Antenna and Propagation

**Course Objectives:**  
To provide the student with an understanding of antennas, EM wave propagation and optical fibre communications.

1. **Radiation and Antenna Fundamentals(6 hours)**
   1. Retarded Potentials:  EM wave generation with a conduction current, the short uniform current dipole, the radiated electric and magnetic fields.
   2. Radiation patterns and input impedance of the short uniform current dipole, the short Dipole and long dipole.
   3. Antenna theorems:  reciprocity, superposition, Thevenin, minimum power transfer, Compensation, equality of directional patterns, equivalence of receiving and Transmitting impedances.

1. **Antenna Parameters and Arrays:(6 hours)**
   1. Basic antenna parameters
   2. Pattern multiplication:  Linear and two-dimensional antenna arrays, end fire and Broadside arrays.

1. **Antennas classification:(10 hours)**
   1. Isotropic antenna
   2. Omni directional antenna; Dipole
   3. Directional antennas;
   4. Travelling wave antennas – single wire, V and Rhombus Reflector antennas – large plane sheet, small plane sheet, linear, corner, parabolic, elliptical, hyperbolic and circular reflector. Aperture antenna - horn Array antennas – Yagi-Uda, Log Periodic Other antennas – Monopole, Loop, Helical, Microstrip.

1. **Propagation and Radio Frequency Spectrum(6 hours)**
   1. Ground or surface wave
   2. Space wave;  direct and ground reflected wave, duct propagation
   3. Ionospheric or sky wave;  critical frequency, MUF, Skip distance
   4. Tropospheric wave
   5. Radio frequency spectrum and its propagation characteristics

1. **Propagation between Antennas:(6 hours)**
   1. Free space propagation: power density of the receiving antenna, path loss
   2. Plane earth propagation: the ground reflection, effective antenna heights, the two ray
   3. propagation  model, path loss
   4. Fresnel Zones and Knife edge diffraction

1. **Optical fibres  (Introductory)(11 hours)**
   1. Optical fibre communication system and its advantages and disadvantages over Metalled wire communication system
   2. Types of optical fibre and its structural difference
   3. Light propagation characteristics and Numerical Aperture (NA) in optical fibre
   4. Losses
   5. Light source and photo detector

**Practical:**

1. Two Experiments in properties of EM waves: refraction, diffraction, polarization
2. Two Experiments in radiation patters of various types of antennas
3. Two Experiments in measurements on optical fibre transmission systems

**References:**

1. J. D. Kraus, “Antenna” McGraw Hill
2. C. A. Balanis, “ Antenna Theory Analysis and Design” John Wiley & Sons, Inc.
3. Collins, R. E., “Antenna and Radio Wave Propagation” McGraw Hill.
4. Gerd Kaiser “Optical Fibre Communications” McGraw Hill.
5. John Gowar “ Optical Communication Systems” PHI Publications.

**Evaluation Scheme:**

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| --- | --- | --- |
| **Unit** | **Hours** | **Questions** |
| 1 | 6 | 1.5 |
| 2 | 6 | 1.5 |
| 3 | 10 | 2.5 |
| 4 | 6 | 1.5 |
| 5 | 6 | 1.5 |
| 6 | 11 | 2.5 |
| **Total** | **45** | **11** |

**\*Note: There may be minor deviation in marks distribution**