M. Tech. (Embedded Systems)

The M. Tech. (Embedded System) course has been designed and launched in view of the heavy demand for the well trained engineers in this domain as forecast by various agencies including Department of Electronics and Information Technology-(DEITY), Government of India. The highlights of the course are given below:

Highlights of the Course

- The complete M. Tech. – Embedded System Program is industry oriented and is designed in accordance with the embedded industry needs.
- The unique feature of this course is that it has practical sessions in all subjects, so that students can have good “hands on” on various embedded system platforms and domains which will help them to reach closer to the industry requirements.
- This program will generate highly employable candidates which can meet the industry requirements in embedded system domain.
- Concept of industry based projects has been included in this program which will enable students to have live experience on the industrial projects.
- The industry oriented practical sessions and project work will also help in creating possibility of initial placement offers through collaborative efforts.
- Courses such as and Research Seminar and Advance Embedded Systems will help students to build a strong foundation for a career in research.
- As a part of the regular curriculum, the Value Added Courses on Embedded Linux, Device Drivers and Soft Skills support and improve the overall learning skills and professional image of a student.
- The curriculum and syllabi has been reviewed by top academic experts from IIT and leading industry experts.
- Highly qualified and experienced faculty is available to teach this course at ITMU.
## M. Tech. (Embedded Systems) Scheme Overview

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code &amp; Course Name</th>
<th>Minor Project</th>
<th>Dissertation/Practice School</th>
<th>Seminar/Training</th>
<th>*VA Course</th>
<th>Lecture Courses</th>
<th>Tutorials (T)</th>
<th>Practical (P)</th>
<th>Weekly Contact Hrs.</th>
<th>Credits (62)</th>
</tr>
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<tbody>
<tr>
<td><strong>First</strong></td>
<td><strong>ECL-533</strong> Real Time Systems (3-0-2)4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>ECV-531 Embedded Operating System</td>
<td>05</td>
<td>14</td>
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<td>10</td>
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<td></td>
<td><strong>ECL-501</strong> Digital Signal Processing (3-0-2)4</td>
<td>-</td>
<td>-</td>
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<td>ECV-532 Device Drivers</td>
<td>04</td>
<td>9</td>
<td>00</td>
<td>14</td>
<td>23</td>
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<td></td>
<td><strong>ECL-550</strong> Embedded System Design (3-0-2)4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>ECV-543 Soft Skills</td>
<td>03</td>
<td>7</td>
<td>00</td>
<td>12</td>
<td>19</td>
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<td></td>
<td><strong>ECL-527</strong> DSD (2-0-2)3</td>
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<td>ECV-604 @Laboratory Teaching Training</td>
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<td><strong>Second</strong></td>
<td><strong>ECL-544</strong> Networked Embedded Systems (3-0-2)4</td>
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<td><strong>ECL-546</strong> Real World Interfacing (2-0-2)3</td>
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<td><strong>Program Elective-1 (2-0-2)3</strong></td>
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<td><strong>Program Elective-2 (2-0-2)3</strong></td>
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<td><strong>Third</strong></td>
<td><strong>ECD-512</strong> Minor Project (0-0-4)2</td>
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<td></td>
<td><strong>$Open Elective (3 Credits)$</strong></td>
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<td><strong>Fourth</strong></td>
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</tbody>
</table>

*VA Course: Total course duration 5 days (30 Hrs.) and will be executed with/without regular time-table.

$Open Elective$: It is a '3' Credit course. The course delivery methodology L-T-P-C: 3-0-0-3 OR 2-0-2-3 will be applicable as per the course.

@Laboratory Teaching: Training is included in fourth semester where students will be associated with faculty in the labs.
The Semester Structure

Semester-FIRST

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>ECL-533</td>
<td>Real Time Systems</td>
<td>3-0-2</td>
<td>04</td>
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<td>2.</td>
<td>ECL-501</td>
<td>Digital Signal Processing</td>
<td>3-0-2</td>
<td>04</td>
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<td>3.</td>
<td>ECL-550</td>
<td>Embedded System Design</td>
<td>3-0-2</td>
<td>04</td>
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<td>4.</td>
<td>ECL-527</td>
<td>Digital System Design</td>
<td>3-0-2</td>
<td>04</td>
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<tr>
<td>5.</td>
<td>CSL-529</td>
<td>Data Structures</td>
<td>2-0-2</td>
<td>03</td>
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<td>6.</td>
<td>ECV-531</td>
<td>VA Course: Embedded Operating System</td>
<td>5 days (30 Hrs.)</td>
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Total Credits: 19
Total Contact Hours per Week: 24

Semester-SECOND

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>ECL-544</td>
<td>Networked Embedded Systems</td>
<td>3-0-2</td>
<td>04</td>
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<td>2.</td>
<td>ECL-546</td>
<td>Real World Interfacing</td>
<td>2-0-2</td>
<td>03</td>
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<td>3.</td>
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<td>Program Elective-1</td>
<td>2-0-2</td>
<td>03</td>
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<td>4.</td>
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<td>Program Elective-2</td>
<td>2-0-2</td>
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<td>5.</td>
<td>ECD-512</td>
<td>Minor Project</td>
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<td>6.</td>
<td>ECC-528</td>
<td>Research Seminar</td>
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<td>7.</td>
<td>ECV-532</td>
<td>VA Course: Device Driver</td>
<td>5 days (30 Hrs.)</td>
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</table>

Total Credits: 16
Total Contact Hours per Week: 23

Semester-THIRD

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>1.</td>
<td>ECL-641</td>
<td>Advance Embedded System Design</td>
<td>3-0-2</td>
<td>04</td>
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<td>2.</td>
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<td>Program Elective-3</td>
<td>2-0-2</td>
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<td>Open Elective</td>
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<td>4.</td>
<td>ECD-605</td>
<td>Thesis Phase-1</td>
<td>0-0-6</td>
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<td>5.</td>
<td>ECT-607</td>
<td>Summer Industrial Training</td>
<td>5 days a week (6 weeks)</td>
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<tr>
<td>6.</td>
<td>ECV-543</td>
<td>VA Course: Soft Skills</td>
<td>5 days (30 Hrs.)</td>
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</table>

Total Credits: 15
Total Contact Hours per Week: 19

Semester-FOURTH

<table>
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<tr>
<th>S.No.</th>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
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<tr>
<td>1.</td>
<td>ECD-602</td>
<td>Thesis Phase-2</td>
<td>0-0-24</td>
<td>12</td>
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</tbody>
</table>

Total Credits: 12
Total Contact Hours per Week: 24
Subject Wise Syllabus
Program Core (PC)

ECL-533 Real Time Systems
(L-T-P): (3-0-2)4
Task and Task Scheduling, Classical uni-
processor scheduling algorithms, uni-
processor scheduling of IRIS tasks,
Programming Languages and Databases,
Programming Environments, Real Time
Communications, Evaluation Techniques,
Operating Systems, Distributive Operating
Systems, Real Time Operating Systems, Real
Time Kernel, RTOS Application Domains,
Clock Synchronization, Fault Tolerant
Synchronization in software.

ECL-501 Digital Signal Processing
(L-T-P): (3-0-2)4
Signal Processing Review and Signal &
System Classification, Z-Transforms, Discrete
time Fourier transform, Filter Design,
Adaptive Filters, Multistage Representation,
Advanced Processors Architectures,
Applications of DSP, TMS 320 C54XX
Processor-Basic Programming, Convolution,
Correlation, Sampling of band pass signal-
anti-aliasing filter, Decimation, Interpolation,
D/A conversion - Introduction to wavelets.

ECL-550 Embedded System Design
(L-T-P): (3-0-2)4
Introduction to ESD, Emulator, RTOS, Task,
Semaphores and Shared Data Operating
system, Processor selection in Embedded
System (Microprocessor V/s Micro-
controller), Detailed Architecture of 8-bit
Microcontroller, Embedded System Development,
Networks for Embedded Systems, Introduction to 32-bit controller
(ARM7).

ECL-546 Real World Interfacing
(L-T-P): (2-0-2)3
Real World Interfacing, Embedded
Peripherals, Issues in Peripheral Selection,
Character LCD, Touch Pad, Touch Screen, ADC
(Analog-to-Digital Converter), DAC, RTC(Real
Time Clock), Analog Sensors, Digital Sensors,
PWM Motor Control, Graphical LCD,
UART/RS232, CAN, Bluetooth, Ethernet, RF
ID, I2C, SPI, USB(Universal Serial Bus), Smart
Cards, Hardware Implementations, Algorithm
Implementation, data communication and
transmission Protocols.

ECL-544 Networked Embedded System
(L-T-P): (3-0-2)4
Introduction to Embedded Network System,
Digital communication, Source detection and
Identification, Networking, Network
Management, Embedded network systems,
representation of signals, Signal propagation,
Sensor principles, Node architecture, Data
and Application, CAN Configuration, CAN
Development Tools, CAN Implementation,
Energy management, Data management,
Articulation mobility and infrastructure.

ECL-527 Digital System Design
(L-T-P): (3-0-2)4
Introduction to ASIC Design Flow,
VerilogHDL-Language Constructs and
Conventions, Modeling in VerilogHDL, Design
of Combinational Circuit; Design of Sequential
Circuits; FSM, Functions, Tasks, User Defined
Primitives, Programming Language Interface,
Actel ACT - Xilinx LCA - Xilinx EPLD - Altera
MAX 5000 and 7000 - Altera MAX 9000 Altera
FLEX, Anti fuse, Programmable logic cells and
I/O cells, Floor planning, placement and
routing.

ECL-641 Advance Embedded System
Design
(L-T-P): (3-0-2)4
Introduction and Review of Embedded
Hardware, Embedded Hardware-Software
and Peripherals, Architecture of 32-bit
controller (ARM), Embedded C Programming
on ARM, Comparison of ARM7/ARM9/ARM11, RTOS porting on ARM
controller, Custom single purpose processors:
Hardware, Combination Sequence, Processor design, RT level design, Finite state machines - Models- HCFSL and state charts language - state machine models - Concurrent process model.

Engineering Arts & Science (EAS) Core

**CSL-529 Data Structures**  
*(L-T-P)*: *(2-0-2)*  

VA Courses

**ECV-531 Embedded Operating System**  

**ECV- 543 Soft Skills**  

**ECV-532 Device Drivers**  
Essential Tools for basic System Administration, Manage Virtual Machines, Package Management, Network Configuration, File system Administration, Additional Storage, Troubleshooting using the Rescue Mode. Introduction to Shell Programming, Command Line Features, Fundamentals of Shell Scripts, Decision Making Constructs, Iterative Constructs, Bash Arithmetic, Miscellaneous Features, e.g., shift, read, etc.
Program Elective (PE)

ECL-548 Pervasive Computing  
(L-T-P): (2-0-2)3

ECL-552 Embedded Software Testing  
(L-T-P): (2-0-2)3
Fundamentals of Testing, Role of Testing in SDLC, Approaches to Static Testing, approaches to Dynamic Testing, Test Management, Testing Tools, Testing Object Oriented Software The Three Principles of Quality, abstraction, recursion, algorithm design and complexity analysis, quality assurance and configuration management, black box testing, risk analysis, troubleshooting and problem reporting, state models, testing APIs, Machine & Assembly Language.

ECL-554 Computer Vision  
(L-T-P): (2-0-2)3
Elements of visual perception, Basic geometric transformations, Separable Image Transforms, Hadamard, Discrete Cosine Transform, Haar, Slant, Image averaging, Image smoothing, sharpening filters, Cameras and optics, Light and color, Pixels and image filters, Introduction to MATLAB and OpenCV, Noise models, Noise reduction, Canny Edge Detection, Viola Jones algorithm, supervised and unsupervised machine learning, Neural networks Using MATLAB.

ECL-538 Hardware – Software Co-design  
(L-T-P): (2-0-2)3
Introduction to hardware & software co-design, Hardware Software back-ground and Hardware Software co-design research, Co-design concepts as functional decomposition and virtual machines, Methodology for co-design and Unified representation for Hardware & Software, Abstract Hardware & Software model, Performance Evaluation, Object oriented techniques in hardware design.

ECL-542 Designing with ASICs  
(L-T-P): (2-0-2)3
ASIC Design Flow, Types of ASICs, CMOS logic cell, Data Path Logic Cells, I/O Cells, ASIC Library Design, Logic synthesis, Low Level Design Entry, Overview of VHDL & VerilogHDL, PLA Tools, EDIF. Logic Synthesis in Verilog and VHDL Simulation. ASIC Construction, Floor Planning, Placement, physical design flow, global routing, detailed routing, special routing, circuit extraction – DRC.

ECL-639 Bluetooth Technology  
(L-T-P): (2-0-2)3

ECL-556 Software Modeling for Embedded System  
(L-T-P): (2-0-2)3
Introduction to Data Representation, Programming in Assembly, Object Oriented Analysis, Connecting the object model with the use case model, UML-Unified Modeling Language, Software/Hardware Partitioning-Co Designing and Co Simulation Techniques. Low level programming in C, Primitive data types, Functions, recursive functions,
Pointers, Structures, Unions, Dynamic memory allocation, File handling, Linked lists.

**ECL-643 Advance Digital Image Processing**
*L-T-P*C: *(2-0-2)*
Basic operations on matrices and other mathematical analysis techniques, Sensor and Imaging: Imaging Optics, Radiometry of Imaging, Illumination source and techniques, Camera Principles, Color Imaging, Range Images, 3D Imaging, Signal Representation, Encoding, JPEG, JPEG - 2000, MPEG1, MPEG4, and MPEG7. Object Analysis and Classification, Neural Network Classifiers, Shape Reconstruction from Volumetric Data.

**ECL-645 Fault Tolerant Systems**
*L-T-P*C: *(2-0-2)*
Fundamental Concepts- Reliable Computer Systems Design, Redundancy theory, limit theorems; decision theory in redundant systems, Fault tolerance, detection of Faults, Replication, Compression, detection of Faults, Replication and Self-Repairing Techniques, concentrated and distributed voters, models of fault tolerant computing systems, Implementation techniques, Coding theory: application to fault tolerant system design.

**ECL-647 Reconfigurable Computing**
*L-T-P*C: *(2-0-2)*

**ECL-558 Embedded Robotics**
*L-T-P*C: *(2-0-2)*

**ECL-649 Real Time Operating System**
*L-T-P*C: *(2-0-2)*

**ECL-651 Wireless Mobile Communication and Its Applications**
*L-T-P*C: *(2-0-2)*
Cellular systems, types of handoff and their characteristics, MAC, SDMA, FDMA, TDMA, CDMA, Wireless LAN, IEEE 802.11 Standards, Mobile Ad hoc Networks, WiFi and WiMAX, Wireless Local Loop, GSM-architecture, SMS, VoIP, GPRS, PDP, Mobile IP Dynamic Host Configuration Protocol, Multicast routing, TCP over Wireless Networks Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks, WAP Model, WML.
Engineering Arts and Science Elective (EAS)

CSL-653 Data Compression
(L-T-P): (2-0-2)3

CSL-517 Advances in Operating System
(L-T-P): (2-0-2)3