IIT Mandi
Proposal for a New Course

Course number	: **EE205**
Course Name	: **Electromagnetics and Wave propagation**
Credit Distribution	: *(format: 2.5-0.5-0-0,) 3-credits*
Intended for	: **Discipline core for 2nd year (Even-sem) B.Tech Electrical Engineering, VLSI students**
Prerequisite	: **None**
Mutual Exclusion	: None

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1. Preamble:

Electromagnetic theory is a core subject for any Electrical Engineering curriculum. This course enables the students to understand the engineering applications of fundamental laws Physics related to electromagnetic theory. The proposed course covers: required basics of Vector Algebra and Coordinate systems, static and dynamic electric and magnetic fields and their interaction. Major topics include Electromagnetic theory, Wave propagation, and Principle of Electromagnetic radiation. Some part of the course credit is devoted to tutorials where students will be demonstrated certain physical phenomena related to laws of Electromagnetic physics and its representation shall be discussed. Successful completion of the course will allow students to understand the working principle of applications ranging from diodes to motors and generation of signals to communication theory. The concepts learned in the proposed course shall aid students in understanding courses like Electrical system around us, Analog electronics, Communication theory, and networks, later they can take up advance courses such as Transmission line theory and Basic Microwave Eng., Radiating systems etc.,.

2. Course Modules with quantitative lecture hours:

i. **Unit/Topic 1:** Vector Analysis **(9 Hours)**
Subtopics: Basic Mathematical operations using vectors, coordinate systems, integrals (line, surface, volume) using vector functions, vector theorems, basics of partial derivatives, Laplacian, Greens functions.

ii. **Unit/Topic 2:** Electrostatics **(9 Hours)**
Subtopics: Electrostatic in free space, Coulomb's law, Gauss Law and its applications, Potential and work done, Conductors, Dielectric, capacitance, static fields in matter, static boundary conditions, method of images

iii. **Unit/Topic 3**: Magnetostatics **(9 Hours)**
Subtopics: Magnetostatics in free-space, Magnetostatics force, Vector Magnetic potential, Biot-Savart law, Ampere's law, Inductance and Magnetic materials, Boundary conditions for Magnetostatics

iv. **Unit/Topic 4:** Time Varying fields **(9 Hours)**
Subtopics: Introduction to time varying fields, limitation of Ampere's law, Continuity relations, Maxwell's Equations and its applications, Boundary conditions for dynamic fields, use of vector potential for dynamic fields, wave equations and propagation (in isotropic and anisotropic medium),

v. **Unit/Topic 5:** Radiation and propagation principle **(9 Hours)**
Subtopics: Relation between guided wave and free space wave, Concept of dipoles and monopoles, radiated fields from dipoles, Far-fields and near fields, Concept of group and phase velocity. Introduction to high frequency transmission line.

Laboratory/practical/tutorial Modules: There shall be practical demonstration for certain fundamental laws of physics and its interpretations shall be derived in mathematical form. This shall be conducted in the form of tutorial sessions to aid theoretical concepts.

3. **Text books (any one) :**

a) **Matthew N.O. Sadiku, Principle of Electromagnetics., Publisher: Oxford Press USA; 4th edition (8 February 2007),**

b) **David. K Cheng, Fields and Wave Electromagnetics, Publisher: Person Education, Country: USA, Year-1989, 5th Impression 2007.**

4. **References:**

a) **R. K. Shevgaonkar, Electromagnetic waves, Publisher: McGraw-Hill Education (India) Pvt Limited, 2005**

b) **David. J Griffith, Introduction to Electrodynamics, Publisher: Cambridge University Press, Republished year-2017.**

c) **G. S. N Raju, Electromagnetic Field Theory and Transmission Lines, Publisher: Pearson Education India, 2006**

d) **Walter Lewin, Lectures on Physics, MIT,**

e) **J. D. Jackson, Classical Electrodynamics, Publisher, Wiley, USA, 1999**

a. **Similarity with the existing courses:**
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Electromagnetic theory	PH521	12 lectures	40-50%

b) Justification of new course proposal if cumulative similarity content is >30%:

The B.Tech (EE) students earlier used to study 'Foundation of electrodynamic course' (IC) in their 2nd year which use to cover their basic fundamental on electromagnetics and time varying fields. Now as the concern IC course is dissolved, to cater the requirement of EE students the proposed course is placed a discipline core course. This course can be considered as fundamental courses for all the courses in EE curriculum, as it deals with basic nature of forces between charges, basic nature of inductance, capacitance and resistance and understanding of wave-propagation in general. There is a similar course PH521 in Physics, whose course content (main topic) is similar with the proposed course. However, the subtopics and its contents for EE 202 are entirely different from PH521. EE 202 course starts with a basics on vector algebra which include all the fundamental mathematical content required for this course. As we go further EE 202 serially engages with fundamental of electric and magnetic fields and then places an introduction to time varying fields with emphases on wave-propagation in medium and transmission line. The contents (subtopics) are curated especially for Electrical engineering and VLSI students. Hence, the mode of teaching for the proposed course i.e. EE 202 will be entirely different from any related course.