GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous) (Approved by AICTE, Permanently Affiliated to JNTUH, Accredited by NAAC with 'A^{+}' Grade) Cheeryal (V), Keesara (M), Medchal Dist., Telangana - 501 301

Automatic Train Protection System – Kavach
(Professional Elective – III)

Course Code: XXXXXX

L	T	P	C
3	-	-	3

B.Tech. ECE - IV Year, I Sem.

Prerequisite(s): None

Course Objectives: Develop ability to

1. Provide students with a comprehensive understanding of automatic train protection technologies, focusing on the architecture and working of the Kavach system.
2. Impart knowledge about the components and subsystems of Kavach, including both onboard and wayside equipment, communication protocols, and signaling interfaces.
3. Equip students with the skills required to explain layout-specific plans, diagrams, and implementation strategies for deploying Kavach systems in railway networks.

At the end of the course, students should be able to

CO	Course Outcomes	Related POs and PSOs	Related Units	BTL	Related SDGs
1.	Explain the concepts of Train Protection Systems in general and Kavach - Indian Railways Automatic Train Protection System in detail.	PO1, PO2, PO3, PSO1	1,2	2	SDG4
2.	Explain the working principles of various elements, subsystems associated with Kavach, those on the ground - wayside, those on the train – onboard.	PO1, PO2, PO3, PSO1	1	2	
3.	Illustrate various plans & diagrams required for implementation of Kavach for typical station layout.	PO1, PO2, PO3, PSO1	3,4	2	

UNIT – I: Introduction to Train Protection Systems (8 Hours)

Train Protection Systems: Auxiliary Warning Systems, European Train Control Systems Communication Based Interlocking System, Spot and Continuous Relay of Information

Working of Train Protection System – Kavach: Overview of Kavach and its Working, Features, Subsystems, Communication Interfaces, Signalling Interfaces With effect from the academic year 2025-26

Subsystem: Onboard Kavach: Driver Machine Interlocking, Braking Interface, Radio Equipment, Onboard Computer, Transponder Receiver, Odometry, GNSS, GPRS, GSM

Subsystem: Stationary Kavach Station Kavach, Track Side Equipment, Signalling Interface, Radio & Tower, GNSS, Transponders, Network Monitoring System

UNIT – II: (6 Hours)

Concepts : Location Referencing - Train position, Modes of Onboard subsystem, Train Characteristics, Mode Transitions, Braking Curves, Speed Profiles, Speed Limits, Speed Monitoring, Target Speed, Target Distance, Movement Authority, Communication Protocols, Key Management System (KMS), Messages & Language.

UNIT – III: Design –Kavach: (8 Hours)

Survey, Assessment & Estimation: Station Layout, Radio Signal Strength, Tower Location, Power Requirement, Cable Survey, Loco Fitment Survey

Station Design: Kavach Scheme Plan, Kavach Control Table, Signalling Interface Diagram, Connectivity Plans for Remote Interface Units (RIUs), Power Supply Plan

Tower Design: Soil Testing, Foundation design, Super Structure Design.

UNIT – IV: Installation, Deployment & Testing (8 Hours)

Stationary Kavach: Interlocking Interface, RFID Tags, Station Master Operation Console Indication Panel (SM_OCIP), GPS/GSM Antennas, Pre commissioning Checklist, Testing

Onboard Kavach: DMI, Speed Sensors, RFID Reader, Onboard Computer, Brake Interface Unit, Pre-commissioning Checklist, Testing

Note: Reference material for this course shall be provided by **Indian Railways Institute of Signal Engineering and Telecommunications (IRISET).**

Hands-on sessions shall be conducted at IRISET Laboratory on the following aspects:

1. Testbench Preparation and deployment of Stationary Kavach Data: Configuration involving Topographical Information - Arrangement of Signals/Markers, Transponders, Inter signal Distances, Signal Routes, Gradients, Speed Restrictions
2. Verification and Validation of Onboard Data – Ceiling

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Signal Engineering (Professional Elective – I)
Course Code: XXXXXX

L	T	P	C
3	-	-	3

B.Tech. ECE - III Year, I Sem.

Prerequisite(s): None

Course Objectives: Develop ability to

1. Provide foundational knowledge of railway signaling systems and interlocking principles for the safe and efficient movement of trains.
2. Familiarize students with the operation and safety aspects of various signaling equipment such as signals, point machines, relays, and track circuits.
3. Impart an understanding of train working systems, station layouts, and modern interlocking techniques, supported by hands-on practical sessions at IRISET.

At the end of the course, students should be able to

CO	Course Outcomes	Related POs and PSOs	Related Units	BTL	Related SDG
1.	Explain the principles of Railway Signaling.	PO1, PO2, PO3, PSO1	1,2	2	SDG4
2.	Explain the failsafe and safety aspects of railway signals.	PO1, PO2, PO3, PSO1	3,4	2	
3.	Explain the working principles of interlocking and Signaling equipment	PO1, PO2, PO3, PSO1	2,3,4	2	

UNIT – I: Introduction to General Signaling

Opening of Railways: Duties of Commissioners, Sanction to Open Railway for Public Carriage of Passengers, Requirements & Recommendations for Signaling and Interlocking Installations, Catechism for Signaling and Interlocking Installations, for 25KV AC, Spl layouts: Isolation, Ruling gradients, Slip, Catch sidings

Schedule of Dimensions: General, Station Yards, Electric Traction 25KV AC 50 Cycles, Clearances required for 25KV single phase AC Electric Traction.

General Rules: Definitions, Type of Signals; Adequate Distance, System of Working, Absolute Block system, Automatic Block System, Block Working, Level Crossings, Station Working Rules.

UNIT – II: Railway Signaling

Station Layouts: MACLS, Signal Aspects, Location of Signals; Station Layouts: Single Line, Double Line, 2-Road, 3-Road, 4-Road.

Signaling Elements: Track Circuits & Axle Counters, Block Instruments, point machines, Relays, Relay Interlocking and Electronic Interlocking, Requirement of Signaling in 25KV AC Electrified Area.
Signaling Interlocking Plan: Essentials of Interlocking, Train Detection, Point Switching, Signal, Block Control, Aspect Control Chart.

UNIT – III: Signaling Equipment – I
Details of Relays, Signal Cables. Signals, Control Panel & Operation – Safety features, Working.
Details of Point Machines – Components, Working, Circuit Progression, Testing, Safety features,
Level Crossing Gates – Working, Circuit Progression, Safety features
Details of Track Circuits, Axle Counters - Single section, Multi-section, Subsystems; Working and Application.

UNIT – IV: Signaling Equipment – II
Details about Block Instruments – Types, Working, Circuit Progression, safety features Data Acquisition System – Interfaces, Fault Logic. Details of Integrated Power Supply, CLS Panel, Lightning and Surge Protection.

Note: Reference material for this course shall be provided by **Indian Railways Institute of Signal Engineering and Telecommunications (IRISET).**

Hands-on sessions shall be conducted at IRISET Laboratory on the following aspects:

1. Relays, Signal Cables. Signals, Control Panel & Operation.
2. Point Machines - Components, Working, Circuit Progression, Testing.
3. Level Crossing Gates - Working, Circuit Progression.
4. Track Circuits, Axle Counters - Single section, Multi-section, Subsystems; Working and Application.
5. Block Instruments - Types, Working, Circuit Progression.
6. Data Acquisition System - Interfaces, Fault Logic.
7. Integrated Power Supply, CLS Panel, Lightning and Surge Protection.