B.Tech. (Honours) in ICT with a
Minor in Robotics and Autonomous Systems

(Effective from B.Tech. (ICT) 2021 batch onwards)

Course structure for B.Tech. (Hons.) ICT with a Minor in Robotics and Autonomous Systems (RAS) program with effect from 2021 Batch onwards is indicated below in table 1. Note that the courses pertaining to the Minor in RAS are given in red. Additionally, in table 2 below (on next page), the partitioning of the total credits among the different categories of the courses is given.

Table 1

Semester-1	L-T-P-C	Semester-2	L-T-P-C
Introduction to ICT	1-0-2-2	Approaches to Indian Society	3-0-0-3
Language and Literature	3-0-0-3	Discrete Mathematics	3-1-0-4
Calculus	3-1-0-4	Digital Logic and Computer Organization	3-0-2-4
Introduction to Programming	3-0-0-3	Data Structures	3-0-0-3
Programming Lab	0-0-2-1	Data Structures Lab using OOP	1-0-2-2
Basic Electronic Circuits	3-0-2-4	Electromagnetic Theory	3-1-0-4
CoCurr-1	0-0-2-1	CoCurr-2	0-0-2-1
		Exploration Project	0-1-0-1
TOTAL	**17**	**TOTAL**	**20**

Semester-3	L-T-P-C	Semester-4	L-T-P-C
Science, Technology, Society	3-0-0-3	Principles of Economics	3-0-0-3
Linear Algebra	3-1-0-4	Probability and Statistics	3-1-0-4
Design and Analysis of Algorithms	3-1-0-4	Database Management System	3-0-2-4
Computer Systems Programming	3-0-2-4	Embedded Hardware Design	3-0-2-4
Signal and Systems	3-0-2-4	Introduction to Communication Systems	3-0-2-4
CoCurr-3	0-0-2-1	CoCurr-4	0-0-2-1
Exploration Project	0-0-2-1	Introduction to Robotics	3-0-2-4
TOTAL	**19**	**TOTAL**	**19+(3/4)**

Semester-5	L-T-P-C	Semester-6	L-T-P-C
Software Engineering	3-0-2-4	Environmental Science	3-0-0-3
Digital Communications	3-0-2-4	**SE-1**	3-0-0-3
Computer Networks	3-0-2-4	ICTE-2	3-0-2-4
ICTE-1	3-0-2-4	TE-2	3-0-0-3
TE-1	3-0-0-3	TE-3	3-0-0-3
Introduction to Autonomous Systems	3-0-2-4	Robot Programming	1-0-2-3
Minor Elective-1*[1]	3-x-x-3/4	Minor Elective-1/2*[1/2]	3-x-x-3/4
TOTAL	**19+(3/4)**	**TOTAL**	**16+(3/4)**

Semester-7	L-T-P-C	Semester-8	L-T-P-C
BTP-1	0-1-6-4	BTP-2 / ITP*	0-2-12-8
ICTE-3	3-0-2-4	OE-1	3-0-0-3
TE-4	3-0-0-3	OE-2	3-0-0-3
HASSE-1	3-0-0-3		
SE-2	3-0-0-3		
Minor Elective-2*[2]	3-x-x-3/4		
Overload Slot			
TOTAL	13+4+(3/4)	TOTAL	6+8+(3/4)

*[1]Minor Elective-1 course should be in the area of Machine Learning/ Artificial Intelligence/ IoT/ Edge Computing or in any other area approved by the RAS group.

*[2]Minor Elective-2 course should be in the area of Computer Vision/ Mechatronics/ AR-VR/ SLAM or in any other area approved by the RAS group.

The courses "Introduction to Autonomous Systems", "Introduction to Robotics" and "Robot Programming" are designated as Minor's (RAS) core courses.

The elective courses basket for the minor electives (1 and 2) will be notified to the students of semesters 5, 6 and 7 (at the start of the respective semester) by the minor's coordinator in consultation with the UG convener and the RAS group. Students need to take courses from this basket only.

A student can opt for a Minor-Mini-Project, henceforth called as MMP, under the Minor Elective – 1/2 category. MMP will be of 3 credits. In a semester, a student can register for a single MMP. It implies that a MMP can be done in either/both of the semesters 5 and 6.

Type	Credits	Type	Credits
Core	90	Course Total	129
TE	12	Internships	7
ICTE	12	BTP/ITP	12
HASSE	3	Honours/Minor	15-18
SE	6	CoCurr	6
OE	6	TOTAL	148+6+(15-18)
Honours/Minor	15-18		
Rural Intern	3		
Res. Intern	4		
BTP/ITP	12		
Exp Proj	2		
CoCurr	4		

Graduation Requirement – BTech in ICT

1. Total credits   156 (included 6 co-curricular credits)
2. Course credits   129
3. Internships and BTP/ITP credits   19
4. Minimum Grade points   5.0

Additional Graduation Requirement – BTech (Hons.) in ICT with a Minor in RAS.

1. Number of Honours courses   5 (Core: 3 and Electives: 2)
2. Honours course credits   Min. 15
3. Minimum Grade points   6.5

B.Tech. (Hons.) ICT with a Minor in Robotics and Autonomous Systems (RAS) degree will be conferred on a student after he/she has fulfilled all the requirements for the B.Tech. (ICT) degree and has also fulfilled the additional requirements given above.

Policies, procedures and guidelines associated with the minor in RAS:

1. Students get an option to choose the minor at the end of **3rd semester**.
2. A minimum CPI of **6.5** at the end of 3rd semester is required to apply for the B.Tech. (Hons.) in ICT with a Minor in RAS.
3. A maximum of **30 students** will be allowed to enroll for the minor (RAS). In case more than 30 applications are received, selection will be done based on descending order of CPI.
4. Students may choose to drop out of the minor (RAS) in any semester. Once the student drops out, he/she cannot re-enroll for the minor (RAS).
5. Lateral entry to the minor (RAS) is not allowed. An option to enroll for the minor (RAS) will be available in semester 4 only. However, the minor (RAS) core courses and minor (RAS) elective courses will be open for all students under the TE category, i.e., without enrolling for the minor (RAS), a student can opt for these courses under the TE category.
6. A student must obtain passing grades in the five designated honors (three core and two electives) courses for the minor (RAS) to obtain the BTech (Hons.) in ICT with a Minor in RAS degree.
7. Enrolled students get an option to choose the RAS electives from 5th semester onwards.
8. Minor Mini Project (MMP) need to be approved by the minor's (RAS) coordinator in consultation with the UG convener. It has to be strictly in the area of Robotics, Autonomous systems, Cyber physical systems, Robotic vision, Machine vision.
9. Pertaining to BTP, there is no restriction on the area of work for the students enrolled in the minor (RAS). A student can choose a topic within the interest of the RAS group or any other area from the ICT domain.

Outline of the Minor's (RAS) core courses:

Introduction to Robotics

Course Overview, History of Robotics, Robot Arm, Kinematic Structure of Human Arm and Humanoid Robot; Coordinate Frames, Rotation Matrix, Translations, Euler Angles, Quaternion; Homogeneous Transform, Compound Transformations, Jacobians, Denavit-Hartenberg (D-H) Parameters; Inverse Kinematics, Inverse Kinematics for Position/Orientation/Velocities, Redundancy, Singularities; Equation of Motion, Euler-Lagrange Formulation, Newton-Euler Formulation; Sensors, Actuators, Control Overview, Joint Space Control, Trajectory Generation.

Introduction to Autonomous Systems

Understanding of dynamic of robot manipulators, mobile robots, and drones (quadrotors), controls for robotic systems for motion-planning, collision avoidance, trajectory optimization, grasping and manipulating objects. Simulation and experiments related to dynamics, trajectory generation, motion planning, and control of autonomous systems, such as robots, manipulators and drones.

Robot Programming

This course introduces students to the Robot Operating System (ROS) as well as to many of the available tools commonly used in robotics. Course focus on theory and hands-on, whereas hands-on will focus on

applications and implementations. Students learn how to create software and simulations, interface to sensors and actuators, and integrate control algorithms. The course works through exercises involving a number of autonomous robots (i.e., ground) that students could eventually use in their future robotics research.