

IIT Palakkad

# UG Curriculum 2022

Applicable to all UG Batches from 2022-23 Academic Year

21 April, 2022

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# Introduction

## The timeline

IIT Palakkad started the journey of revising the UG regulations on November 30, 2020. Three independent working groups, consisting of 4 faculty members each, were constituted. The working groups were given the mandate of proposing a wishlist without worrying about any restrictions. Working groups' recommendations were shared with the faculty members and were discussed in an all faculty meeting on January 15, 2021. The key outcome of the all faculty meeting recommendations of the working group were: bringing in flexibility in the existing curriculum; enabling more hands-on activity; enabling the option for students to take longer breaks for entrepreneurship and other activities; and provisioning enough time for extracurricular activities.

A UG regulations drafting committee (UGRDC) was constituted to draft the new UG regulations of IIT Palakkad. The committee was represented by all the then eight streams of IIT Palakkad including representations from the working groups. The mandate of the committee was to frame the regulations based on recommendations by the working groups and the faculty and, at the same time, considering the industry consultations (done separately) and ABET and AICTE guidelines. The committee conducted a joint meeting with the Senate appointed sub-committee, Board of Academic Courses in two sessions and proposed the draft regulations. The draft regulations were discussed with the Institute Advisory Committee (IAC) in a meeting conducted via video conferencing on June 14, 2021 and the feedback from IAC was shared with the UGRDC for further considerations. The revised regulations were presented again to the in-person meeting of the IAC on July 30, 2021. The final version of the regulations were presented to-, discussed in-, and approved by-, the Senate in its 17th meeting on August 20, 2021. The regulations and the associated curricula will be applicable to all UG students from 2022-23 Academic Year onwards. In the next section, we present the underlying philosophy that guides the new regulations and summarise its main highlights.

## Key ideas of the regulations

The regulations aim to impart an undergraduate education that follows the institute motto "*Nurturing Minds for a Better World*". The stand out features of the regulations and the associate curriculum are:

**Broad-based education:** Designed to provide students with a comprehensive, well-rounded education by integrating courses in the basic sciences, mathematics, engineering, humanities and social sciences, in appropriate proportions.

**Student-driven and flexible:** Dynamic credit based curriculum gives students freedom to chalk out their own graduation plan by offering diverse options to gain wider expertise . This includes taking courses outside their professional major, more open electives, options for minor, double major degrees, BTech-Mtech dual degree and BTech Honours by Research options to gain breadth and depth.

Project-oriented: Plenty of opportunities for students to do a range of different projects throughout the programme. The projects are intended to be student-driven, can be hands-on and product development oriented to encourage start-up and entrepreneurship activities. Alternatively, for those who want to get started with research early on, research-driven projects can also be taken up. Main aim is to give students the opportunity to steer their careers in the directions they choose.

Contemporary & Futuristic: The regulations and the curriculum have taken inspiration from institutes within India and abroad. It is contemporary and well-integrated with academia and industry. Students interested in joining industry/launching a start-up after graduation will get enough training through various innovation and development projects. The new curriculum permits students to take long breaks for exploring entrepreneurship activities. Furthermore, if a student is interested in pursuing higher studies, the flexibility offered by the curriculum allows students to take enough electives and projects to gain deeper knowledge in the areas of their interest; at the same time students can earn project credits through work on research projects.

Industry-oriented: Our students get exposure to a set of courses/activities that are directly relevant to industry and they get industry-ready at the time of graduation. The same set of courses/activities combined with the expertise of our faculty in specific areas can help industry improve the skills of their existing manpower in targeted areas.

Innovative: Our primary focus is on imparting fundamental knowledge and professional skills based on a flexible, dynamic student-driven curriculum to set the stage for students to excel both in industry and in academia depending on where their interests lie. In addition, our curriculum has certain unique features. These include:

- Courses developed and offered by experts from industry.
- Permitting students to work in industry/research institutes/universities to earn their project credits.
- Provision for minor degrees designed and offered in close consultations with interested industries.

# The New UG Regulations for IIT Palakkad: A Highlight

1. Total credits: 144 credits<sup>1</sup> to give the student more time for co-curricular activities, skill development, social engagements and deep and diverse explorations.
2. Retains the balance:
  - a. Humanities and Social Sciences - 2 core credits + 9 elective credits
  - b. Basic Sciences including Mathematics - 22 core credits + 6 elective credits
  - c. Basic Engineering - 18 core credits
  - d. Professional Major - maximum 48 credits Program Major Core (PMC) + minimum 15 Program Major Elective (PME) + 9 project<sup>2</sup> credits
  - e. Open Electives - 15 credits.
3. More electives, option to choose courses across disciplines: minimum 54 credits of electives. Projects (9 credits) and open electives (15 credits) can be from within or outside the stream.
4. Dynamic credit based curriculum: Courses not linked to semesters. Standard course plan is provided to complete all the credit requirements in 4 years. But each student is free to modify it as they go. Course registration is restricted only by pre-requisites and consent of the teacher and not attached to the student-semester.
5. Multiple degree options:
  - a. Minor by earning 12 credits (within 144) from a predefined basket. Open electives can be used by a student for this.
  - b. Honours by earning 12 extra credits from the parent discipline with CGPA 8.5 or higher. Honours can be claimed by successfully completing 12 credits of additional Program Elective Courses or by carrying out 12 credits of research work.
  - c. Double Major (5 years, 180 credits) by completing the professional major core from a second discipline.
  - d. BTech-MTech Dual Degree (5 years, 180 credits) by completing 50 credits from courses and projects of an MTech. program. Stipend in the final year.
6. Industry connect: Minors and MTech components of dual degrees can be co-developed and co-run with industry partners.
7. Long breaks up to two semesters: For taking up activities such as Start-ups, Internships, etc.

Multiple exit options: Multiple exit options (at two year and three year point) are being worked out.

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<sup>1</sup> **Credit definition:** One credit for each lecture hour per week, lecture hour being defined as 50 minutes; One credit for each tutorial hour per week, tutorial hour being defined as 50 minutes; Two credits per laboratory for a practical session of 3-hours duration per week

<sup>2</sup> BTech Project (BTP) is optional and is an elective for 6 credits. While a student can credit multiple Open Ended Lab/ Projects (OELPs with 3 credits each) courses, only one BTP can be credited.

## The Institute Core Courses

Program : **Bachelor of Technology**

Department : **All available departments**

Year : **2022 Onwards**

The institute core courses are designed to give a strong all-round basic foundation to the students. These include courses from mathematics, humanities, sciences, life sciences and various basic engineering areas. The laboratory and workshop courses give the necessary basic hands-on training to all the students irrespective of their branch of study. The institute core courses aim to impart scientific temper, rigorous mathematical capabilities, critical thinking and practical skills to our students. These are mostly Level 1 courses constituting a total of 42 credits recommended to be completed in the 1st year of the UG program.

<b>Level 1</b>	<b>Level 2</b>
Ecology and Environment Linear Algebra and Series Physics Engineering Drawing Engineering Design Mechanical Workshop Physics Lab/Chemistry Lab	Basic Chemistry for Engineers Engineering Mechanics Introduction to Programming Multivariable Calculus Technology and Society Electrical Workshop Chemistry Lab/Physics Lab

# The UG Curriculum for Civil Engineering

Program : Bachelor of Technology

Department : Civil Engineering

Year : 2022 Onwards

The BTech CE programme aims to provide students with comprehensive knowledge in Civil Engineering and empower them as technically adept, socially responsible, ethical, and critical system thinkers. The curriculum is designed with basic science, mathematics, humanities, social sciences, and engineering courses, fundamental courses of civil engineering, and electives courses that cover a broad range of state-of-the-art topics. The total credit assigned to each category of courses is presented below.

Total Credits	
Institute Core (IC)	42
Program Major Core (PMC)	48
Program Major Elective (PME)	15
Humanities and Social Sciences Elective (HSE)	9
Sciences and Mathematics Elective (SME)	6
Open Elective (OE)	15
Project	9
<b>Total</b>	<b>144</b>

The professional major core courses cover fundamental courses in all streams of Civil Engineering and are presented in the sample template. In the proposed curriculum, many of the core courses include laboratory components to ensure effective learning of the concepts. The syllabi of the core courses are designed in such a way that it encourages the students to choose advanced courses from the pool of elective courses. The tentative list of elective courses are: Advanced Structural Analysis; Advanced Mechanics of Structures; Structural Dynamics; Advanced Design of Metal Structures; Advanced Concrete Technology; Airport and Railway Engineering; GIS and Remote Sensing; Geotechnical Investigations and Instrumentation; Ground Improvement; BIM for Construction Management; Finite Element Applications; Earthquake analysis and design of structure; Pavement Analysis and Design; Foundation Engineering; Geosynthetics and Reinforced Soil Structures; Irrigation Engineering; Solid Waste Management; Hazardous waste management; Construction Methods and Equipment; Project Management for Engineers; Optimization Techniques in Engineering; and Advanced Reinforced Concrete: Analysis and Design. The curriculum also ensures practice-oriented learning through different courses under the project category. This provides an opportunity for the students to start working on real-world problems from the 3rd year of their studies. Courses in the Open Elective category provide students the opportunity to learn interdisciplinary courses of their choice.

A course plan is proposed to guide the students in a credit-based system.

# The UG Curriculum for Computer Science and Engineering

Program	<b>: Bachelor of Technology</b>
Department	<b>: Computer Science and Engineering</b>
Year	<b>: 2022 Onwards</b>

The BTech CSE program strives to impart knowledge across the depth and breadth of Computer Science and Engineering. The curriculum is developed with a special emphasis on fundamentals and practical learning. The core courses are intended to prepare and motivate the students for a large pool of electives which covers several deep and state-of-the-art topics. The core courses are listed below.

Level 1	Level 2	Level 3
Introduction to Programming	Discrete Mathematics Foundations of Computing Systems Foundations of Computing Systems Lab Systems Programming Data Structures and Algorithms Data Structures and Algorithms Lab Introduction to Artificial Intelligence	Design and Analysis of Algorithms Theory of Computation Computer Architecture Computer Architecture Lab Operating Systems Operating Systems Lab Compiler Design Compiler Design Lab

A tentative set of program electives include (but not limited to) the following: Logic, Topics in Discrete Mathematics, Graph Theory and Combinatorics, Topics in Graph Theory, Probabilistic Method, Probability and Computing, Parameterized Algorithms, Approximation Algorithms, Combinatorial Optimization, Computational Complexity, Foundations of Data Science and Machine Learning, Coding Theory, Cryptography, Game Theory and Mechanism Design, Paradigms of Programming, Functional Programming, Parallel Programming, Computational Methods and Applications, Computer Networks, Database Management Systems, Compiler Optimizations and Program Analysis, Advanced Computer Architecture, Advanced Computer Architecture Lab, Embedded Systems, Synthesis of Digital Systems, PreSilicon Design Verification using Formal Property Verification, Software Engineering, Real Time Systems, System on Chip Design Lab, Artificial Intelligence for Cyber Security, Responsible Artificial Intelligence, Machine Learning, Big Data Lab, Information Retrieval, Natural Language Processing, Computer Vision.

To guide the students towards arriving at a feasible ordering of courses, a course plan is proposed. Multiple variations of this plan are possible.

# The UG Curriculum for Data Science and Engineering

Program : **Bachelor of Technology**

Department : **Data Science**

Year : **2022 Onwards**

The BTech program in Data Science and Engineering aims to impart the principles of analysis and design of building large-scale data driven decision-making systems that involves humans, machines, and the environment at large. The core courses in the curriculum build a strong foundation in mathematics, probability and statistics, computational thinking, data management, modeling and assessment, and ethics. The elective courses cut across various facets and applications of data science and engineering. The courses are designed to impart both the theoretical and practical aspects of the discipline. The table below lists the program core courses

## **List of program core courses:**

<b>Level 1</b>
Introduction to Data Science and Engineering, Discrete Mathematics
<b>Level 2</b>
Introduction to Optimization, Data Structures and Algorithms for Data Science, Computer Systems for Data Science, Introduction to Artificial Intelligence
<b>Level 3</b>
Database Systems, Data Analytics, Machine Learning, Deep Learning, AI Ethics

**Note:** Level 1 courses require no prerequisites while Level 2 and 3 courses may require the prerequisites from Level 1 and 2 courses.

The tentative list of program elective courses includes (but not limited to): Signal Processing for Data Science, AI of Things, Applied Accelerated AI, Big Data Lab, Information Theory and Statistics, Reinforcement Learning, Probabilistic Machine Learning, Computer Vision, AI for Cybersecurity, Econometrics, Natural Language Processing, Information Retrieval, Foundations of Data Science and Machine Learning, Bioinformatics, Responsible AI. The humanities and social science and open elective courses provide students the opportunity to learn interdisciplinary courses.

# The UG Curriculum for Electrical Engineering

Program : Bachelor of Technology

Department : Electrical Engineering

Year : 2022 Onwards

The Department of Electrical Engineering is diverse with specializations spanning across core electrical engineering, electronics engineering, communication engineering, and instrumentation engineering. The BTech Electrical Engineering program envisages to provide a platform for students to build their careers/knowledge in these varied fields of electrical engineering. The program aims at breadth through the sufficient number of core courses in these varying domains, and a wide list of electives to enable students to achieve depth in desired sub-areas. Further, to emphasize practical learning, almost all core courses are integrated with a lab/practice component. The core courses are listed below:

Level 1	Level 2	Level 3
Digital Systems (4) Electrical and Magnetic Circuits (3) Signals and Systems (3) Solid State Devices (3) Engineering Electromagnetics (4)	Control Engineering (4) Analog Circuits Theory (4) Microprocessor Systems Design and Interfacing (4) Digital Signal Processing (3) Principles of Communication (4) Electrical Machines (4) Measurements and Instrumentation (4)	Power Systems (4)

**Note:** Level 1 courses require no prerequisites, Level 2 courses require some prerequisites from Level 1, whereas Level 3 courses require some prerequisites from Level 2.

Tentative list of program electives in various wide-ranging sub-areas are listed below:

Devices, VLSI and RF
Principles and Design of MEMS, CMOS Analog and Digital Circuits, VLSI Architectures for Signal Processing and Machine Learning, RF Remote Sensing Systems, Nanoelectronic Devices, RF and Microwave Active Circuits, RF and Microwave Passive Circuits, Principles and Design of MEMS
Communication and Signal Processing
Information Theory and Statistics, Biomedical Instrumentation and Signal Processing, Information Theory and Coding, Wireless Communications, Digital Image Processing
Power Electronics, Power Systems and Machines
Power System Protection, Power Systems Analysis and Operation*, Power Converter Analysis and Design, Power Converters - Modulation Control and Applications, Electrical Machines Analysis and Modeling, Renewable Energy Systems, Electric Drives
Control Systems and Instrumentation
Synthesis of Control, Control of Nonlinear Dynamical Systems, Sensors and Signal Conditioning, Optimal Control, Reinforcement Learning based Control, Robot Implementation Methods, Advanced Sensors Laboratory
General Courses
Linear Algebra for Engineers, Computational Methods in Electrical Engineering

The curriculum provides flexibility to the students to credit courses in a sequence determined by prerequisites. While several sequences could be possible, one plan is presented with a few illustrations on combinations of electives and projects.

# The UG Curriculum for Mechanical Engineering

Program : **Bachelor of Technology**  
Department : **Mechanical Engineering**  
Year : **2022 Onwards**

The Department of Mechanical Engineering offers a good blend of fundamental knowledge from all the three sub-domains that include Manufacturing, Design and Thermo-fluids. Specially designed program core courses impart fundamental engineering knowledge on basic physical principles of the domain. Further, a wide range of program elective courses deepen their understanding to a sufficient level in the field of their interest. The curriculum also exposes the students to get enough practical experience through various laboratory and project based courses. Overall, the BTech (ME) program at IIT PKD provides a strong base to the students to pursue their curiosity in both academia and industry. The following tables provide the list of program core and elective courses.

## List of program core courses:

<b>Level 1</b>
Engineering Thermodynamics, Materials Science and Engineering, Mechanical Measurements: Theory and Practice
<b>Level 2</b>
Dynamics, Fluid Mechanics: Theory and Practice, Manufacturing Processes-I, Mechanics of Solids: Theory and Practice
<b>Level 3</b>
Automation in Manufacturing, Design of Machine Elements, Energy Conversion Systems, Heat and Mass Transfer, Industrial Engineering and Operations Research, Manufacturing Processes-II, Mechanisms and Machines: Theory and Practice, Manufacturing and Materials Engineering Lab, Thermal Engineering Lab
<b>Note:</b> Level 1 courses require no prerequisites while Level 2 and 3 courses may require the prerequisites from Level 1 and 2 courses.

## List of program electives that are being currently offered to the senior UG students:

<b>Manufacturing and Materials Engineering</b>
Additive Manufacturing, Advanced Engineering Materials, Advanced Finishing Technologies, Computer Aided Metrology, Digital Manufacturing, Lean Manufacturing, Soft Mechanical Behavior of Materials, Mechanics of Machining, Computing techniques, Surface Degradation and Surface Engineering Processes, Welding Technology
<b>Design</b>
Finite Element Methods, Fracture Mechanics, Fundamentals of Acoustics, Impact Mechanics of Solids, Mechanics and Control of Robotic Manipulators, Solid Mechanics, Continuum Mechanics, Wheeled Mobile Robots
<b>Thermo-fluids engineering</b>
Advanced Heat Transfer, Advanced Refrigeration and Air Conditioning, Aerospace Propulsion, Combustion, Computational Fluid Dynamics, Measurements in Thermo Fluids
<b>Note:</b> Students can credit the Elective courses, if they satisfy the prerequisites needed for the course.