in Engineering/Technology (from any Institute other than IITs) in a relevant area with a minimum CPI of 8.0 or 75% of marks.
A.1.3. Bachelor's degree from an Indian Institute of Technology (IIT) in a relevant area with a minimum CPI of 7.0.

A.1.4. Master's degree in Science in a relevant area with a minimum CPI of 7.5 or 70%.

A.2 Ph.D. in Science

For admission to the Ph.D. Programme in Science departments, a candidate must satisfy one of the following criteria:
A.2.1 M.Phil. or Master's degree in Science in a relevant area with a minimum CPI of 6.5 or 60% of marks.

A.2.2 Master's degree in Engineering/Technology in a relevant area with a minimum CPI of 6.5 or 60% of marks

A.2.3 Bachelor's degree in Engineering/Technology from an Indian Institute of Technology (IIT) in a relevant area with a minimum CPI of 7.0.

A.2.4 Bachelor's degree in a related area in Engineering/Technology (from any Institute other than IITs/IISc) in a relevant area with a minimum CPI of 8.0 or 75% of marks.

A.3 Ph.D. in Humanities and Social Sciences
For admission to the Ph.D. Programme in the department of Humanities and Social Sciences (HSS), a candidate must satisfy one of the following criteria:

A.3.1 M.Phil.or Master's degree in Arts/Commerce/Science in a relevant area with a minimum of 55%marks or equivalent.

A.3.2 Master's degree in Engineering/Technology/Design in a relevant area with a minimum CPI of 6.5 or 60% marks.

A.3.3 Bachelor's degree from an Indian Institute of Technology (IIT) in a relevant area with a minimum CPI of 7.0.

A.3.4 Bachelor's degree in Engineering/Technology (from any Institute other than IITs/IISc) in a relevant area with a minimum CPI of 7.5 or 70% marks.

Candidates should note that if both CPI/CGPA and percentage are indicated in transcript/marksheet of the qualifying degree then only CPI/CGPA shall be taken into account for determining eligibility.

Direct Admission (Waiver of Entrance Test):

For candidates in Sciences, Engineering &Technology:

The Institute may admit exceptionally bright students and Full-time (Institute Fellows) directly (i.e., without entrance test) into the Ph.D. program.
Eligible candidates meeting one of the following criteria may be considered for a waiver of the entrance test:

1. B.Tech. from the IITs, graduated within the last five years, with a degree in the respective discipline with a CPI/CGPA of 8/10 and above.
2. Masters from the IITs/IISc, graduated within the last five years, with a degree in the respective discipline with a CPI/CGPA of 8.5/10 and above.

Such a candidate has to apply online. Additionally, an email must be sent with scanned copy of the supporting documents to aracademic@iitp.ac.in
There would be no admission in direct admission category in Department of Humanities and Social Sciences.

Relaxation for SC/ST Candidates:
Eligibility criteria will be relaxed by 5% marks or 0.5 CPI for SC/ ST applicants.

Reservations:
The reservation of seats in admissions for SC, ST, OBC, EWS categories and for Persons with Disability (PwD) will be as per Government of India rules. OBC (Non-creamy layer) candidates will have to produce certificate and self-declaration statement as per formats indicated at Annexure- I and II **available in the website, link** https://www.iitp.ac.in/acad/admission.php

FINANCIAL SUPPORT:

The Institute assistantships will be available to eligible (Indian) students as per prevailing (MoE, GoI) norms, as applicable from time to time. At present total emoluments are Rs 31,000/- per month.

Assistantships from external funding organizations will be available as per terms and conditions of the concerned funding organizations.

Students receiving assistantships from the Institute or fellowships from any other funding agencies are required to perform academic duties as per prevailing norms.

The continuation of the assistantship/fellowship is subject to satisfactory performance of the assigned duties and satisfactory progress of the student in the Ph.D. Programme.

Under Visvesvaraya Ph.D Scheme.
For details, please visit:- https://phd.digitalindiacorporation.in/assets/documents/Scheme-document-Phase-II.pdf

CATEGORY OF ADMISSION:

The Institute admits Ph.D. students under the following categories:
1.1 REGULAR and FULL-TIME
A student in this category works full-time for her/his Ph.D. degree. They can be classified as:

1.1 a) INSTITUTE FELLOWS
S/he receives assistantship from the Institute. The qualifying Degree for Financial Support is:
1.1.1 BE/ BTech/ MSc/ MA/ MBA/ MCA /equivalent degree with valid GATE score above the prescribed cut off level/ NET qualification.

B.Tech from IITs with CGPA 8.0 and above are exempted from GATE qualification as per MHRD (*now MoE*) letter no. 17-2/2014-TS.I dated Feb 18, 2015.

1.1.2 ME/ MTech/ MPhil /equivalent degree with GATE/ NET qualification.
Age Limit: Please refer to Eligibility Criteria for Admission into Ph.D. Programme

1.1 b) RESEARCH FELLOWS (JRF/SRF)
S/he receives fellowship from any government recognized funding agencies, such as CSIR, UGC, DBT, NBHM, DST (INSPIRE programme), etc
1.2 SPONSORED
A student in this category is sponsored by a recognized industrial R&D organization, academic institution (universities/colleges), government organization (defence or other ministries of the Government of India or any other government organizations including PSUs and autonomous bodies) or reputed industries (as may be recognized by this Institute) for doing research in the Institute. The Institute does not provide any assistantship/fellowship to such a student.
Candidate in Sponsored category must be a regular employee of the sponsoring organization (of repute) with a minimum of two-year job experience in the respective field. A student in this category is therefore a professionally employed person, who pursues Ph.D. while continuing her/his services. The candidate has to work full time in institute to obtain the degree for a period of 3 years. **An intending sponsored candidate must produce NOC on the day of interview in the prescribed format: Form I, available in the website, link** https://www.iitp.ac.in/acad/admission.php

1.3 SELF-FINANCED

A student in this category may work full-time towards the Ph.D. Programme. The Institute does not provide any assistantship/fellowship to such a student. The applicant should have qualified a national level exam (NET/GATE).

1.4 PROJECT STAFF

This category refers to a student who, as a project staff, is working on a sponsored project (registered in R&D Unit, IIT Patna). The said project staff is eligible to be admitted in the Ph.D. Program (of this Institute) to work on a full-time basis. The minimum remaining duration of the project at the time of admission as well as tenure of the project employee should be at least 2 years from the date of joining the Ph.D. program. **She/he must have qualified GATE/NET**.

If the project gets completed before the student completes her/his Ph.D., her/his category will no longer be that of Project Staff and her/his category will be converted to that of SELF-FINANCED unless she/he is granted an assistantship/fellowship from the Institute or any other agency.

A project staff intending to join the Ph.D. program of IIT Patna must produce NOC on the day of interview in the prescribed format: **Form II, available in the website, link** https://www.iitp.ac.in/acad/admission.php for admission through Principal Investigator, Head of the Department and Dean/ Associate Dean R&D with suitable endorsement.

Under Visvesvaraya Scheme, only regular and full time candidates will be considered.

1.5 EMPLOYED & PART-TIME

A candidate in this category is a regularly employed person (including the staff of IIT Patna), who pursues the Ph.D. program, while continuing the duties of her/his service. The institute does not provide any assistantship/ fellowship to such a student. The minimum residential requirement is one or two semester(s) depending on the completion of mandatory course work required for Ph.D. students. Candidate in Employed and Part-time category must be a regular employee of his/her organization with at least two years of professional experience in the respective field. **The work-experience of minimum two years is essential with current employer.** NOC must be produced on the day of interview in the prescribed format: **Form III**, **available in the website, link** https://www.iitp.ac.in/acad/admission.php

Withdrawal Policy:

One should not drop /leave the programme before course completion without valid reasons thereof. Selected candidates shall have to submit an undertaking/declaration at the time of admission for refunding fellowship/assistantship drawn from the institute in case of resignation from the program

Health Care Policy:

Health Services for enrolled students during their tenure will be governed by the terms and conditions of insurance policy procured by them at the time of admission which shall be renewed on yearly basis. OPD inside the institute health centre is available for all students in accordance with the institute policy framed from time to time in this matter.

Accommodation Policy:

Institute does not guarantee hostel accommodation inside the campus. However, accommodation may be provided on first come first served basis subject to availability of vacant rooms in the hostel.

Research Scholar under Visvesvaraya scheme will be governed by the terms and conditions of Visvesvaraya PhD scheme in accordance with the Implementation Order No.: PhD-02/2022/27 dated 06ᵗʰ September, 2022 for financial benefit.

APPLICATION PROCEDURE (go through it very carefully):

Firstly, application fee must be paid before proceeding for online application. The details of application fee are given below:

Category	Male	Female
GEN/EWS/OBC-NCL	Rs 1000/-	Rs 500/-
SC/ST/PwD	Rs 500/-	Rs 500/-

The application fee should be paid online through SBI Collect. Application fee shall not be refunded.

Link for payment: https://www.onlinesbi.com/sbicollect/icollecthome.htm?corpID=595859

After the payment, a reference/journal number will be generated, which must be mentioned in the application form and the printed e-receipt of payment must be preserved carefully.
Only after the above step and noting down reference/journal number generated through payment, candidates are required to use the following link to fill and submit application form online. Please read complete advertisement very carefully before applying online. To avoid internet congestion, candidates are advised not to wait for the last date of application.

Link for online application (should be accessed after payment):

https://www.iitp.ac.in/phd_admission/phd_form

After successful online application, candidates shall receive application details to the registered email address.
Candidates, applying for more than one department, must submit a separate application with separate fee- payment. Fresh fee payment is required for each application.
The candidates are required to take printout of the application details received in email after submitting online application. This printout along with self-attested copies of mark sheets & certificates (from class X to highest degree obtained/appeared), caste certificate (if applicable), GATE /NET/Relevant certificate related to any fellowship, experience certificate, other testimonials (both sides), and printed e-receipt of online payment must be produced on the day of test/interview, failing which the candidature is liable to be rejected.

If any of the prescribed documents (as mentioned above) is not produced on the day of test/interview, then attending test/interview may not be allowed.
Please note that depending upon the situation, above documents can be asked any time before the day of interview.

Candidates are NOT required to send application by post.

No call letter will be sent by post. The candidates must check email and website regularly for important information. On the day of test/interview, a candidate must produce his/her valid original Identity card.

Selection:

The Institute reserves the right to call a limited number of candidates for test/interview, based on performance in GATE/NET, grades/marks in the qualifying examination, shortlisting criteria etc and merely fulfilling minimum eligibility criteria does not guarantee call for test/interview.

Important Dates:
Start Date of On-line Application: 27/10/2022
Last Date of On-line Application: 16/11/2022 (Till 11:59 PM)

Helpline: Please note that no correspondence / query shall be entertained regarding correction of mistake in the submitted application, details already available in the advertisement and irrelevant matters. First issues/problems should be identified strictly as provided in the following table and use ONLY the concerned link/ email id mentioned against the issues.

S.N.	Issues	
1	**Technical issues regarding online application**	*https://forms.gle/ZSXd4K6s8iQ81j7c9*
2	**Academic matter**	acadphd@iitp.ac.in or aracdemic@iitp.ac.in 06115-233-684/697
3	**Fee -payment/ SBI collect**	arfa@iitp.ac.in 06115-233-062

Note: The above information is not the complete set of Rules & Regulations for the Ph.D. programme of IIT Patna.

Legal Jurisdiction: The court at Patna alone shall have the jurisdiction to settle and decide all matters and disputes related to the above referred admission process.