

Faculty Mission: Enable 49 ML & AI Solutions

That 1.4 Billion People Are Waiting For

Where Intelligent Software Meets Designed-and-Built-in-India Hardware

Appendix E: Certification & Compliance

What Nobody Teaches Until the Product Cannot Be Sold

E-1 Landscape · E-2 BIS CRS · E-3 WPC · E-4 TEC · E-5 CDSCO · E-6 AIS 140 · E-7 Food/Pharma · E-8 Industrial · E-9 Export · E-10 Cost & Timeline · E-11 Template · E-12 Standards

For: All Faculty · ECE & CSE Students Building Deployable Products · Anyone Who Has Ever Been Asked 'What is your WPC approval number?' and Answered with Silence

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Why This Appendix Exists

The most expensive lesson in product engineering:

Three years of development. ₹25 lakh invested. Product ready to ship.

Someone asks: 'What is your WPC approval number?' Silence.

'Your BIS CRS registration?' Silence.

'Your TEC type approval for the cellular modem?' Silence.

The product cannot be legally sold in India.

Three years. ₹25 lakh. Zero revenue.

This appendix ensures your students never have that conversation.

Certification is not the last step.

It is designed into the product from Day 1.

Or it costs 10× more to retrofit.

Section	Content
E-1	India Certification Landscape — Complete Overview
E-2	BIS CRS — Compulsory Registration Scheme
E-3	WPC Equipment Type Approval — Wireless Products
E-4	TEC Type Approval — Telecom Connected Devices
E-5	Medical IoT Certification — CDSCO Deep Dive
E-6	Automotive IoT — AIS 140 & Related Standards
E-7	Food & Pharma — FSSAI, WHO PQS, Schedule M
E-8	Industrial & Safety — ATEX, DGMS, Legal Metrology
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E-10	Certification Cost & Timeline Guide
E-11	Certification Planning Template
E-12	Engineering Standards Every IoT Engineer Must Know

E-1: India Certification Landscape — The Complete Map

The Three Categories of Certification

CATEGORY 1: MANDATORY – CANNOT SELL WITHOUT

- BIS CRS – all electronic products in schedule
- WPC Type Approval – all wireless devices
- TEC Type Approval – all telecom-connected devices
- CDSCO – medical devices
- AIS 140 – commercial vehicle tracking
- Legal Metrology – billing instruments (meters, scales)
- FSSAI – food contact + food safety devices

CATEGORY 2: DOMAIN MANDATORY – REQUIRED FOR SPECIFIC USE

- ATEX / IECEX – explosive atmosphere (coal mines, chemical plants)
- DGMS – mine safety equipment
- CPCB OCEMS – industrial effluent monitoring
- CEA approval – grid-connected energy equipment
- RDSO – railway equipment
- WHO PQS – vaccine cold chain equipment

CATEGORY 3: EXPORT MANDATORY – REQUIRED TO SELL OUTSIDE INDIA

- CE Mark – European Union
- FCC ID – United States
- UKCA – United Kingdom (post-Brexit)
- IC – Industry Canada
- RCM – Australia + New Zealand

The India Certification Authority Map

Authority	Full Name	What It Certifies	Website
BIS	Bureau of Indian Standards	Electronic products — safety + EMC + quality	bis.gov.in
WPC	Wireless Planning & Coordination Wing, DoT	All wireless transmitting devices	dot.gov.in/wpc
TEC	Telecom Engineering Centre	Telecom network-connected equipment	tec.gov.in
CDSCO	Central Drugs Standard Control Organisation	Medical devices + in-vitro diagnostics	cdsco.gov.in
IRDAI	Insurance Regulatory and Development Authority	Vehicle telematics, health IoT (insurance)	irdai.gov.in
CEA	Central Electricity Authority	Grid-connected equipment, smart meters	cea.nic.in
DGMS	Directorate General of Mines Safety	Mine safety equipment	dgms.gov.in
RDSO	Research Designs & Standards Organisation	Railway equipment	rdso.indianrailways.gov.in
Legal Metrology	Legal Metrology Department, DPIIT	Weighing + measuring instruments for trade	legalmetrology.gov.in
FSSAI	Food Safety & Standards Authority of India	Food contact materials, food monitoring devices	fssai.gov.in

Authority	Full Name	What It Certifies	Website
NABL	National Accreditation Board for Testing & Calibration	Laboratory calibration + testing	nabl-india.org
NPL	National Physical Laboratory	Primary measurement standards	nplindia.org
MHA	Ministry of Home Affairs	Defence, border, surveillance equipment	mha.gov.in
ECI	Election Commission of India	Election technology	eci.gov.in

The Certification Decision Tree

Is the device sold in India?

- └ YES → Does it have any wireless radio?
 - └ YES → WPC Type Approval MANDATORY
 - + Does it connect to telecom network (4G/NB-IoT)?
 - └ YES → TEC Type Approval ALSO MANDATORY
 - └ NO → Is it an electronic product in BIS CRS schedule?
 - └ YES → BIS CRS registration MANDATORY

Is it a medical device or diagnostic?

- └ YES → CDSCO registration MANDATORY (Class A/B/C/D)

Is it used in a vehicle commercially?

- └ YES → AIS 140 compliance may apply

Does it measure for billing (energy, water, weight)?

- └ YES → Legal Metrology type approval MANDATORY

Is it used in food processing/contact?

- └ YES → FSSAI compliance required

Is it used in a mine or explosive atmosphere?

- └ YES → ATEX/IECEX + DGMS MANDATORY – no compromise

Is it used on Indian Railways?

- └ YES → RDSO approval MANDATORY

Is it exported to EU?

- └ YES → CE Mark MANDATORY

Is it exported to USA?

- └ YES → FCC ID MANDATORY

E-2: BIS CRS — Compulsory Registration Scheme

BIS CRS (Compulsory Registration Scheme) under BIS Act 2016 mandates that specific electronic products sold in India must be registered with the Bureau of Indian Standards.

Without BIS CRS:

Product cannot be legally imported into India

Product cannot be legally manufactured in India for sale

Penalty: product seizure + fine up to ₹2 lakh + imprisonment

BIS CRS Product Categories Relevant to IoT

Product Category	IS Standard	Key Requirements	Notes
Mobile phones	IS 13252 (Part 1)	Safety + EMC + SAR	Includes IoT devices with phone functionality
Laptops/tablets	IS 13252	Safety + EMC	Edge compute devices
Power adapters/chargers	IS 13252	Safety + efficiency	Every IoT power supply
LED drivers + luminaires	IS 15885 + IS 16102	Safety + efficiency	Smart lighting (SC-4)
Smart energy meters	IS 16444	Accuracy + safety + tamper	Mandatory for billing-grade (EN-1)
Inverters + UPS	IS 16242	Safety + efficiency	Solar + backup power (EN-2)
CCTV cameras	IS 13252	Safety + EMC	Surveillance IoT (GV-3)
Wearable devices	IS 13252	Safety + SAR	Health IoT wearables (HC-1, HC-6)
Smart meters (water/gas)	IS standards + Legal Metrology	Safety + accuracy	Utility metering (SC-1)

The BIS CRS Registration Process

STEP 1: IDENTIFY APPLICABLE IS STANDARD

- Check BIS CRS product schedule
- Identify IS number for your product category
- Download IS standard from BIS website (paid document)

STEP 2: PRODUCT TESTING

- Submit product samples to NABL-accredited test lab
- Lab tests against IS standard – safety + EMC
- Labs: ERTL (government), TUV SUD, Intertek, Bureau Veritas
- Timeline: 4-8 weeks
- Cost: ₹50,000-₹3,00,000 depending on product complexity

STEP 3: FACTORY AUDIT (for some categories)

- BIS auditor visits manufacturing facility

- └ Verifies production quality system
- └ Timeline: 2-4 weeks after test report
- └ Cost: ₹25,000-₹75,000 travel + audit fee

STEP 4: BIS APPLICATION

- └ Online portal: crsbis.in
- └ Timeline: 4-8 weeks review
- └ Fee: ₹10,000-₹50,000

STEP 5: REGISTRATION CERTIFICATE

- └ Valid for 2 years - renewable every 2 years
- └ Renewal cost: ₹10,000-₹30,000

TOTAL TIMELINE: 3-6 months from start to certificate
TOTAL COST: ₹1,00,000-₹5,00,000 for typical IoT product

BIS CRS Design Checklist — Design In from Day 1

- Identify IS standard applicable to your product before starting design
- Read IS standard safety section — creepage + clearance requirements
- Read IS standard EMC section — conducted + radiated emissions limits
- Design PCB to meet IS safety requirements — isolation voltages
- Select components with safety ratings matching IS requirements
- Keep component markings visible on assembled PCB — BIS requires it
- Design BIS mark placement into enclosure moulding
- Prepare documentation: circuit diagram, BOM, test points, operating manual
- Budget ₹1-₹5 lakh and 3-6 months for registration
- Identify NABL test lab before first prototype — get pre-submission advice

E-3: WPC Equipment Type Approval — Mandatory for Every Wireless Device Sold in India

WPC (Wireless Planning & Coordination Wing) under DoT regulates all wireless equipment in India.

India's general exemptions (no WPC ETA needed):

WiFi 2.4 GHz indoor, < 100 mW: exempt

BLE < 10 mW: generally exempt

LoRa 865–867 MHz < 1W EIRP: exempt (Short Range Device)

Zigbee 2.4 GHz < 100 mW: exempt

WPC ETA required:

Any 5 GHz WiFi outdoor

Any cellular (4G, NB-IoT, 5G) — TEC approval also required

Any satellite transmitter

Any product marketed as a wireless communication device

India Frequency Exemptions — Quick Reference

Technology	Frequency	Power Limit	WPC ETA Required?	Notes
WiFi 802.11b/g/n	2.4–2.4835 GHz	100 mW EIRP	No — exempt	Indoor only
WiFi 802.11ac/ax	5.15–5.35 GHz	200 mW EIRP	No — exempt	Indoor only
WiFi 5 GHz outdoor	5.470–5.725 GHz	1W EIRP	Yes — ETA required	Outdoor 5 GHz regulated
BLE 5.x	2.4–2.4835 GHz	100 mW EIRP	No — exempt	Low power
Zigbee	2.4–2.4835 GHz	100 mW EIRP	No — exempt	—
LoRa / LoRaWAN	865–867 MHz	1W EIRP	No — SRD exempt	NOT 868 MHz — European band
NB-IoT	Carrier band	Carrier controlled	No — via carrier SIM	Carrier holds approval
4G LTE (in device)	Carrier band	Carrier controlled	TEC approval required	See E-4
Satellite uplink	Various	Carrier controlled	Yes — WPC required	VSAT, Iridium uplink
RFID 865–867 MHz	865–867 MHz	4W EIRP	No — SRD exempt	UHF RFID

The WPC ETA Process

STEP 1: DETERMINE IF ETA IS NEEDED

- Check WPC exemption list for your frequency + power
- If exempt: no ETA needed – maintain compliance documents
- If not exempt: proceed to ETA application

STEP 2: TYPE TESTING

- Test at WPC-approved test lab or NABL lab
- Tests: frequency accuracy, power output, spurious emissions, occupied BW
- Timeline: 4-8 weeks
- Cost: ₹25,000-₹1,50,000

STEP 3: WPC APPLICATION

- Online portal: sachet.dot.gov.in/ims
- Fee: ₹1,000-₹10,000 (government fee – low)
- Timeline: 4-8 weeks review
- WPC ETA certificate valid for 5 years

TOTAL TIMELINE: 2-4 months

TOTAL COST: ₹30,000-₹2,00,000 including testing

E-4: TEC Type Approval — Mandatory for Cellular-Connected IoT Devices

TEC (Telecom Engineering Centre) under DoT mandates that any equipment connecting to India's telecom network must have TEC Type Approval.

This includes:

- Any device with 4G LTE modem
- Any device with NB-IoT modem
- Any device with 5G modem
- Routers, gateways with cellular backhaul
- Industrial IoT devices with cellular connectivity

The TEC Type Approval Process

STEP 1: IDENTIFY APPLICABLE ESD

- TEC publishes ESD (Equipment Specification Document) for each category
- Download relevant ESD from tec.gov.in
- Understand mandatory + optional test requirements

STEP 2: MODEM CERTIFICATION VERIFICATION

- The cellular modem chip must already have:
 - 3GPP certification (global - from chip manufacturer)
 - WPC ETA (for India frequency approval)
- Use a certified modem module - reduces your testing significantly

STEP 3: DEVICE LEVEL TESTING

- Test at TEC-approved lab
- Tests: EMC + safety + network compatibility + interface compliance
- Timeline: 6-10 weeks
- Cost: ₹50,000-₹2,00,000

STEP 4: TEC APPLICATION

- Online portal: tec.gov.in
- Fee: ₹10,000-₹50,000
- Timeline: 4-8 weeks
- Certificate valid for 3 years

TOTAL TIMELINE: 3-5 months

TOTAL COST: ₹1,00,000-₹3,50,000

Certified Modem Modules — Use These, Not Discrete Chips

Using a pre-certified cellular modem module: module has 3GPP + WPC + TEC (for module) already. Your product testing is reduced significantly. Faster time to certification. Lower risk of test failure.



Module	Technology	India Bands	Certifications	Source
Quectel EC21-G	4G LTE Cat-1	B1/B3/B5/B8/B28	WPC + TEC + CE + FCC	Mouser India
Quectel BC660K	NB-IoT	B1/B3/B5/B8/B20/B28	WPC + TEC + CE	Mouser India
Quectel BG77	4G + NB-IoT + GNSS	Multi-band India	WPC + TEC + CE + FCC	Mouser India
Sierra Wireless HL7800	4G LTE Cat-M/NB-IoT	India bands	WPC + TEC + CE + FCC	Arrow India
u-blox SARA-R410M	4G LTE Cat-M + NB-IoT	Global bands	WPC + TEC + CE + FCC	Mouser India
Telit ME910C1-WW	NB-IoT worldwide	India bands	WPC + TEC + CE	Arrow India

E-5: Medical IoT Certification — CDSCO — The Highest Regulatory Bar in India

CDSCO (Central Drugs Standard Control Organisation)
under Ministry of Health & Family Welfare
regulates medical devices in India under Medical Devices Rules 2017.

Any device that diagnoses, monitors, treats or prevents disease,
measures a physiological parameter,
or is intended for use in or on the human body
— must be registered with CDSCO.

Failure to register = illegal medical device.
Penalty: imprisonment up to 3 years + fine.
For adulterated medical device causing death: 7+ years imprisonment.

Medical Device Classification — India

Class	Risk Level	Examples in IoT	Regulatory Path
Class A	Low risk	Thermometer (non-electronic), bandage	Self-declaration + enrollment
Class B	Low-moderate	Electronic thermometer, pulse oximeter, BP monitor, ECG monitor, RPM device	CDSCO enrollment + conformity assessment
Class C	Moderate-high	Implantable devices, ventilators, glucose meters	CDSCO license + audit
Class D	High risk	Implantable pacemaker, coronary stent, HIV test kit	CDSCO license + clinical evaluation + audit

For IoT health devices — most fall in Class B:
Wearable ECG — Class B
SpO₂ monitor — Class B
RPM device — Class B
Smart BP cuff — Class B
Fetal monitor — Class B/C

The CDSCO Registration Process for Class B IoT Device

STEP 1: DETERMINE CLASSIFICATION

- Review Medical Devices Rules 2017 – Schedule III classification
- Class B for most wearable monitoring IoT devices

STEP 2: SAFETY & PERFORMANCE TESTING

- IEC 60601-1: General safety – electrical, mechanical, radiation
- IEC 60601-1-2: EMC – electromagnetic compatibility
- IEC 60601-1-6: Usability engineering
- Device-specific: IEC 60601-2-47 (ECG), IEC 60601-2-55 (SpO₂/fetal)
- Testing at NABL + CDSCO notified lab
- Timeline: 3-6 months
- Cost: ₹3,00,000-₹10,00,000

STEP 3: QUALITY MANAGEMENT SYSTEM

- ISO 13485 – Medical device quality management
- Audit by accredited body
- Timeline: 6-12 months to implement + audit
- Cost: ₹5,00,000-₹20,00,000 for implementation

STEP 4: CLINICAL EVALUATION

- Literature review of similar devices
- Clinical data if novel device
- Timeline: 3-12 months
- Cost: ₹2,00,000-₹50,00,000 for clinical study

STEP 5: CDSCO APPLICATION (MD-7 import / MD-13 manufacture)

- Online portal: cdsco.gov.in
- Fee: ₹10,000-₹50,000 government fee
- Timeline: 3-6 months
- License valid: 3-5 years with surveillance

TOTAL TIMELINE: 12-24 months for Class B device

TOTAL COST: ₹15,00,000-₹80,00,000

Critical Medical IoT Safety Requirements — IEC 60601-1

Applied Part Type	Protection Level	Use Case	Leakage Current Limit
Type B	Basic — not isolated from earth	Non-cardiac, not directly connected	< 100 μ A
Type BF	Floating — isolated from earth	ECG patches, most wearables	< 10 μ A to patient
Type CF	Cardiac floating — highest isolation	Cardiac catheters, pacemaker lead connections	< 10 μ A — strictest

THE MOST IMPORTANT WARNING FOR MEDICAL IoT STUDENTS:

Do NOT use any biometric sensor on a real human being without CDSCO clearance. This is not an engineering caution. It is a legal prohibition.

An ECG module from Amazon connected to a student's chest is an illegal unregistered medical device.

For POC — use only:

Cardiac simulators — IEC 60601 standard simulation signals

Publicly available ECG datasets — PhysioNet

Mannequins or phantom simulators

NEVER connect body electrodes to mains-referenced circuits

For any human subject testing:

Ethics committee approval from college + hospital

CDSCO approval or investigational device exemption

Informed consent documentation

Principal investigator must be a registered medical professional

E-6: Automotive IoT — AIS 140 — Mandatory for Commercial Vehicles

AIS 140 (Automotive Industry Standard 140) mandates vehicle location tracking for:

- All commercial passenger vehicles (buses, taxis, school buses)
- All goods carriages above a specified GVW
- Government vehicles

Mandated by Ministry of Road Transport & Highways (MoRTH) under Motor Vehicles Act 1988 amendment.

AIS 140 Technical Requirements

Requirement	Specification	Notes
GNSS	GPS + GLONASS minimum, NavIC recommended	NavIC mandated from 2024 for new devices
Cellular	4G LTE (with 2G/3G fallback)	Must work in areas with 2G only coverage
Emergency button	Panic button — 5-second hold	Sends alert to control room + police
Data protocol	AIS 140 binary protocol — specific packet format	Not a proprietary format
Position accuracy	< 5m CEP (Circular Error Probable)	Multi-constellation GNSS required
Position frequency	Every 5 seconds when moving	Every 30 seconds when stationary
Tamper detection	Hardware + software tamper detection	Report to server if device tampered
Operating temperature	-20°C to +70°C	Vehicle interior conditions
Power supply	9–36V DC (12V/24V vehicle)	Voltage transient protection per ISO 7637
Battery backup	Minimum 4 hours	If vehicle power cut
IP rating	IP65 minimum	Dust and splash protection

AIS 140 Certification Process

STEP 1: ICAT OR ARAI TESTING

- ICAT (International Centre for Automotive Technology) – Manesar
- ARAI (Automotive Research Association of India) – Pune
- Tests: GNSS accuracy, cellular protocol, EMC, environmental, tamper
- Timeline: 4-8 weeks
- Cost: ₹1,00,000-₹3,00,000

STEP 2: MoRTH TYPE APPROVAL

- Submit test report to MoRTH
- Register device on Vahan portal
- Timeline: 4-8 weeks
- Cost: ₹10,000-₹30,000

STEP 3: STATE TRANSPORT SERVER INTEGRATION

- Each state has different VTS server – integrate your device
- Use AIS 140 standard protocol
- Timeline: 2-6 months for major states

TOTAL TIMELINE: 3-6 months

TOTAL COST: ₹1,50,000-₹4,00,000

E-7: Food & Pharma Certification — FSSAI, WHO PQS, Schedule M

FSSAI — Food Safety & Standards Authority of India

Aspect	Requirement	Application
Food contact materials	FSSAI approved materials only	Any sensor touching food or food packaging
Temperature monitoring	Schedule 4 calibration requirements	Cold chain temperature loggers (CC-1)
Laboratory equipment	NABL accreditation for testing labs	Food quality testing IoT
Food business operator	FBO license if operating a food business	Cold chain service providers
Sensor calibration	FSSAI grade calibration — not just NABL	Temperature sensors for food cold chain

WHO PQS — Vaccine Cold Chain Equipment Standards

Standard	Coverage	Key Requirements	Certification Body
WHO PQS E6/TR06	Temperature monitoring devices for immunisation	±0.5°C accuracy, 30-day battery, data logger	WHO — Geneva
WHO PQS E3	Refrigerators + freezers for vaccines	Temperature uniformity, recovery time	WHO
WHO PQS E4	Cold boxes and vaccine carriers	Thermal performance, duration	WHO
WHO TIR32	Temperature monitoring in pharmaceutical supply chain	±0.1°C for pharma grade	WHO

Schedule M — Pharmaceutical GMP

Schedule M under Drugs & Cosmetics Act 1940 mandates Good Manufacturing Practice.

Key Schedule M requirements for IoT:

Data integrity — all records accurate, legible, complete, original, attributable

Audit trail — who changed what, when — electronic records

Data backup — all monitoring data backed up

Calibration — all instruments with calibration records

21 CFR Part 11 (US FDA) — for Indian pharma exporting to USA:

Electronic records and signatures — validation required

Audit trail — mandatory for all GxP systems

Applicable to any pharma IoT data system for US-export products

E-8: Industrial & Safety Certification — ATEX, DGMS, Legal Metrology

ATEX / IECEx — Explosive Atmosphere Certification

Mandatory for any device used in:

- Coal mines (methane zones)
- Chemical plants (flammable vapour)
- Grain silos above 50 g/m³ dust concentration
- Petroleum refineries
- Paint spray booths

Zone	Description	Gas/Dust	Frequency
Zone 0 / Zone 20	Explosive atmosphere continuously present	Gas / Dust	Always
Zone 1 / Zone 21	Explosive atmosphere likely in normal operation	Gas / Dust	Normal operation
Zone 2 / Zone 22	Explosive atmosphere unlikely — abnormal only	Gas / Dust	Abnormal only

ATEX Protection Concepts for IoT

Protection Concept	Code	How It Works	Best For
Intrinsic Safety	Ex ia / Ex ib	Limits energy so no ignition possible	Sensors, transmitters — low power (EN-5, MF-2)
Flameproof	Ex d	Explosion contained inside housing	High-power devices
Increased Safety	Ex e	No sparks in normal operation	Junction boxes, terminals
Encapsulation	Ex m	Potted in compound — no ignition path	Electronics modules
Purge + Pressurisation	Ex p	Positive pressure keeps gas out	Control panels

For IoT gas sensors in mines: Intrinsic safety (Ex ia) is the correct protection concept. Circuit must be certified intrinsically safe — not just the enclosure. Every component in the sensor circuit must be IS certified. This is why ATEX certification costs ₹10–₹50 lakh. It is not just the box — it is the entire electrical design.

Legal Metrology — Billing Instruments

The Legal Metrology Act 2009 mandates that any instrument used for trade measurement must have Legal Metrology type approval.

Trade measurement = measurement used for:

Determining price of goods/services (billing)

Determining duty, tax, freight

Determining compliance with regulations

Device	Standard	Solution
Smart energy meter	BIS IS 16444 + OIML R46	EN-1
Water meter for billing	BIS IS 779 + OIML R49	SC-1
Smart weighing machine	BIS IS 9281 + OIML R76	GR-4, GR-5
Fuel dispenser	OIML R117	Transport sector
Grain procurement weighing	Legal Metrology Packaged Commodities Rules	GR-5, GR-4

The Legal Metrology type approval process:

Apply to State Legal Metrology Controller or DPIIT for national approval

Testing at NABL accredited metrology lab

Stamp/seal requirement — every instrument must be verified and stamped by Inspector of Weights & Measures

Timeline: 6–12 months

Renewal: every 2 years for instruments in trade use

E-9: Export Certification — CE Mark, FCC ID, UKCA

CE Mark — European Union

CE Mark = Conformité Européenne. Mandatory for all products sold in the European Union.

For IoT products — applicable directives:

- RED (Radio Equipment Directive 2014/53/EU) — all wireless devices
- LVD (Low Voltage Directive 2014/35/EU) — electrical safety
- EMC Directive (2014/30/EU) — electromagnetic compatibility
- RoHS (2011/65/EU) — restriction of hazardous substances
- GDPR — data protection (software/cloud component)

CE Mark process:

- Test product against harmonised European standards (EN standards)
- Prepare Technical Construction File (TCF)
- Write Declaration of Conformity (DoC)
- Apply CE mark — self-declaration for most products
- Timeline: 3–6 months | Cost: ₹3,00,000–₹8,00,000

FCC ID — United States

FCC ID mandatory for all intentional RF emitters sold in USA.

Issued by FCC-authorized Telecommunication Certification Body (TCB).

FCC testing:

- Radiated + conducted emissions — FCC Part 15
- RF exposure (SAR) — FCC Part 1.1310
- Specific technology tests: FCC Part 22 (cellular), Part 24, Part 27

Two paths:

1. Certification (FCC ID): Required for intentional radiators — WiFi, BLE, LoRa, cellular
2. SDoC (Supplier Declaration of Conformity): For unintentional radiators — computers, power supplies

FCC process:

- Test at FCC-accredited lab (A2LA accredited)
- Submit to TCB (Telecommunication Certification Body)
- FCC ID issued and listed on FCC database
- Timeline: 2–4 months | Cost: ₹2,00,000–₹6,00,000

Certification Comparison Table — Complete

Certification	Market	Authority	Timeline	Cost (₹)	Self-Declaration?
BIS CRS	India	BIS	3–6 months	1–5 lakh	No — lab + BIS
WPC ETA	India	WPC/DoT	2–4 months	30K–2 lakh	No — WPC
TEC TA	India	TEC/DoT	3–5 months	1–3.5 lakh	No — TEC
CDSCO (Class B)	India	CDSCO	12–24 months	15–80 lakh	No — CDSCO license
AIS 140	India	MoRTH/ICAT	3–6 months	1.5–4 lakh	No — ICAT
Legal Metrology	India	DPIIT/State	6–12 months	1–5 lakh	No — Inspector stamp
ATEX/IECEX	India + export	IECEX	6–18 months	10–50 lakh	No — notified body
CE Mark	EU	Self + Notified Body	3–6 months	3–8 lakh	Mostly yes + TCF
FCC ID	USA	FCC TCB	2–4 months	2–6 lakh	No — TCB
UKCA	UK	UKAS	3–6 months	3–8 lakh	Mostly yes + TCF
WHO PQS	Global	WHO	6–18 months	5–30 lakh	No — WHO evaluation

E-10: Certification Cost & Timeline Guide — Realistic Numbers for Product Planning

Scenario 1: Indian Smart Agriculture Sensor (LoRa + NB-IoT + Soil + Solar) — India + EU Export

Certification	Required?	Cost	Timeline	Notes
BIS CRS	Yes	₹1,50,000	4 months	IS 13252 safety + EMC
WPC ETA	Exempt	₹0	—	LoRa 865 MHz < 1W exempt
TEC TA	Yes (NB-IoT)	₹1,00,000	3 months	Quectel module pre-certified helps
CE Mark (RED)	Yes (EU export)	₹4,00,000	4 months	EN 300 220 + EN 301 521 + LVD
NABL calibration (soil sensor)	Yes	₹50,000	2 months	Per batch + annual
TOTAL		₹7,00,000	~8 months	Parallel testing reduces clock time

Scenario 2: Wearable Remote Patient Monitoring (BLE ECG + SpO₂ + ABDM) — India Only, Class B

Certification	Required?	Cost	Timeline
CDSCO Class B	Yes	₹20,00,000	18 months
BIS CRS	Yes	₹1,50,000	4 months
WPC ETA	Exempt (BLE)	₹0	—
ISO 13485 QMS	Yes (for CDSCO)	₹10,00,000	12 months
IEC 60601-1 testing	Yes (for CDSCO)	₹5,00,000	4 months
TOTAL		₹36,50,000	18–24 months

This is why medical IoT requires serious investment.

A college project with AD8232 on a breadboard is 24 months and ₹36 lakh away from being a legal product.

Know this. Plan for it. Or don't call it a medical device.

Certification Planning — When to Start

PRODUCT DEVELOPMENT TIMELINE WITH CERTIFICATION:

Month 1: Requirements + architecture – IDENTIFY all certifications needed
Month 2-3: Schematic + PCB design – DESIGN for compliance
(ground plane, isolation, safety materials)
Month 4: First prototype – PRE-COMPLIANCE testing
(NanoVNA, PPK2, near-field probe)
Month 5: PCB revision based on pre-compliance – SUBMIT to test lab
Month 6-8: Formal testing at lab – PARALLEL certification applications
Month 9-10: Certification received – PRODUCT RELEASE

WRONG WAY:

Month 1-8: Build product without thinking about certification
Month 9: Submit to test lab – FAIL EMC
Month 10: Redesign PCB – resubmit
Month 11: Pass – apply for BIS CRS
Month 14: BIS registration received
(5 months late, ₹3 lakh extra testing costs)

BUILD CERTIFICATION IN FROM MONTH 1. NOT FROM MONTH 9.

E-11: Certification Planning Template — For Every Student Capstone Project

PROJECT: _____
STUDENT: _____
DATE: _____ SUPERVISOR: _____

SECTION 1: PRODUCT DESCRIPTION

Product name: _____
Intended use: _____
Target user: _____
Deployment environment: _____
Does it contact: Human body Food Water None

SECTION 2: WIRELESS TECHNOLOGIES

- WiFi 2.4 GHz – Power: _____ mW
- WiFi 5 GHz – Power: _____ mW – Outdoor? Yes No
- BLE – Power: _____ mW
- LoRa – Frequency: _____ MHz – EIRP: _____ dBm
- NB-IoT / 4G – Module: _____
- Zigbee – Power: _____ mW
- Other: _____

SECTION 3: CERTIFICATION REQUIREMENTS

- BIS CRS – IS standard: _____
- WPC ETA – Required? Yes No – Reason: _____
- TEC TA – Required? Yes No – Module: _____
- CDSCO – Class: A B C D – Not applicable
- AIS 140 – Commercial vehicle? Yes No
- Legal Metrology – Billing instrument? Yes No
- FSSAI – Food contact? Yes No
- ATEX – Explosive atmosphere? Yes No
- CE Mark – EU export? Yes No
- FCC ID – USA export? Yes No
- Other: _____

SECTION 4: CERTIFICATION PLAN

Test lab identified: _____
Pre-compliance test date: _____
Formal test submission date: _____
Certification receipt estimate: _____
Total estimated cost: ₹ _____

SECTION 5: DESIGN COMPLIANCE CHECKLIST

- PCB stack-up: 4-layer with solid ground plane
- RF traces: 50Ω impedance controlled
- Antenna keepout zone: respected all layers
- Safety isolation: per applicable standard
- ESD protection: TVS on all external connectors
- Materials: food-safe / body-safe where applicable
- IP rating: _____
- Temperature range: _____ °C to _____ °C

- Sensor calibration: NABL traceable
- Pre-compliance: NanoVNA + near-field + PPK2 done

SUPERVISOR APPROVAL: _____ Date: _____

NOTE: This plan must be submitted BEFORE PCB layout begins.

E-12: Engineering Standards Every IoT Engineer Must Know

Standard	What It Covers	Why IoT Engineers Need It	Where to Get
IEC 60601-1	Medical electrical equipment — general safety	Medical IoT device design — mandatory	IEC Webstore
IEC 60601-1-2	Medical equipment — EMC	EMC for medical IoT — mandatory	IEC Webstore
IEC 61000-4-2	ESD immunity test	ESD design requirement for all products	IEC Webstore
IEC 61000-4-4	Electrical fast transient immunity	Indian power quality — EFT events daily	IEC Webstore
IEC 61000-4-5	Surge immunity	Lightning indirect effects — outdoor India	IEC Webstore
IEC 60529	IP ingress protection rating	Enclosure design for Indian field conditions	IEC Webstore
IEC 60664-1	Insulation coordination	Creepage + clearance in PCB design	IEC Webstore
IEC 60079-29-1	Explosive atmosphere gas detectors	Mine + industrial safety gas sensors (EN-5)	IEC Webstore
IEC 62052-11	Electricity metering equipment safety	Smart meter design (EN-1)	IEC Webstore
IEC 61508	Functional safety of E/E/PE systems	Safety-critical IoT — automotive, industrial	IEC Webstore
ISO 26262	Automotive functional safety	Vehicle IoT — AEC-Q100 context (TR-1)	ISO Store
ISO 13485	Medical device quality management	CDSCO prerequisite	ISO Store
IPC-2221B	PCB design generic standard	Every PCB design — mandatory reading	IPC
IPC-A-610	PCB assembly acceptability	Solder joint quality for field deployment	IPC
IPC-2141A	Controlled impedance PCB	RF trace design — 50Ω microstrip	IPC
IS 16444	India smart energy meter	Smart metering design (EN-1) — BIS	BIS
IS 13252	IT equipment safety — India	BIS CRS for IT/electronics	BIS
MISRA-C	C coding standard for safety-critical	Medical, automotive firmware — mandatory	MISRA
OIML R46	Active electrical energy meters	Smart meter metrology	OIML
AIS 140	India vehicle tracking standard	Commercial vehicle IoT (TR-1, TR-2, TR-5)	MoRTH — free

Standard	What It Covers	Why IoT Engineers Need It	Where to Get
WHO TIR32	Pharma cold chain temperature	Cold chain IoT design (CC-2)	WHO — free
WHO PQS E6/TR06	Vaccine cold chain monitoring devices	Vaccine IoT design (CC-3, HC-2)	WHO — free

How to Access Standards in India

Standard Body	Free Access?	Cost	How to Purchase
BIS standards	Some free — most paid	₹300–₹5,000 per standard	bis.gov.in — online store
IEC standards	No	USD 200–500 each	webstore.iec.ch
ISO standards	No	USD 100–400 each	iso.org/store
IEEE standards	Some via IEEE Xplore	USD 50–200	ieeexplore.ieee.org
IPC standards	No	USD 100–300	ipc.org/standards
MISRA	No	GBP 15–50	misra.org.uk
WHO standards	Free — PDF download	Free	who.int/publications
MoRTH / AIS	Free	Free	morth.nic.in

For college labs:

Purchase the 5–10 most relevant standards for your domain.

These are reference documents used for life — worth the investment.

BIS standards are cheapest — start there for India-specific certification.

The three standards every IoT engineering student must read before graduation:

IEC 60529 — IP rating (every outdoor device ever)

IEC 61000-4-2 — ESD immunity (every product sold publicly)

IPC-2221B — PCB design standard (every PCB ever made)

Cross-References

For	Go to
BIS IS 16444 smart meter design — tamper detection, metering IC selection	Appendix A3: Smart Cities & Energy EN-1
CDSCO Class B design — IEC 60601 AC coupling, body-safe materials	Appendix A2: Healthcare & Cold Chain HC-1, HC-3
ATEX intrinsic safety barrier design — STM32N6 in Zone 1	Appendix A3: Energy EN-5
AIS 140 hardware — AEC-Q100, ISO 7637-2 transient protection	Appendix A4: Manufacturing & Transport TR-1
WHO PQS temperature sensor calibration chain	Appendix A2: Healthcare & Cold Chain CC-3, HC-2
Pre-compliance testing with NanoVNA + near-field + PPK2	Appendix C: Engineering Integrity C-19
Antenna VSWR testing for WPC ETA preparation	Appendix D: Antenna Engineering D-7
India hardware ecosystem — PCB fabs, ERTL test labs, government labs	Appendix F: India Hardware Ecosystem
All 52 solutions with certification tiers — Tier 1/2/3	Appendix A6: Master Solutions Index