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**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Course Descriptive File**

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| 1 | Course Title | RF and Microwave Engineering |
| 2 | Course Code | EE433 |
| 3 | Credit Hours | 3,1 |
| 4 | Pre-requisites |  |
| 5 | Co-requisites |  |
| 6 | Semester | VIII |
| 7 | Resource Person | Fatima Qazi |
| 8 | Contact Hours (Theory) |  |
| 9 | Contact Hours (Lab) |  |
| 10 | Office Hours | 8am to 4pm |
| 11 | Email | fatimaqazi090@gmail.com |
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| 12 | Course Outline as per Scheme of Studies ( SoS) | |
| RF behavior of Passive Components and RF models, Chip components, Distributed Circuit elements, Strip Lines, Microstrip Lines, Coupled Striplines/Coupled microstriplines, Smith Chart, Impedance and Admittance Transformation, Parallel and series Connection, Impedance Matching Networks, Analysis of Single and Multiport Networks using Network Parameters, Microwave Filter Design, Microwave Amplifier design, Mixers and Detectors, Oscillators, Power dividers, Directional Couplers, Circulators, Microwave Systems. | | |
| 13 | Course Objectives as per SoS | |
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| 14 | Books | |
| David M. Pozar, "Microwave Engineering", Wiley, 2009. | | |
| 15 | Course Learning Outcomes (CLOs) | |
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| 16 | Marks Breakup | |
| |  |  |  |  | | --- | --- | --- | --- | | Quizzes | |  | | | Homework/assignments | |  | | | Midterm exam | |  | | | Terminal exam (3 hours) | |  | | | Total (theory) | % | |   Theory   |  |  | | --- | --- | | Lab Assessments |  | | Lab Sessional Exams  ( Lab performance + Lab Assessments) |  | | Lab Terminal Exam  (%Viva +%Project+%Paper) |  | | Total (lab) | % |   Lab   |  |  | | --- | --- | | Final marks | Theory marks \* 0.75 + Lab marks \* 0.25 | | | |

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| **17** |
| **Week** | **Topic** | **CLO** | **Taxonomy**  **Level** | **Specific Outcome** | **Contact Hours** | **Assessment** |
| Mid Term  1 | Introduction to Microwave Engineering, Maxwell Equations, Fields in Media and Boundary Conditions, The Helmholtz Equation of Plane Waves in Lossless, Lossy and Good Conductor Medium | CLO1 | C2 |  |  | Assignment 1  Quiz 1 |
| 2 | General Plane Wave Solutions, Pointing’s Theorem in Terms of Energy and Power, Plane Wave Reflection from Media Interface (General Medium, Lossless Medium and Good Conductor) | CLO1 | C3 |  |  |
| 3 | The Lumped Circuit Model for a Transmission Line, The Terminated Lossless Transmission Line, The Smith Chart, The Quarter Wave Transformer | CLO2 | C4 |  |  |
| 4 | Generator and load Mismatches, Lossy Transmission Lines General Solutions for TEM, TE and TM waves, Attenuation due to Dielectric Loss | CLO2 | C3 |  |  | Assignment 2  Quiz 2 |
| 5 | Rectangular Waveguides (TE and TM Mode), Coaxial Line TEM Modes, Strip-line, Micro-stripline, Wave Velocities and Dispersion, Impedance and Equivalent Voltages and Currents | CLO2 | C4 |  |  |
| 6 | Impedance and Admittance Matrices, The Scattering Matrix (Reciprocal Networks and the Lossless Networks, A Shift in Reference Planes, Generalized Scattering Parameters), The Transmission (ABCD) Matrix | CLO1 | C4 |  |  |
| 7 | Signal Flow Graphs, Discontinuities and Modal Analysis, Introduction to Impedance Matching and Tuning | CLO1 | C3 |  |  | Assignment 3  Quiz 3 |
| 8 | Analytical Solutions of Matching Networks with Lumped Parameters, Smith Chart Solutions, Single Stub Tuning, Double Stub Tuning, The Quarter Wave Transformer | CLO2 | C5 |  |  |
| 9  Final  Term | Introduction to Microwave Resonator, Series and Parallel Resonance Circuit, Transmission Line Resonator, Rectangular Waveguide Cavities | CLO2 | C4 |  |  |
| 10 | Basic Properties of Dividers and Couplers, The T Junction Power Divider, Lossless Divider, Resistive Divider, The Wilkinson Power Divider, The Quadrature Hybrid, Coupled Line Directional Couplers, The1800 Hybrid |  |  |  |  |  |
| 11 | Introduction to Microwave Filters, Filter Design by Insertion Loss Method, Maximally Flat Low Pass Filter Prototype, Equal Ripple Low Pass Filter Prototype, Linear Phase Low Pass Filter Prototypes |  |  |  |  |
| 12 | Filter Transformations using Impedance and Frequency Scaling, Low Pass to High Pass Filter Transformation, Low Pass to Band Pass and Band Stop Filter Transformation, Filter Implementation, Stepped Impedance Low Pass Filters |  |  |  |  |
| 13 | Introduction to Active Microwave Circuits, Noise in Microwave System, Detectors and Mixers, Pin Diode Phase Shifters |  |  |  |  |  |
| 14 | Design of Microwave Amplifiers and Oscillators, Microwave Field Effect Transistors, Microwave Bipolar Transistors, Gain and Stability |  |  |  |  |
| 15 | Single Stage Transistors Amplifier Design, Constant Gain Circles and Design for Specified Gain |  |  |  |  |
| 16 | Introduction to Microwave Systems, System Aspects of Antennas, Basic Types of Antennas, Antenna Pattern Characteristics, Microwave Communication System, The Friis Power Transmission Formula |  |  |  |  |  |
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* Every instructor have his/her plan for course material used for assignments and quizzes, table above is just a guideline.

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| **18** | **Course Learning Outcomes (CLOs) and Assessment Plan** |
| |  |  |  |  | | --- | --- | --- | --- | | CLO  Activity | CLO 1 | CLO2 | CLO3 | | | Quiz 1 | C1, C2 |  |  | | Quiz 2 |  | C3, C4 |  | | Quiz 3 |  |  | C3, C4 | | Assignment 1 |  |  |  | | Assignment 2 |  |  |  | | Assignment 3 |  |  |  | | MID TERM EXAM |  |  |  | | Quiz 1 |  |  |  | | Quiz 2 |  |  |  | | Quiz 3 |  |  |  | | Assignment 1 |  |  |  | | Assignment 2 |  |  |  | | Assignment 3 |  |  |  | | FINAL TERM EXAM |  |  |  |   \*Add columns according to number of course CLO’s for your respective course. Complete as per your planned quiz and assignments for this session. | |

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| **19** | **Course Learning Outcomes (CLOs) and Assessment Plan (LAB)** |
| |  |  |  |  | | --- | --- | --- | --- | | CLO  Activity | CLO L1 | CLO L2 | CLO L3 | | | Lab 1 | C1, C2 |  |  | | Lab 2 |  | C3, C4 |  | | Lab 3 |  |  | C3, C4 | | Lab 4 |  |  |  | | Lab 5 |  |  |  | | Lab 6 |  |  |  | | Lab 7 |  |  |  | | Lab 8 |  |  |  | | Lab 9 |  |  |  | | Lab 10 |  |  |  | | Lab 11 |  |  |  | | Lab 12 |  |  |  | | Term Project |  |  |  | | Session Test |  |  |  | | Final Lab paper |  |  |  | | Viva |  |  |  |   \*Add columns according to number of course CLO’s for your respective course. Complete as per your planned quiz and assignments for this session. | |

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| **20** | **Lab Details** | |
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| **Laboratory Resources** | | |
| * Hardware based | | |
| **Computer Resources** | | |
| * Software based | | |
| **21** | | **Mapping of CLOs to PLOs** |

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| PLO  CLOs | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PLO11 | PLO12 |
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| CLO1 | C1 |  |  |  |  |  |  |  |  |  |  |  |
| CLO2 |  |  |  | C4 |  |  |  |  |  |  |  |  |
| CLO3 |  |  |  | C4 |  |  |  |  |  |  |  |  |
| CLO4 |  | C2 |  |  |  |  |  |  |  |  |  |  |
| LAB CLO1 |  |  |  |  |  |  |  |  |  |  |  |  |
| LAB CLO2 |  |  |  |  |  |  |  |  |  |  |  |  |
| LAB CLO3 |  |  |  |  |  |  |  |  |  |  |  |  |

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| **22** | **List of Experiment With Objectives as Per OBE Format** |
| |  |  | | --- | --- | | **Lab Experiment No.** | **Title and Objectives** | | **1** | **Title:**  Objectives | | **2** | **Title:**  Objectives | | **3** |  | | **4** |  | | **5** |  | | **6** |  | | **7** |  | | **8** |  | | **9** |  | | **10** |  | | **11** |  | | **12** |  | | **13** |  | | **14** |  | | **15** |  | | **16** |  | | |

**\*title and objective to be achieved in every experiments**