CENTRAL UNIVERSITY OF KARNATAKA
KALABURAGI

COURSE STRUCTURE FOR

M.Tech. in RF & Microwave Engineering

Learning Outcomes-based Curriculum Framework

(Effective from the academic year 2023 –24)

Department of
Electronics & Communication Engineering
School of Engineering

COURSE STRUCTURE - M. TECH
RF & MICROWAVE ENGINEERING
(Effective from the academic year 2023-24) – Programme Code: PRFMI

I SEMESTER											
Course code	Course Type	Course Title	Teaching Hrs./Week				Examination				Credits
			Theory Lecture	Tutorial	Practical/ Drawing/	Total	Duration in Hrs.	IA Marks	End Sem Marks	Total Marks	
			L	T	P						
PRFTC10601	CC	Microwave Devices & Systems	4	-	-	4	2.5	40	60	100	**4**
PRFTC10602	CC	Advanced Digital Communication	4	-	-	4	2.5	40	60	100	**4**
PRFTC10603	CC	Antenna Theory and Practice	4	-	-	4	2.5	40	60	100	**4**
PRFTC10604	PE	Embedded Systems and IoT	3	-	-	3	2	30	45	75	**3**
PRFPC10605	CC	Microwave Measurements Lab	-	-	3	3	3	30	45	75	**3**
PRFRC10606	CC	Seminar-I	-	-	3	3	3	30	45	75	**3**
		Total	**15**	**-**	**6**	**21**	**15.5**	**210**	**315**	**525**	**21**

Note: EC-Core Course, PE-Programme Elective.

COURSE STRUCTURE - M. TECH
RF & MICROWAVE ENGINEERING

(Effective from the academic year 2023-24) – Programme Code: PRFMI

II SEMESTER												
Course code	**Course Type**	**Course Title**	**Teaching Hrs./Week**				**Examination**				**Credits**
			Theory Lecture	**Tutorial**	**Practical/ Drawing/**	**Total**	**Duration in Hrs.**	**IA Marks**	**End Sem Marks**	**Total Marks**	
			L	**T**	**P**						
PRFTC20607	CC	Microwave Communication Systems	4	-	-	4	2.5	40	60	100	**4**
PRFTC20608	CC	Signal Processing for Communication	4	-	-	4	2.5	40	60	100	**4**
PRFTD20609	MC	Research Methodology	3	-	-	3	2	30	45	75	**3**
PRFTC20610	PE	Advanced Materials for High-Frequency Applications*	3	-	-	3	2	30	45	75	**3**
PRFRC20611	CC	Seminar-II	-	-	3	3	3	30	45	75	**3**
PRFRC20612	CC	Mini Project	-	-	3	3	3	30	45	75	**3**
		Total	**14**		**6**	**20**	**15**	**200**	**300**	**500**	**20**

Note: CC-Core Course, PE-Programme Elective, MC-Mandatory courses.

*Students can opt for PE or any one of the NPTEL Discipline courses specific for 12 Weeks duration.

CENTRAL UNIVERSITY OF KARNATAKA	**Central University of Karnataka** (Established by an Act of the Parliament in 2009) **School of Engineering**	**Dept.: ECE Dept.** **M. Tech. in RF & Microwave Engg.** **Syllabus** **2023-24**

COURSE STRUCTURE - M. TECH
RF & MICROWAVE ENGINEERING

(Effective from the academic year 2023-24) – Programme Code: PRFMI

III SEMESTER												
Course code	Course Type	Course Title	Teaching Hrs./Week				Examination				Credits
			Theory Lecture	Tutorial	Practical/ Drawing/	Total	Duration in Hrs.	IA Marks	End Sem Marks	Total Marks	
			L	T	P						
PRFTD30707	MC	Publication Ethics	2	-	-	2	1.5	20	30	50	**02**
PRFTC30708	CC	NPTEL Course*	-	-	-			20	30	50	**02**
PRFRC30709	CC	M.Tech. Project-Stage-I	-	-	5	5	5	160	240	400	**16**
		Total	**2**		**5**	**7**	**6.5**	**200**	**300**	**500**	**20**

Note: CC-Core Course, MC-Mandatory courses.

* In Consultation with the Project Guide

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COURSE STRUCTURE - M. TECH
RF & MICROWAVE ENGINEERING

(Effective from the academic year 2023-24) Programme Code: PRFMI

IV SEMESTER											
Course code	Course Type	Course Title	Teaching Hrs./Week				Examination				Credits
			Theory Lecture	Tutorial	Practical/ Drawing/	Total	Duration in Hrs.	IA Marks	End Sem Marks	Total Marks	
			L	T	P						
PRFRC40710	CC	M.Tech. Project-Stage-II	-	-	5	5	5	200	300	500	**20**
		Total			**5**	**5**	**5**	**200**	**300**	**500**	**20**

Note: CC-Core Course, MC-Mandatory courses.

Microwave Devices and Systems

Semester :	I	Internal Assessment :	40
Course Code :	PRFTC10601	End Sem. Exam :	60
Teaching Hours/Week (L:T:P) :	4:0:0	Exam Duration (Hours) :	2.5
Credits : 4			

PREREQUSITES

Exposure to Electromagnetic Theory.

COURSE OUTCOMES

After completing this Course, the students should be able to:

1. Describe the use and advantages of microwave transmission.
2. Analyze various parameters related to microwave transmission lines and waveguides.
3. Identify microwave passive devices for several applications.
4. Identify microwave Active devices for several applications.
5. Analyze various microwave oscillators and amplifiers for various applications.

UNIT-I

Microwave waveguides and components: Rectangular Waveguides, Solutions of wave Equations in Rectangular Coordinates, TE Modes in Rectangular Waveguides, TM Modes in Rectangular Waveguides, Power Transmission in Rectangular Waveguides, Power Losses in Rectangular Waveguides, Excitations of Modes in Rectangular waveguides, Rectangular-Cavity Resonator.

RBT Levels: L1, L2, L3, L4

UNIT-II

Microwave Field-Effect Transistor: Junction Field-Effect Transistors: Physical Stucture, principles of operation, current-voltage characteristics.

Metal Semiconductor Field-Effect Transistors: physical structure, principles of operations, small signal equivalent circuit, drain current, cut-off frequency, and maximum oscillation frequency.

High Electron Mobility Transistors: Physical structure, operational mechanism, performance characteristics, electronic applications.

RBT Levels: L1, L2, L3, L4

UNIT-III

Microwave Hybrid Circuits Waveguide Tees, Magic Tees (H ybrid Trees), Hybrid Rings (Rat-Race Circuits), Waveguide Corners, Bends, and Twists,

Directional Couplers Two-Hole Directional Couplers, S-Matrix of a Directional Coupler, Hybrid Couplers.

Circulators and Isolators Microwave Circulators, Microwave Isolators,

RBT Levels: L1, L2, L3, L4

UNIT-IV

Microwave Linear Beam Tubes: Introduction, Reflex Klystron Oscillator, Velocity Modulation, power output and efficiency, Travelling wave tubes, slow wave structure, amp[lication process, convection current, axial electric field, wave modes, gain considerations.

Microwave Crossed-Field Tubes: Cylindrical magnetron, linear magnetron, co-xial magnetron, voltage tunable magnetron, inverted coaxial magnetron, Frequency agile coaxial magnetron.

RBT Levels: L1, L2, L3, L4.

TEXT BOOKS

1. Microwave Devices and circuits- Samuel Y Liao, Pearson Education
2. Microwave Engineering – Annapurna Das, Sisir K Das, TMH, Publication, 2nd, 2010.
3. Microwave Engineering - David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn, 2008.

REFERENCE BOOKS

1. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.

ONLINE RESOURCES

https://ocw.mit.edu

https://nptel.ac.in

ADVANCED DIGITAL COMMUNICATION

Semester :	**I**	**Internal Assessment :**	**40**
Course Code :	PRFTC10602	**End Sem. Exam :**	**60**
Teaching Hours/Week (L:T:P) :	**4:0:0**	**Exam Duration (Hours) :**	**2.5**
Credits: 4			

PREREQUSITES

Basic exposure to analog communication Engineering & electronics theory.

COURSE OUTCOMES

After completing this Course, the students should be able to:

1. Explain different digital modulation techniques, BER, and inter symbol interference
2. Analyse the effect of signals over band limited signals
3. Compare performance of different types of fading channels and other subsystems
4. Explain different spread spectrum systems and their comparisons.

UNIT-I

Digital Modulation Techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent Quadrature – modulation techniques, No-coherent binary modulation techniques, Comparison of binary and quarternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit verses symbol error probabilities, Synchronization, Applications. **RBT Levels: L1, L2.**

UNIT-II

Band Limited Channels: Band limited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duo-binary and Modified Duobinary-signalling schemes. **RBT Levels: L1, L2, L3.**

UNIT-III

Fading : Large scale, small scale; Statistical characterization of multi path channels – Delay and Doppler spread, classification of multi path channels, scattering function; Binary-signalling over frequency non selective Rayleigh fading channel. **RBT Levels: L1, L2, L3.**

UNIT-IV

Spread Spectrum Signals for Digital Communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, some applications of DS spread spectrum signals, generation of PN sequences, Frequency hopped spread spectrum signals, Time hopping SS, Synchronization of SS systems. **RBT Levels: L1, L2, L3, L4.**

TEXT BOOKS

5. John G. Proakis, “Digital Communications”, McGraw Hill, 5th Edition, 2008.
6. Simon Haykin, “Digital Communication Systems”, Illustrated Reprint, Wiley, 2013.

REFERENCE BOOKS

7. Bernard Sklar, “Digital Communications - Fundamentals and Applications”, Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014.

8. M.K.Simon, S.M.Hinedi and W.C.Lindsey, “Digital communication techniques; Signal Design and Detection”, Prentice Hall of India, New Delhi, 1995.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/117105144

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ANTENNA THEORY AND PRACTICE

Semester :	**I**	**Internal Assessment :**	**40**
Course Code :	PRFTC10603	**End Sem. Exam :**	**60**
Teaching Hours/Week (L:T:P) :	**4:0:0**	**Exam Duration (Hours) :**	**2.5**
Credits: 4			

PREREQUSITES

Basic exposure to Electromagnetic theory and electrical network theory.

COURSE OUTCOMES

After completing this Course, the students should be able to:

1. Explain baisc parameters of antennas and their applications
2. Design of frequency independent and microstrip antennas
3. Design and analysis of antenna arrays
4. Explain the types of antennas used for cellular communications

UNIT-I

Introduction: Concepts of antenna parameters, application areas of antennas, review of maxwell equations and boundary conditions, wave equations, infinitesimal (Hertzian) dipoles. **RBT Levels: L1, L2.**

UNIT-II

Wire Antennas and Microstrip Antennas: Finite Length Dipoles from Transmission line approach, Monopoles, Inverted-F Antennas, Loop Antennas, Yagi-Uda and Log-periodic antennas, Microstrip antennas, design, modeling of rectangular and circular patch antennas. **RBT Levels: L1, L2, L3.**

UNIT-III

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method, and Woodward-Lawson method. **RBT Levels: L1, L2, L3.**

UNIT-IV

Antennas for Mobile Communication: Handset antennas, base station antennas, Beam steering and antennas for MIMO applications, miniaturized antennas, micromachined antennas, active and smart microstrip antennas. **RBT Levels: L1, L2, L3, L4.**

TEXT BOOKS

5. C. A. Balanis, “Antenna Theory and Design”, John Wiley & Sons. 1997.
6. J. D. Kraus, “Antennas”, Mc-Graw Hill. 1988.

REFERENCE BOOKS

7. G. Kumar and K. P. Ray, “Broadband Microstrip Antennas”, Artech House, 2003.
8. R. Garg, P. Bharthia, I. Bahl, and A. Ittipiboon “Microstrip Antenna Design Handbook”, Artech House.

ONLINE RESOURCES

9. https://archive.nptel.ac.in/courses/108/101/108101092/

Embedded Systems and Internet of Things

Semester :	**I**	**Internal Assessment :**	**30**
Course Code :	PRFTC10604	**End Sem. Exam :**	**45**
Teaching Hours/Week (L:T:P) :	**3:0:0**	**Exam Duration (Hours) :**	
Credits: 03			

PREREQUSITES

Basic exposure to Microcontroller, C Programming and Internet.

COURSE OUTCOMES

After completing thisCourse,the students should be able to:

CO1. Understand Embedded systems and its requirements.
CO2. Understand basic components of Internet of Things.
CO3. Apply skills to conduct interfacing of embedded boards with components, actuators and sensors
CO4. Choose appropriate microcontroller for design specification with reference to a real time problem.
CO5. Incorporate suitable microcontroller for Internet of Things application along with appropriate interfacing circuits and implement.

UNIT-I

Introduction to Embedded Systems: Basic components of Embedded Systems. Classification and Characteristics of Embedded Systems.
Core of Embedded System: Various computing devices for Embedded system and Commercial Off-The-Shelf Components (COTS).
RBT Levels: L1, L2, L3.

UNIT-II

Embedded Hardware
AVR: Introduction to AVR, Architecture, Pin Configuration, Memory, Registers and Ports. Programming with AVR.
RBT Levels: L1, L2, L3,L4.

UNIT-III

Embedded System Design Concepts: Challenges and issues in embedded software development. Embedded software development tools.
Embedded System case studies.
RBT Levels: L1, L2, L3,L4.

UNIT-IV

Internet of Things: Basics of Internet of Things, Architecture and working of IoT. Chellenges, Applications, Current Status and Future Prospects of IoT.
Internet of Things case studies.
RBT Levels: L1, L2, L3.

TEXT BOOKS

10. Shibu K V, “Introduction to Embedded Systems”, TMH Education Private Limited, 2009.
11. Rajkamal, "Embedded Systems- Architecture, Programming & Design,TMH, 2007.
12. Arshdeep Bahga, and Vijay Madisetti, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.

REFERENCE BOOKS

13. Patrick R. Schaumont, A Practical Introduction to Hardware/Software Co-design, 2010

14. Danny Causey, Muhammad Ali Mazidi, and Rolin D. McKinlay, PIC Microcontroller and Embedded SystemsUsing Assembly and. C for PIC18. Pearson 2008.
15. Matt Richardson & Shawn Wallace, “Getting Started with Raspberry Pi”, , O'Reilly, 2014,

ONLINE RESOURCES

16. https://nptel.ac.in/courses/108/102/108102045/
17. https://nptel.ac.in/courses/106/105/106105193/
18. https://nptel.ac.in/courses/106/105/106105159/

Microwave Measurements Lab

Semester :	I	Internal Assessment :	30
Course Code :	PRFPC10605	End Sem. Exam :	45
Teaching Hours/Week (L:T:P) :	0:0:3	Exam Duration (Hours) :	2.5
Credits : 3			

PREREQUSITES

Exposure to Microwave Engineering

COURSE OUTCOMES

After completing this Course, the students should be able to:

CO6. Recognize and demonstrate functioning of Microwave sources.

CO7. Evaluate the characteristics, and scattering matrix of microwave passive devices.

CO8. Analyze the response and plot the characteristics of radiation pattern.

CO9. Able to measure the input impedance of Microwave antennas

LIST OF EXPERIMENTS

1. Microwave source characteristics-Reflex Klystron and Gunn oscillator (X-band)
2. Measurement of Frequency and wavelength.
3. Measurement of Standing wave ratio and Reflection coefficient for a given load.
4. S-matrix of Directional Coupler, Circulator, Magic Tee.
5. Gain measurement of i) Pyramidal Horn, ii) Conical Horn antennas.
6. Pattern Measurement of i) Pyramidal Horn ii) Conical Horn antennas.
7. Measurement of Input Impedance of an Antenna
8. Measurements with Network Analyzer

TEXT BOOKS

19. Microwave Devices and circuits- Samuel Y Liao, Pearson Education
20. Microwave Engineering - David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn, 2008.

REFERENCE BOOKS

21. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.

SEMINAR

Semester :	**I**	**Internal Assessment :**	**20**
Course Code :	PRFRC10606	**End Sem. Exam :**	**30**
Teaching Hours/Week (L:T:P) :	**0:0:3**	**Exam Duration (Hours) :**	**2.5**
Credits : 3			

OBJECTIVE

To provide an opportunity to students to demonstrate the ability to develop the skill in written and oral presentation. Further, the seminar aims to give an opportunity to students to harness the skill of literature survey in their respective fields.

COURSE OUTCOMES

After completing this Course, the students should be able to:

CO1. Identify, analyze and formulate seminar topic with a systematic approach.

CO2. Summarize and analyze the literature review and relate them to current project.

CO3. Enhance presentation and report writing skills..

CO4. Develop creative thinking abilities.

Guidelines

There shall be an seminar topic to be chosen in consultation with the department faculties of their specialization. Every student will register for seminar title at the time of commencement of I semester. The seminar shall be presented and submitted in a report form before the committee in the I semester. The following points need be considered for seminar

1. Student has to select a seminar topic either of their own interest or in consultation with faculty members of the department.
2. Every student must carry out seminar and present it independently along with report, with appropriate permission from HoD / Dean and department guide.
3. The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
4. If student has his/her own idea for an individual Project, it is the student's responsibility to find a faculty member who both approves of the proposed programme of work and is willing to be the supervisor.
5. It is the responsibility of the student to report the progress of the work regularly to the concerned supervisor. A proper documentation has to be maintained in this regard.
6. A report of atleast 20 pages (printed on double side) must be submitted before the commencement of 1st semester end semester examinations (ESE).

Report Format

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  - -Title of the Project: 24, Bold
  - -Main/Chapter Header (1, 2, etc..): 16, Bold
  - -Sub title: 14, Bold -Running Text: 12, Regular
  - -Lines Spacing: 1.5 Lines

-Paragraph Beginning: 0pt. (No Space)
-Paragraph Spacing: 6pt.
-Figure Caption (Below Figure, Center Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Center Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against Plagiarism and percentage of duplication must be less than 10% (As suggested by UGC).

RUBRICS FOR EVALUATION

Topic – Technical Relevance, Sustainability and Societal Concerns	15%
Literature Review	25%
Presentation Skills	35%
Report	25%

Microwave Communication Systems

Semester :	**II**	**Internal Assessment :**	**40**
Course Code :	PRFTC20607	**End Sem. Exam :**	**60**
Teaching Hours/Week (L:T:P) :	**4:0:0**	**Exam Duration (Hours) :**	**2.5**
Credits: 04			

PREREQUSITES

Exposure to Electromagnetic Theory.

COURSE OUTCOMES

After completing this Course, the students should be able to:

1. Describe the use and advantages of microwave Links and path losses.
2. Analyze various parameters related to orbital parameters.
3. Analyze microwave oscillators and amplifiers.
4. Identify microwave Radar applications.
5. Analyze various microwave Tracking systems.

UNIT-I

Overview of Microwave Communication Systems: Introduction, Frequency Allocations for Satellite Communication Orbits and Launching Methods

Kepler's Laws Definitions of Terms of Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee heights, Orbit perturbations, Sidereal time.

The Geostationary Orbits: Introduction, Earth Eclipse of Satellite, Sun Transit Outage, Launching orbits, Polarization.

RBT Levels: L1, L2, L3, L4

UNIT-II

The Space Segment: The Power Supply, Attitude Control, Spinning Satellite stabilization, Station keeping, TT&C Subsystem, Transponder.

The Earth Segment: Receive-only Home TV Systems, Master Antenna TV System, Community Antenna TV System.

The Space Link: Equivalent Isotropic Radiated Power, Transmission Losses, Free space Transmission, Feeder Losses, Antenna Misalignment losses, The Link Power Budget Equation.

Carrier-to-Noise Ratio: The Uplink, Saturation flux density, Input backoff, The earth Station HPA, Down link, Output back-off, The Satellite TWTA output.

RBT Levels: L1, L2, L3, L4

UNIT-III

An Introduction to Radar: Range to Target, Radar waveforms, The Simple form of the Radar equation, Radar Block Diagram and Operation , Applications of Radar, Detection of signals in noise, Receiver noise and the Signal-to-noise, Pulse repletion frequency.

Introduction to Dopller and MTI Radar: Dopller frequency shift, Simple CW Doppler Radar, Sweep to Sweep subtraction and delay line canceler, MTI Radar block diagram, Frequency response of a single-delay-line canceler, Blind speeds.

RBT Levels: L1, L2, L3, L4

UNIT-IV

Digital MTI processing: Blind phases, I and Q channels, Moving Target detector.

Tracking Radar: Types of Tracking Radar systems, Angle tracking, Monopulse tracking, Amplitude comparision monopulse, Phase comparision monopulse, Conical scanning and sequential lobing.

Tracking in Range: Split-Gate Range, Range Glint, Comparision of Trackers.

RBT Levels: L1, L2, L3, L4.

TEXT BOOKS

6. Microwave Engineering - David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn, 2008.
7. Satellite Communications – Dennis Roddy, 4th Edition
8. Introduction to Radar Systems – Merrill I. Skolnik

REFERENCE BOOKS

9. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.

ONLINE RESOURCES

https://ocw.mit.edu

https://nptel.ac.in

SIGNAL PROCESSING FOR COMMUNICATION

Semester :	**II**	**Internal Assessment :**	**40**
Course Code :	PRFTC20608	**End Sem. Exam :**	**60**
Teaching Hours/Week (L:T:P) :	**4:0:0**	**Exam Duration (Hours) :**	**2.5**
Credits : 4			

PREREQUSITES

Basic exposure to calculus, linear algebra, and basic probability theory, as well as, a course in digital signal processing.

COURSE OUTCOMES

After completing this course, the students should be able to:

1. Identify signals and signal types
2. Apply the correct analysis tools to specific signals
3. Manipulate rational transfer functions
4. Interpret complex signal processing systems

UNIT-I

Signals and Hilbert Spaces: Review on Euclidean Geometry, From Vector Spaces to Hilbert Spaces, Subspces, Bases, Projection, Signal Spaces Revisited. **RBT Levels: L1, L2.**

UNIT-II

Interpolation and Sampling: Continuous-Time Signals, Bandlimited Signals, Interpolation and its Types, The Sampling Theoram, Aliasing, Discrete-Time Processing of Analog Signals, A/D and D/A Conversions. **RBT Levels: L1, L2, L3.**

UNIT-III

Multirate Signal Processing: Down Sampling, Properties of the Downsampling Operator, Frequency Domain Representation, Upsampling and Interpolation, Rational Sampling Rate Changes, Oversampling. **RBT Levels: L1, L2, L3.**

UNIT-IV

Design of a Digital Communication System: The Communication Channel, Modern Design: The Transmitter, Digital Modulation, and Bandwidth Constraint, Signaling Alphabets, and Power Constraint, Modern Design: The Receiver, Hilbert Demodulation, The Effects of the channel, Adaptive Synchronization. **RBT Levels: L1, L2, L3, L4.**

TEXT BOOKS

5. P Prandoni and M Vetterli. Signal Processing for Communication. EPFL press. 2008.
6. Fredic J Harris. Multirate Signal Processing for Communication Systems. River Publishers. 2021.

REFERENCE BOOKS

7. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
8. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach. vol. 2. New York: McGraw-Hill Higher Education, 2006

ONLINE RESOURCES

1. http://www.sp4comm.org/
2. https://nptel.ac.in/courses/117102060

COURSE ASSESSMENT

1. **Continuous Assessment** (Weightage **30 Marks**)
    1. Two internal assessments will be conducted with each one of **20 marks** weightage.
    2. Remaining **10 marks** will be given for Assignments/Quiz/Seminar/Class performance etc. based on the decision of the subject incharge.
    3. If only Quizes (MCQ type) are preferred then a minimum of two are to be conducted and the necessary proof has to be maintained.
    4. If only assignments are considered then Four Assignments are to be given with one each from respective units.
    5. In case of seminar, student must give 20 minutes presentation and ppt file has to be submitted to the subject incharge & department.

ADVANCED MATERIALS FOR HIGH FREQUENCY APPLICATIONS

Semester :	**II**	**Internal Assessment :**	**30**
Course Code :	PRFTC20610	**End Sem. Exam :**	**45**
Teaching Hours/Week (L:T:P) :	**3:0:0**	**Exam Duration (Hours) :**	**2**
Credits: 3			

UNIT-1

Introduction to Materials

Introduction to Engineering Materials: Classification of material, Characteristics of materials, metals, alloys and plastics, polymer and composites

UNIT-2

Advance electronics materials

Phase change materials, Ultra-wide band gap materials, Piezoelectric materials, micro-scale sensors and actuators.

UNIT-3

High frequency materials and Applications

Polytetrafluoroethylene (PTFE), Glass fiber reinforced composites (GFRC), hydrocarbon ceramics,Ceramics, glassbubbles, Polyamide (PA), Polycarbonate (PC), PBT,Epoxy, Gallium Nitride and its apilcations

TEXT BOOKS :

1. SK Bhattacharya, “Electrical and Electronic Engineering Materials”1stedition Khanna Publishers, New Delhi,2006.(Unit 1,2,3)

2. A.J. Dekker “Electrical Engineering Materials”, PHI, 2006. (Unit 4,5) 146G V P College of Engineering (Autonomous) 2013

REFERENCES:

1. Grover and Jamwal, “Electronic Components and Materials” DhanpatRai and Co., New Delhi.

2. Sahdev, “Electrical Engineering Materials”, Unique International Publications 3. C. S. Indulkar& S. Thiruvengadam, “Electrical Engineering Materials”, S. Chand & Com. Ltd, New Delhi -55 4. S.P. Seth, P.V. Gupta “A course in Electrical Engineering Materials”, DhanpatRai& Sons

3. Callister Jr, William D., and David G. Rethwisch. *Callister's materials science and engineering*. John Wiley & Sons, 2020.

Online :

https://studylib.net/doc/18602382/selecting-pcb-materials-for-high-frequency

https://link.springer.com/article/10.1007/s10832-007-9044-3

https://www.sciencedirect.com/science/article/abs/pii/S0927796X07000502

MINI PROJECT

Semester	:	II	Internal Assessment	:	30
Course Code	:	PRFRC20612	End Sem. Exam	:	45
Teaching Hours/Week (L:T:P)	:	0:0:3	Exam Duration (Hours)	:	3
Credits: 03					

PREREQUSITES

Working knowledge of Electronics and Communication areas focusing on RF and Microwave Engineering.

COURSE OUTCOMES

After completing this Course, the students should be able to:

CO1. Identify, analyze and formulate projects with a systematic approach.

CO2. Summarize and analyze the literature review and relate them to current project.

CO3. Device system integration skills

CO4. Demonstrate documentation skills

CO5. Develop Project management skills to work effectively and constructively.

CO6. Develop problem solving skills.

Guidelines

There shall be an PG mini-project to be chosen in consultation with the department faculties of their specialization. Students will register for the project at the time of commencement of II semester. The PG mini-project shall be submitted in a report form and presented before the committee in the VI semester. The following points need be considered for PG Mini Project.

1. Student has to select a project either of their own interest or in consultation with faculty members of the department.
2. Every student must carry out project independently, with appropriate permission from HoD / Dean and department guide.
3. If student has his/her own idea for an individual mini project, it is the student's responsibility to find a faculty member who both approves of the proposed programme of work and is willing to be the supervisor.
4. It is the responsibility of the student to report the progress of the work regularly to the concerned supervisor. A proper documentation has to be maintained in this regard.
5. A report of atleast 20 pages (printed on double side) must be submitted before the commencement of 3rd semester end semester examinations (ESE).

Report Format

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  - -Title of the Project: 24, Bold
  - -Main/Chapter Header (1, 2, etc..): 16, Bold
  - -Sub title: 14, Bold -Running Text: 12, Regular
  - -Lines Spacing: 1.5 Lines
  - -Paragraph Beginning: 0pt. (No Space)
  - -Paragraph Spacing: 6pt.

-Figure Caption (Below Figure, Center Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Center Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against Plagiarism and percentage of duplication must be less than 10% (As suggested by UGC).

MAJOR PROJECT PHASE I

Semester :	**III**	**Internal Assessment :**	**160**
Course Code :	PRFRC30709	**End Sem. Exam :**	**240**
Teaching Hours/Week (L:T:P) :	**0:0:6**	**Exam Duration (Hours) :**	**3.0**
Credits : 16			

PREREQUSITES

Working knowledge of Electronics and Communication areas focusing on RF and Microwave Engineering.

COURSE OUTCOMES

After completing this Course, the students should be able to:

CO1. Identify, analyze and formulate projects with a systematic approach.

CO2. Summarize and analyze the literature review and relate them to current project.

CO3. Device system integration skills

CO4. Demonstrate documentation skills

CO5. Develop Project management skills to work effectively and constructively.

CO6. Develop problem solving skills.

Guidelines

There shall be an PG major-project to be chosen in consultation with the department faculties of their specialization. Students will register for the project at the time of commencement of III semester. The PG major-project shall be submitted in a report form and presented before the committee in the VI semester. The following points need be considered for PG Major Project Phase-I

1. Student has to select a project either of their own interest or in consultation with faculty members of the department.
2. Every student must carry out project independently, with appropriate permission from HoD / Dean and department guide.
3. If student has his/her own idea for an individual Project, it is the student's responsibility to find a faculty member who both approves of the proposed programme of work and is willing to be the supervisor.
4. It is the responsibility of the student to report the progress of the work regularly to the concerned supervisor. A proper documentation has to be maintained in this regard.
5. In this phase student is expected to complete the detailed literature review and should define the problem statement to implement the project in the subsequent semester. Evidence of part of the implementation of the project work is an added advantage for grading.
6. A report of atleast 30 pages (printed on double side) must be submitted before the commencement of 3rd semester end semester examinations (ESE).

Report Format

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  - -Title of the Project: 24, Bold
  - -Main/Chapter Header (1, 2, etc..): 16, Bold
  - -Sub title: 14, Bold -Running Text: 12, Regular
  - -Lines Spacing: 1.5 Lines
  - -Paragraph Beginning: 0pt. (No Space)
  - -Paragraph Spacing: 6pt.

-Figure Caption (Below Figure, Center Justified)): 10, Regular Times New Roman
-Table Caption (Above Table, Center Justified): 10, Regular Times New Roman
-References must be placed at the end of Report
-References must be cited in square brackets [1][2], [3-5], [6-9, 11, 14] etc.

- Report must be tested against Plagiarism and percentage of duplication must be less than 10% (As suggested by UGC).

MAJOR PROJECT PHASE II

Semester :	**IV**	**Internal Assessment :**	**200**
Course Code :	PRFRC40710	**End Sem. Exam :**	**300**
Teaching Hours/Week (L:T:P) :	**0:0:6**	**Exam Duration (Hours) :**	**3**
Credits : 20			

PREREQUSITES

Thorough working knowledge of Electronics and Communication areas focusing on RF and Microwave Engineering.

COURSE OUTCOMES

After completing this Course, the students should be able to:

CO1. Identify, analyze and formulate projects with a systematic approach.

CO2. Summarize and analyze the literature review and relate them to current project.

CO3. Device system integration skills

CO4. Demonstrate documentation skills

CO5. Develop Project management skills to work effectively and constructively.

CO6. Develop problem solving skills.

Guidelines

There shall be an PG major-project, in collaboration with an Industry / department faculties / Educational institute of national repute of their specialization. The following points need be followed for PG Major Project Phase-II

1. Students will have to continue the project chosen in the 3rd semester for its implementation. Those who would like to go for external project with industry/an educational institute of national importance may continue the existing project or may choose different one as per the suggestion of external supervisor.
2. The PG major-project shall be submitted in a report form and presented before the committee in VI semester.
3. In case students would like to work with other institute or industry, they have to inform the HoD /Dean and take appropriate permission.
4. In this phase student is expected to complete the project implementation and should keep the working model ready at the time of final internal demonstartion/external examination.
5. Evidence of paper publication or acceptance in any of the International Conferences is must.

Report Format

Following points may be noted regarding the format of a report:

- A4 size, 1.5 inches margin on left side and 1 inch margin on remaining three sides.
- Times New Roman fonts:
  - -Title of the Project: 24, Bold
  - -Main/Chapter Header (1, 2, etc..): 16, Bold
  - -Sub title: 14, Bold -Running Text: 12, Regular
  - -Lines Spacing: 1.5 Lines
  - -Paragraph Beginning: 0pt. (No Space)
  - -Paragraph Spacing: 6pt.
  - -Figure Caption (Below Figure, Center Justified)): 10, Regular Times New Roman
  - -Table Caption (Above Table, Center Justified): 10, Regular Times New Roman
  - -References must be placed at the end of Report
  - -References must be cited in square brackets as [1][2], [3-5], [6-9, 11, 14] etc.
- Report must be tested against Plagiarism and percentage of duplication must be less than 10%. (As suggested by UGC).

RESEARCH METHODOLOGY

Semester :	**II**	**Internal Assessment :**	**30**
Course Code :	PRFTD20609	**End Sem. Exam :**	**45**
Teaching Hours/Week (L:T:P) :	**3:0:0**	**Exam Duration (Hourse) :**	**2**
Credits : 03			

COURSE OBJECTIVES

This course will enable students to:

CO1.Describe research, identification of research problems, and preparation of proposals.
CO2.Analyze the results using mathematical and statistical tools and pctice ethics.
CO3.Collect necessary data and analyze and represent them
CO4.Write review article, research article and write thesis

UNIT-I

Research methodology: Need, motivation, definition,meaning and objectives of research,types of research , research approaches, significance of research,research methods versus methodology,research and scientif methods, research process, criteria good research. Research process, Identification of the problem, Research evaluation methods, Various indexes (h-index, i-index, etc.). Laboratory Methods of research: Qualitative and Quantitative.

UNIT-II

Literature surveey: Importance of literature survey. Literature review, need of review, benefits and steps for condicting review . Guiedline for revies Record of research record. Research report, articles, review, and references

UNIT-III

Data Collection: collection of primary data ,secodmnary data, data organioztiona, methods of data grouping, diagrammatic representation of data, graphical representation of data. Sample design, samplingestaimation oif population role of statisticsa for data anlysis, descriptive stasticsmeasures of central tendancey, hypothesis testing, use of stastistical tools

UNITIV

Report Writing: Tools for report writing, format of research report,synopsis,dissertation disserrtaion, thesis its differention, references/bibography,techinial report writing/journal report writing presentation, plagiarism, research proposal writing and presentation, Reserahc report, Research grant proposal. Intriduction to intellectual property rights

TEXT BOOKS and REFERENCE BOOKS

1. C R Kothari, Research Methodoly,Methods and Technique, New Age International publishers
2.J. Anderson, B. H. Dursten and M. Poole, Thesis and Assignment Writing, Wiley Eastern.

3. Y P Agarwal, Ststistical Methods:Concepts,Aplications and Computation,sterling Publication Pvt Ltd, New Delhi-2004

4. D. C. Harris Quantitative Chemical Analysis, 2007, W. H. Freeman and Company

5.G nageswara Rao, Research Methodology and Uqantative methods, BS Publications, Hyderabad,2012

3. R. Panneerselvan, Research Methodology, PHI, New Delhi.

4. Michael M. Marda, Research Methods of Science, 1st Ed., Cambridge University Press, New York.

5. C. C. Kothari and Gourav Garg, Research Methodology, 3rd Ed., New Age Internationa.

6. S. K. Muthu, Probability and Error for Physical Science, Orient Lougman.

7. P. R. Majhi and P. K. Khatua, Research Methodology, Himalaya Publication House.

RESEARCH AND PUBLICATION ETHICS

Semester :	**III**	**Internal Assessment :**	**20**
Course Code :	PRFTD30707	**End Sem. Exam :**	**30**
Teaching Hours/Week (L:T:P) :	**2:0:0**	**Exam Duration (Hourse) :**	**1.5**
Credits : 02			

COURSE OBJECTIVES

This course will enable students to:

CO1. Understand philosophy and ethics in research,Practice intellectual honesty and research integrity.

CO2. Discuss scientific misconducts, conflicts of interest and predatory publishers and journals

CO3. Demonstrate the use of plagiarism software like Turnitin, Urkund, and other open source software tools

CO4. Judge the quality of the publications using Indexing databases

UNIT-I

Introduction to research :Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, nature of moral judgements and reactions.

Scientific conduct:Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts:Falsification, Fabrication and Plagiarism, Redundant Publications: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data

UNIT-II

Publication ethics: Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types, Violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals

UNIT-III

Open access publishing: Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Publication misconduct:Group discussion: Subject specific ethical issues, FFP, authorship; Conflicts of interest; Complaints and appeals: examples and fraud from India and abroad; Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools

UNITIV

Databases and research metrics:Databases: Indexing databases, Citation databases: Web of Science, Scopus etc.; Research Metrics: Impact factor of journal as per jounal citation report, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index, altmetrics

TEXT BOOKS and REFERENCE BOOKS

1. Bird A: Philosophy of Science. Routledge
2. MacIntyre, Alasdair (1967) A short history of ethics, London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition (2009)
5. Resnik, D B (2011), What Is Ethics in Research and Why Is It Important? National Institute of Environmental Health Sciences, 1-10
6. Beall, J (2012) Predatory publishers are corrupting open access, Nature, 489 (7415), 179-179.
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019)