Proceedings of Board of Studies Meeting

(Held on July 07, 2023)

Course Structure & Syllabus for the programs:

Master of Technology

in

Electronics & Communication Engineering

(As per the Ordinances for Master of Technology as per Academic Council)

Submitted By

Department of Electronics Engineering,

Harcourt Butler Technical University,

Nawabganj, Kanpur-208002 (UP)

VISION AND MISSION OF THE DEPARTMENT

Vision

Department of Electronics Engineering aims to deliver Technical Education in the field of Electronics and Communication Engineering, for producing Engineers and Technologists who are happy, healthy and competent professionals, motivated to serve the society through research & innovation.

Mission

1. To educate and train the students with state-of-the-art in Electronics and Communication Engineering.
2. To prepare the students who are fit for meeting the requirements and challenges of the Industry right at the time of their graduation by evolving a sustainable Industry-University interaction system for this.
3. To upgrade the teaching standards through continued efforts toward improvement of the qualification and expertise of the teachers as well as supporting staff.
4. To create awareness amongst the students towards socio environmental technologies by offering related courses and organizing seminars/workshops on these topics in the university and by encouraging participation in similar activities at other places.
5. To expand research and development activities in the frontier areas related to Electronics and Communication.
6. To include the aspect of integration of environmental balance and human values in the curriculum.
7. To provide academic support to other technical institutions at state & national level through the process of networking.
8. To start social service programs like education for masses, particularly using the enhanced means of communication.

VISION AND MISSION OF THE UNIVERSITY

VISION

"To achieve excellence in technical education, research and innovation".

MISSION

1. Imparting Knowledge to develop analytical ability in science and technology to serve the industry and society at large.
2. Equip and enable students with conceptual, technical and managerial skills to transform the organization and society.
3. Inculcating entrepreneurial philosophy and innovative thinking to promote research, consultancy and institutional social responsibility.
4. Serving people, society and nation with utmost professionalism, values and ethics to make development sustainable and quality of life.

Program Educational Objectives (PEOs)

Program graduates, within three years from their graduation will

PEO 1: have knowledge of basic and applied sciences, so as to apply the necessary competence for technically sound, economically feasible and socially acceptable solutions of real life complex engineering problems.

PEO 2: be fit for meeting the requirements and challenges of industries, research and academic institutions both at the national and International level, by applying expertise gained in area of electronics and communication engineering.

PEO 3: be professionally competent with excellent communication and management skills along with being enterprising professionals and responsible citizens capable of delivering their services individually as well as in a collaborative framework.

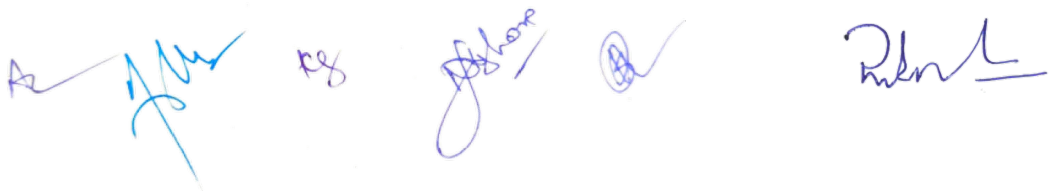
Structure of the Curriculum
Semester Wise Course Structure & Evaluation Scheme
For M.Tech. in Electronics & Communication Engineering

I Semester

Sr. No	Course Type	Subject code	Course title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	NET 501	Introduction to Signal Analysis	4(3-1-0)	30	20	-	50	50	100
2.	PCC	NET 503	Data Communication Networks	4(3-0-2)	15	20	15	50	50	100
3.	PCC	NET 505	Optical Communication	4(3-1-0)	30	20	-	50	50	100
4.	PEC	NET	PEC-I (Program Elective- I)	4(3-1-0)	30	20	-	50	50	100
Total Credits				16						

II Semester

Sr. No	Course Type	Subject code	Course title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	NET 502	Digital Communication	4(3-1-0)	30	20	-	50	50	100
2.	PCC	NET 504	Architecture & Applications of Digital Signal Processors	4(3-1-0)	30	20	-	50	50	100
3.	PCC	NET 506	Estimation and Detection Theory	4(3-1-0)	30	20	-	50	50	100
4.	PEC	NET	PEC-II (Program Elective- II)	4(3-1-0)	30	20	-	50	50	100
Total Credits				16						

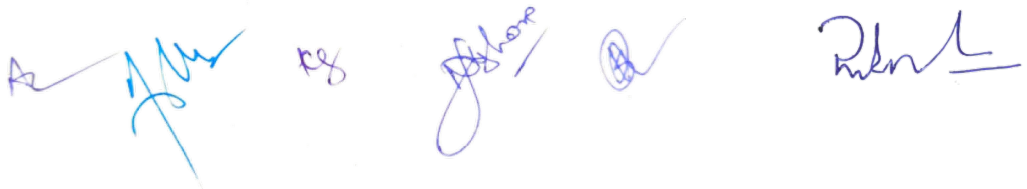


III Semester

Sr. No	Course Type	Subject code	Course title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	NET 671	Seminar	2(0-0-4)	-	50	-	50	50	100
2.	PCC	NET 681	Industrial training/ Minor Project	2(0-0-4)	-	50	-	50	50	100
3.	PCC	NET 691	Dissertation (Part-I)	12(0-0-24)	-	50	-	50	50	100
Total Credits				16						

IV Semester

Sr. No	Course Type	Subject code	Course title	Credits	Sessional Marks				ESM	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	NET 692	Dissertation (Part-II)	16(0-0-32)	-	50	-	50	50	100
Total Credits				16						



Program Elective-I (PEC-1)

Sl. No.	Course Code	Name of the course	Credit (L-T-P)
1.	NET 521	Space Communication	4(3-1-0)
2.	NET 523	Wireless Communication	4(3-1-0)
3.	NET 525	Advanced Microprocessor	4(3-1-0)
4.	NET 527	Communication Theory	4(3-1-0)
5.	NET 529	Analog VLSI Circuits	4(3-1-0)
6.	NET 531	Neural Network	4(3-1-0)
7.	NET 533	Antenna Analysis & Synthesis	4(3-1-0)
8.	NET 535	Information Theory & Coding	4(3-1-0)

Program Elective-II (PEC-2)

Sl. No.	Course Code	Name of the course	Credit (L-T-P)
1.	NET 522	RF Systems	4(3-1-0)
2.	NET 524	Digital System Design	4(3-1-0)
3.	NET 526	VLSI System Design	4(3-1-0)
4.	NET 528	Embedded Systems	4(3-1-0)
5.	NET 530	Advanced Semiconductor Devices	4(3-1-0)
6.	NET 532	Image Processing	4(3-1-0)
7.	NET 534	VLSI Implementation of Digital Processors	4(3-1-0)
8.	NET 536	Telecommunication & Switching	4(3-1-0)

The components of the curriculum

Table (a) Program curriculum grouping based on course components

Course Component	**Curriculum Content (% of total Credits of the program)**	**Total number of credits**
Program Core (PCC)	37.5	24
Program Electives (PEC)	12.5	8
Seminar (S)	3.1	2
Industrial training / Minor project (IT)	3.1	2
Dissertation (D)	43.8	28
Total		**64**

Table (b) Program curriculum grouping based on course components as per semester: **Frequency & Credits**

Sem	**PCC**		**PEC**		**Seminar**		**Ind. Training/ Minor project**		Dissertation		**Total**
	Credits	No.	Credits	No.	Credit	No.	Credit	No.	Credit	No.	Credit
I	12	3	4	1	-	-	-	-	-	-	**16**
II	12	3	4	1	-	-	-	-	-	-	**16**
III	-	-	-	-	2	1	2	1	12	1	**16**
IV	-	-	-	-	-	-	-	-	16	1	**16**
Tot	**24**	**6**	**8**	**2**	**2**	**1**	**2**	**1**	**28**	**2**	**64**

1st Semester

PCC (NET501)	INTRODUCTION TO SIGNAL ANALYSIS	3L:1T:0P	4 credits

Course Objectives: To understand the concept of different signals and its parameters. Also analyze these signal properties in different conditions.

Syllabus

Discrete and Continuous time signals and systems, LTI systems, Convolution, Difference equations. Frequency domain representation: Fourier transform and its properties. Random discrete signals. Sampling and reconstruction: Change of sampling rate, Image as a Signal, Sampling of Image. Normed vector spaces, basis, linear independence, orthogonality. Linear systems of equations. Over and Under-determined systems. Row- and Column spaces, Null spaces. Eigenvectors and Eigenvalues, Least square and minimum norm solutions. Inverse and pseudo inverse, Symmetry transformations.. Hilbert transforms,band pass representations and complex envelope. Base band pulse transmission.

Course Outcome:

1. Represent and analyze continuous and discrete time signals and LTI systems and apply convolution operator.
2. Compute Fourier transform of continuous and discrete time signals and understand the process of Sampling.
3. Understand the concepts of vector space, basis and linear independence and to solve system of linear equations.
4. Apply the concept of vector space to find least square solution, minimum norm solution, Inverse and Pseudo inverse.
5. Represent band pass signals and to understand baseband transmission through band limited channels.

References/Text Books:

1. Oppenheim Schafer, “Discrete-Time Signal Processing”. TMH
2. Gilbert Strang, “Linear Algebra and its Applications”, Thomson
3. John G. Proakis, Masoud Salehi, “Communication Systems Engineering”, PearsonEducation.
4. Simon Haykin, “Communication Systems”, Wiley India.
5. Lectures of NPTEL.

PCC (NET503)	DATA COMMUNICATION NETWORKS	3L:0T:2P	4 credits

Course Objectives: To understand the concepts of layered network architecture and analysis of schemes and protocols related to different layers and their experimental verification.

Syllabus

OSI model, queuing theory, physical layer, error detection and correction, data link layer, ARQ strategies, framing, media access layer, modeling and analysis of important media access control protocols, FDDI and DQDB MAC protocols for LANs and MANs, network layer, flow control & routing, TCP/IP protocols, ATM, Virtual Switches

Experiments

1. To create two nodes and a link and send data between them.
2. To create two nodes and a link and send data between them and monitor the queue.
3. To create a dynamic network.
4. To plot throughput of flow using Xgraph.
5. To create a simple wireless network.
6. To create a wireless network and use movement pattern and traffic pattern files.
7. To create a simple wired-cum-wireless topology.
8. To create a Running Mobile IP in a simple wired-cum-wireless topology.

Course Outcome

1. Understand the concepts of OSI model, queuing theory, and physical layer.
2. Analyze and apply the concepts of error detection and correction techniques such as ARQstrategies.
3. Model and analyze the important media access control protocols
4. Understand the sharing of virtual circuits using ATM layer
5. Analyze the communication between virtual machines using virtual switches.

References/Text Books:

1. Kartalopoulos, "Understanding SONET/SDH and ATM Communication", Networksfor the next millennium", PHI
2. A.S. Tanenbaum, "Computer Networks", PHI
3. William Stallings, "Data and Computer Communication", Pearson

PCC (NET 505)	OPTICAL COMMUNICATION	3L:1T:0P	4 credits

Course Objectives: To understand the concepts of wave propagation, optical fiber, optical sources, optical detector, optical receiver & analyze different noise.

Syllabus

Wave Propagation through Optical Fibers, Optical Sources, Optical Detectors, Optical Receiver Design, Optical Fiber Communication Systems; Digital system design, Modulation formats for analog optical communication systems, Introduction to WDM concepts, advancedmultiplexing strategies.

Optical Wireless Communication: Introduction, Historical Overview, Recent developments Existing and Future Application Areas

Course Outcome:

1. Understand the Basic Principles of Wave Propagation through Optical Fiber, Characteristics of Optical Fibersand Signal Degradation in Optical Fibers, Optical Emission, Optical Source Materials.
2. Compare Structure and Operation of LED and Laser diodes
3. Understand and compare Principles of Optical Detection, Structure, Operation andcharacteristics of PIN, APD and its Noise Performance.
4. Understand the principle of operation and designing of Optical Receiver and analyzedifferent types of Noise. Design and analyze Complete Optical Communication Link.
5. Analyze Recent developments of Existing and Future Application Areas of opticalwireless communication.

References/Text Books:

1. Keiser, Gerd / "Optical Fiber Communications" / McGraw-Hill.
2. Senior, John M. / "Optical Fiber Communications Principles & Practices" /Prentice-Hall (India).
3. William, B. Jones Jr. / "Introduction to Optical Fiber Communication Systems" /Holt, Rinehart and Winston, Inc. International Edition
4. Wilson, J. & Hawkes, J.F.B. / "Optoelectronics an Introduction" Prentice-Hall(India)
5. Khare, R.P. /"Fiber Optics & Optoelectronics" / Oxford University Press
6. Agrawal, D.C. / "Fiber Optic Communication" / S. Chand
7. Slavarajan, A., Kar.S. & Srinivasan T. / "Optical Fiber Communication Principles &Systems" / Tata McGraw Hill.
8. Roberto Ramirez-Iniguez, Sevia M. Idrus, Skudai Johor, / “Optical wirelesscommunication: IR for Wireless Connectivity”/ZiranSun, CRC Press.
9. Uysal, M., Capsoni, C., Ghassemlooy, Z., Boucouvalas, A., Udvary, E. /OpticalWireless Communications: An Emerging Technology/.

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2nd Semester

PCC (NET 502)	**DIGITAL COMMUNICATION**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the concepts of pulse modulation systems, baseband transmission. To understand the concepts of digital modulation and demodulation techniques, channel coding schemes, and spread spectrum communication and CDMA

Syllabus

PCM, DPCM, DM, TDM; ISI, Pulse shaping, Partial response signaling, Optimum transmit and receive filters, Error probability, Equalization, Matched filtering, Correlation Receivers, Digital Transmission- Baseband and Passband. Baseband Signaling- Unipolar, Bipolar, RZ, NRZ etc., Digital modulation, Keying- ASK PSK, FSK, MASK MPSK, MFSK; Error correcting codes Linear and Convolutional codes; Spread Spectrum Techniques- Direct Sequence Frequency Hopped, CDMA.

Course Outcome:

1. Analyse different pulse modulation schemes with the basics of sampling, quantization,encoding and time division multiplexing.
2. Understand the concepts of base band and pass band digital transmission and partialresponse signaling.
3. Analyse and compare different digital modulation schemes.
4. Understand the concepts of error control coding schemes
5. Understand spread spectrum technique with modulation.

References/Text Books:

1. John G. Proakis, Masoud Salehi, “Communication Systems Engineering”, PearsonEducation.
2. Proakis J. G. / “Digital Communications” / McGraw Hill /
3. Haykin, Simon / “Communication Systems” / John Wiley
4. Lathi, B.P / “Modern Digital & Analog Communication Systems” / Oxford UniversityPress /.
5. Simon Haykin / “Digital Communication” / John Wiley.
6. Taub& Schilling / “Principles of Communication Systems” / Tata McGraw-Hill /
7. Proakis J. G. / “Digital Communications” / McGraw Hill /
8. Schaum’s Outlines / “Analog & Digital Communication” / Tata McGraw-Hill.

PCC (NET 504)	ARCHITECTURE AND APPLICATIONS OF DIGITAL SIGNAL PROCESSORS	3L:1T:0P	4 credits

Course Objectives: To understand & apply the concepts of architecture and programming of different digital signal processors and to apply those concept for different applications.

Syllabus

DSP Processors: DSP Hardware & Circuits; 8-bit, 16-bit, 32-bit DSP Processors; Analog Devices, DSP Processors Devices and their Comparison. Data width and dynamic range, Limitations of DSPs.

Architecture: DSP System, ADSP-2100 Family base Architecture, MAC & Shifter block diagrams, architectures of real digital signal processors

Instruction Set: Instruction Sets, Certain application programs: ADC/DAC, Filter design, Function Generation etc.

Applications: Filtering: Low pass, high pass, band pass, Hilbert transformations etc.

Voice/Speech

Voice mail, speech Decoding, speech recognition Speaker Verification etc

Telecommunication: Digital PBX, Line Repeaters, MODEMS, Data Encryption etc.

Imaging: Image Transmission Compression, Pattern recognition Image Enhancement, Homomorphic Processing etc.

Instrumentation: Spectrum Analysis, Pattern matching, Transient Analysis etc.

Military: Radar & Sonar Processing, Image Processing Radio frequency MODEM, MissileGuidance.

Course outcome

1. Understand about different Digital Signal Processors hardware and circuits.
2. Know the architecture and instruction set for various digital signal processors.
3. To apply these concepts on programming & downloader.
4. Apply the concepts in synchronization filtering voice /speech processer.
5. Apply these concepts in applications e.g. telecomm, Image, military & other apps.

References/Text Books:

1. Sen M. Kuo & Woon-Seng S. Gan, "Digital Signal Processors-architectures,implementation and applications" / Pearson Education
2. K. Padmanabhan, S. Ananthi & R. V. Rajeshwaran / "A Practical Approach to DigitalSignal Processing"
3. TMS, Data Manual
4. ADSP Data Manual
5. Robiner, L.R. & Gold, B. / "Theory and application of Digital Signal Processing" /Prentice-Hall (India).
6. Oppenheim, A. V. & Schafer R. W. / "Digital Signal Processing" / Prentice-Hall India).

PCC (NET 506)	Estimation and Detection Theory	3L:1T:0P	4 credits

Course Objectives: To solve the problems that involve estimation of signal parameters or detection of signals or problems where joint detection and estimation is required.

Syllabus

Estimation theory: Minimum variance unbiased estimation, best linear unbiased estimation, Cramer-Rao Lower Bound (CRLB), General CRLB for signals in White Gaussian Noise, CRLB for General Gaussian Noise, Linear Models, BLUE, MLE, Least Squares, Bayesian Estimator, Wiener Filter, Kalman Filter. Detection Theory: Neyman-Pearson Theorem, Likelihood Ratio testing, Bayes Risk, Bayes detectors, Neyman-Pearson detectors, Multiple Hypothesis Testing, Matched Filters, Generalized Matched Filters, Generalized Likelihood ratio Tests (GLRTs)

Course outcomes:

1. Acquire basics of parametric estimation theory and to find the Performance Bounds of an estimator.
2. Perform the estimation of unknown parameters using different Linear Models.
3. Understand the Bayesian Philosophy of estimation and apply Bayesian estimators.
4. Acquire basics of statistical decision theory used for signal detection and estimation.
5. Design, apply and analyze different hypothesis testing and Bayesian algorithms for signal detection.

References/Text Books:

1. S.M. Kay, “Fundamental of Statistical Signal Processing: Estimation Theory”, Vol-I,Prentice Hall PTR, 2009
2. S.M. Kay, “Fundamental of Statistical Signal Processing: Detection Theory”, Vol-II,Prentice Hall PTR, 1998
3. H.V. Poor, “An Introduction to Signal Detection and Estimation”, Springer,2/e,1998
4. Harry L. Van Trees,” Detection, Estimation and Modulation Theory” (Detection, Estimation and Modulation Theory, Part-I), John Wiley & Sons,2002

PEC-I

PEC-1 (NET 521)	**SPACE COMMUNICATION**	**3L:1T:0P**	**4 credits**

Course Objectives: To learn & understand the concepts of satellite communication, its link design, different earth station & tracking satellite. Also analyze different digital technologies

Syllabus

Introduction, Historical background and overall perspective, Orbital considerations, Launching, Atmospheric effects, Transponders, satellite network modeling, link calculations, FM analysis, Multiple access: FDMA, TDMA, CDMA, Earth stations, TV Transmission, Introduction to GPS. Recent Developments

Course outcome

1. Learn and understand the basic laws and dynamics of the satellite.
2. Understand communication satellite design.
3. Analyze and understand how analog and digital technologies are used for satellite communication networks.
4. Understand the design of satellite links.
5. Study the design of Earth station and tracking of the satellites.

References/Text Books:

1. Pratt & Bostian, "Satellite Communications", John Wiley & Sons
2. Roddy D. "Satellite Communications", Prentice Hal
3. M. Richaria, "Satellite Communication Systems"

PEC-1 (NET 523)	**WIRELESS COMMUNICATION**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the principles of wireless communication and to study the recent trends adopted in cellular systems and wireless standards.

Syllabus

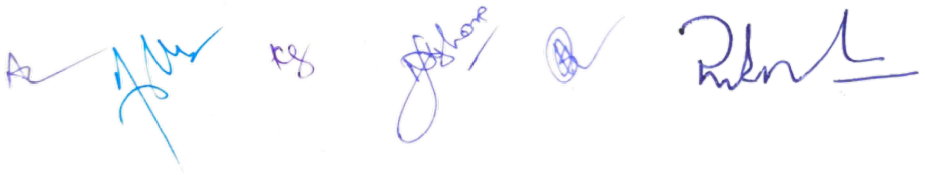
Introduction to Wireless Communications, multi path channel models, capacity of wireless channels, performance of digital modulation techniques over wireless channels, combining techniques, multicarrier modulation, coding for wireless channels, overview of current wireless standards, MIMO techniques

Course outcome

1. Understand the basics of wireless communication.
2. Understand capacity of wireless channels.
3. Understand digital modulation techniques.
4. Study coding of wireless channels.
5. Study MIMO concepts.

References/Text Books:

1. Wireless Communications: Principles and Practice by TS Rappaport, Prentice Hall
2. Principles of Mobile Communications by GL Stuber, Kluwer Academic
3. Wireless Communications by AJ Goldsmith, Cambridge University Press.
4. Multiuser Detection by S Verdu, Cambridge University Press,
5. Modern Wireless Communications by S Haykin and M Moher, Prentice Hall, 2004.



PEC-1 (NET 525)	**ADVANCED MICROPROCESSORS**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand and apply the concepts of different microprocessor & microcontroller architecture, addressing modes & apply it in real world.

Syllabus

Architecture of 16 Bit Microprocessor (8086), Instruction Set, Memory Organization and Memory Control; Signals for 8086 Microprocessor, Input / Output Interface, Interrupt Structure, Assembly Language Programming, Controllers, Intel 80286, 80386, 80486, Pentium Processors, ARM Processors.
Microcontrollers: Introduction to 8031/8051, Microcontroller's Architecture, Memory Organization, Internal 8051 Memory, Addressing Modes, Interrupt Structure and Interrupt

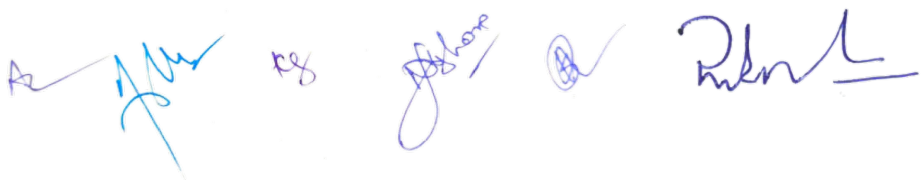
Priorities, Port Structure and Applications, Accessing Internal and External Memory, Timer/Counter Function and Different Modes of Operations.

Course outcome

1. Have the basic knowledge of 16 bit microprocessor, Microcontroller and ARM processorwith its memory organization and control.
2. Able to design smaller modules using Assembly language programming.
3. Apply these concepts on different addressing modes, interrupts.
4. Apply these concepts on real world application.

References/Text Books:

1. Hall, D. V. "Microprocessor and Interfacing", TMH
2. Brey, "The Intel Microprocessor", PHI
3. Y. Rajasree, "Advanced Microprocessor", New age international publishers.
4. Aditya P. Mathur, "Introductionto Microprocessors", TMH.
5. Hennessy &Pattereson, "Computer Architecture" Elsevier.



PEC-1 (NET 527)	**COMMUNICATION THEORY**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the concepts of Source coding, Modulation Schemes, Channel coding, and their applications. To understand the effect of finite bandwidth and fading during transmission, the concept of diversity reception and equalization.

Syllabus

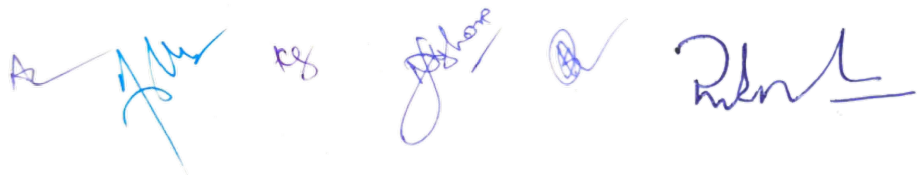
Rate distortion theory, channel coding theorems, digital modulation schemes, Trellis coded modulation, digital transmission over band limited channels, fading multipath channels, synchronization. Analog modulation schemes, optimum/suboptimum receivers, diversity combing, cellular mobile communication. Equalization.

Course outcome

1. Have the basic knowledge of rate distortion theory and different digital modulationschemes.
2. Apply these concepts on digital transmission with its challenges.
3. Analyze different modulation schemes with its receivers.
4. Design a communication system with its various challenges in cellular mobile communication.

References/Text Books:

1. S.Haykin, "Communication Systems", Wiley Eastern
2. D.Sakrison, "Communication Theory", John Wiley & Sons
3. Taub & Schilling, "Principles of communication systems" McGraw Hill



PEC-1 (NET 529)	Analog VLSI Circuits	3L:1T:0P	4 credits

Course Objectives: To apply & understand the concepts of CMOS, VLSI circuit & SRAM circuit.

Syllabus

Analog MOS circuits, opamps, frequency and transient responses, stability and compensation. Analog switches, sample and hold circuits, switched capacitor circuits. MOS inverters and gate circuits, interfacing, transmission gates. MOS memory circuits. Digital building blocks multiplexers, decoders, shift registers,etc. Gate array, standard cell, and PLA based designs. Digital to Analog and Analog to Digital converters.

Course Outcomes:

1. Apply knowledge of mathematics, science, and engineering to design and analysis of analog integrated circuits.
2. Identify, formulates, and solves engineering problems in the area of analog integrated circuits.
3. Understand various dissipation types in CMOS.
4. Estimate and analyse the power dissipation in VLSI circuits.
5. Derive the architecture of low power SRAM circuit.

References/Text Books:

1. Behzad Razavi,/ Design of Analog CMOS Integrated Circuits/Tata McGraw-Hill Education
2. Low Power CMOS VLSI Circuit Design- Kaushik Roy and Sarat C.Prasad

PEC-I (NET 531)	Neural Network	3L:1T:0P	4 credits

Course Objectives: To understand and apply the concepts of neural network computation and its algorithm. Also able to solve different problems of neural network.

Syllabus

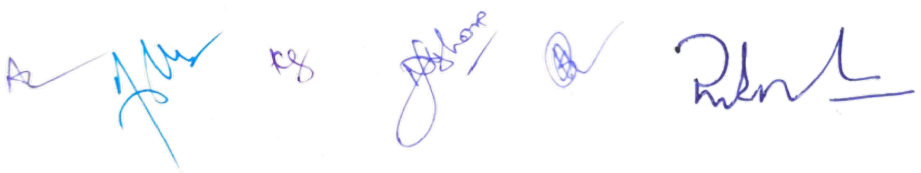
Neural Networks: History, Articial and biological neural networks, Artificial intelligence and neural networks
Neurons and Neural Networks: Biological neurons, Models of single neurons, Differentneural network models
Single Layer Perceptrons: Least mean square algorithm, Learning curves, Learning rates,Perceptron
Multilayer Perceptrons: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm
Radial-Basis Function Networks: Interpolation, Regularisation, Learning strategies
Kohonen Self-Organising Maps: Self-organising map, The SOM algorithm, Learning vector quantisation

Course outcome:

1. Understand the learning and generalisation issue in neural computation.
2. Understand the basic ideas behind most common learning algorithms for multilayerperceptrons, radial-basis function networks, and Kohonen self-organising maps.
3. Implement common learning algorithms using an existing package.
4. Apply neural networks to classification and recognition problems.
5. To formalize the problem, to solve it by using a neural network

References/Text Books:

1. An Introduction to Neural Networks, K. Gurney, UCL Press, London, 1997
2. Introduction to Neural Networks, R. Beale and T. Jackson, IOP Press, 1990
3. The Essence of Neural Networks, R. Callan, Prentice Hall Europe, 1999
4. Neural Networks: A Comprehensive Foundation, Simon Haykin, Prentice Hall, 1999



PEC-I (NET 533)	**ANTENNAS ANALYSIS & SYNTHESIS**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand, apply and analyze the concepts of different types of antenna structure & its parameters.

Syllabus

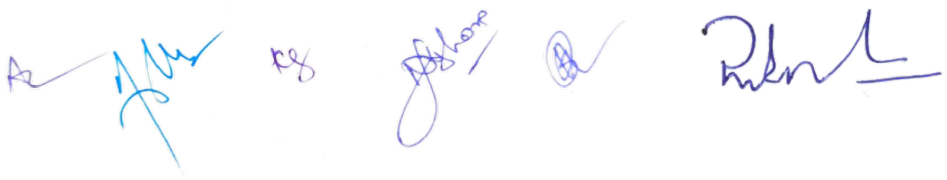
Vector potential antenna theorems and definitions, dipole, loop, slot radiators, aperture antennas array theorems, pattern synthesis, self and mutual impedance, scanning antennas, signal processing antennas, traveling wave antenna, antenna measurements.

Course Outcome:

1. Understand the basic concept of radiation inside antenna and their different structure.
2. Understand the basic Parameters of antenna, with Analysis of dipole antenna and theirapplication.
3. Apply the concepts for understanding different antenna arrays.
4. Analyze different types of antenna like Loop antenna, micro strip antenna, and helicalantenna.
5. Understand the concept of smart antenna and measurement of antenna.

References/Text Books:

1. Robert S. Elliot, "Antenna theory & Design", PHI
2. J.D. Kross," Antenna Theory", McGraw Hill International
3. C.A. Ballani, / “Antenna Theory: Analysis and Design”/, Wiley
4. C.A. Ballani, / “Modern Antenna Handbook”/, Wiley.



PEC-I (NET 535)	INFORMATION THEORY AND CODING	3L:1T:0P	4 credits

Course Objectives: To understand the concepts of information, entropy, different source coding techniques, and channel coding techniques. Also able to analyze image & video processing.

Syllabus

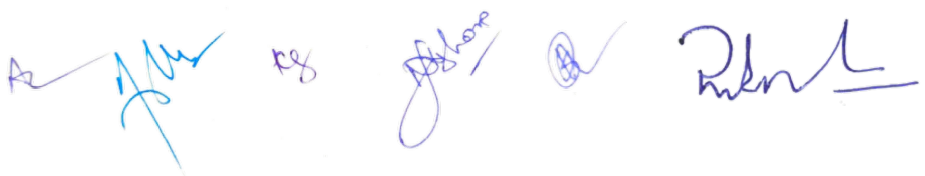
Coding- Source Encoding & Channel Encoding, Entropy and mutual information, rate distortion function, Source Encoding -Source Encoding Theorem, Variable length coding, Discrete memory less channels, capacity cost functions, Channel coding theorems; Channel Capacity Theorem, Channel Encoding- Linear block codes, Cyclic codes, Convolutional codes, Sequential and Probabilistic decoding, Majority logic decoding, Burst error-correcting codes.

Course outcome

1. Understand the concepts of entropy and mutual information with its application in thecommunication system.
2. Understand different source coding techniques with some practical applications.
3. Apply and analyze the concepts of channel properties such as channel capacity incommunication.
4. Analyze and understand the different channel coding techniques with its application invarious fields.
5. Analyze and apply these concepts to video abstraction, image compression and speechcoding techniques, variation auto-encoders.

References/Text Books:

1. Cover & Thomas, "Elements of Information Theory"
2. Peterson & Weldon, "Information and coding theory
3. Robert Ash, "Information Theory'
4. Gallager, "Information Theory and Reliable Communication"



PEC-II

PEC-II (NET 536)	**TELECOMMUNICATION SYSTEM ENGINEERING**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the concepts of telecommunication system & switching networks. Also study different mathematical model of communication system.

Syllabus

Clos Network, Recursive construction of switches, strictly Non-blocking, re-arrangebly non- blocking, Clos theorem, Duguid theorm. Paull's theorem, Paull's matrix, Cantor network.

Network traffic arrival and Service characterization, Erlang formulae, Mathematical modeling, Blocking Models (Lee's approximation), Karnaugh's method for Blocking probability estimate.

Stored program control (SPC) exchange, Space, Time switch implementation. Super multiplexing. Operating system architecture for switching system. Overload control mechanisms.

User to network signaling, pulse, tone signaling, common channel signaling. SS7 architectureand protocol stack. IP telephony, IP network architecture, Generic architecture, Banyan networks, Delta networks, Shuft1enet as delta network, buffered banyan network, Input vs. output queuing. Discussion of various packet switching architectures.

Course Outcome

1. Understand concept of Clos Network, Recursive construction of switches.
2. Learn about Clos theorem, Duguidtheorm. Paull's theorem, Paull's matrix and theirapplication.
3. Understand Mathematical modeling, Blocking Models (Lee's approximation), Karnaugh'smethod for Blocking probability estimate.
4. Understand SS7 architecture and protocol stack. IP telephony, IP network architecture,Generic architecture.
5. Analyze various packet switching architectures with their advantages and disadvantages.

References/Text Books:

1. Joseph Y. Hui. Switching and Traffic theory for integrated broadband networks, Kluwer Academic Press M. Schwartz, Telecommunication Networks: protocols. Modeling and analysis,Addison- Wesley Longman publishing company.
2. H. Jonathan Chao, Broadband Packet Switching Techno1ogy- A practical guide'. toATM Switches and 1P routers, John Wiley and sons. Inc.
3. T. Viswanathan, Telecommunication Switching Systems and networks, Prentice Hallof India.
4. R-L. Freeman, Telecommunication System Engineering, John Wiley and Sons

PEC-II (NET 526)	VLSI SYSTEM DESIGN	3L:1T:0P	4 credits

Course Objectives: To understand, and analyze the concepts of related to arithmetic building blocks, memory, array and digital ICs.

Syllabus

Emphasis on the synthesis based approach to VLSI Design Relevant issues related to physicaldesign automation such as placement, floor planning, routing and compaction are covered. Combinational & sequential logic synthesis issues and algorithms are discussed. Detailed coverage of HDLs and high level synthesis algorithms and issues.

Course outcome

1. Understand different implementation strategies for fabrication of digital ICs.
2. Understand parasitic parameters of digital components.
3. Apply these concepts to understand the Arithmetic building blocks, Memory, Arraystructures.
4. Analyze the timing issues for designing a digital ICs and architecture design using VHDL.
5. Apply the concept to validation of digital circuits.

References/Text Books:

1. D.A. Pucknell, "Basic VLSI Design:"
2. Kamran Eshranghian, Neil Weste, "Principles of CMOS Design",
3. Addison Wesley & Rashid, "Spice for Circuit of Electronics using Pspice", PHI
4. Baker Li Zoyce, "CMOS Circuit Design, Layout and Simulation", PHI.

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PEC-II (NET 524)	**DIGITAL SYSTEM DESIGN**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand designing concept of digital systems using MOS & CMOS devices.

Syllabus

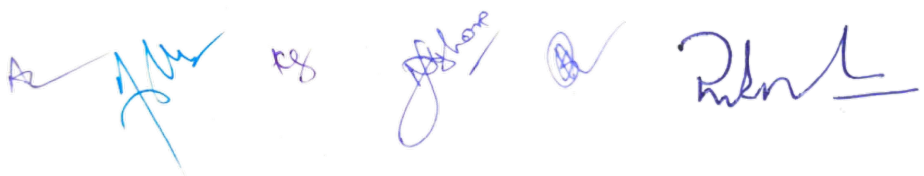
Introduction, The Manufacturing Process, The Devices, The Wire, The CMOS Inverter, Designing Combinational Logic Gates in CMOS, Designing Sequential Logic Circuits, Coping with Interconnect, Timing Issues in Digital Circuits.

Course outcomes:

1. Learn the design rules of future trends in integrated circuit technology.
2. Understand qualitative understanding of MOS devices.
3. Determine and quantify interconnection.
4. Design combinational logic gates in CMOS.
5. Design sequential logic circuits (flip-flops, latches, oscillators, pulse generators, andSchmitt triggers)

References/Text Books:

1. Jan M Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: ADesign Perspective" Pearson Education.
2. John F. Wakerly, "Digital Design Principles and Practices", Prentice Hall.
3. Gaetano Boriello, Randy H. Katz, “Contemporary Logic Design”, Prentice Hall
4. Howard G. Johnson, "High-Speed Digital Design - A handbook of black magic", PrenticeHall
5. Wayne Wolf, “FPGA-based System Design”, Prentice Hall



PEC-II (NET 530)	ADVANCED SEMICONDUCTOR DEVICES	3L:1T:0P	4 credits

Course Objectives: To understand the concepts of semiconductor material, opto electronic devices. Also analyze BJT, MOS & microwave devices.

Syllabus

Energy bands & charge carriers in semiconductors, Excess carriers in semiconductors, Junctions, BJT, Metal Oxide Field effect transistors, Negative conductance microwave devices, Optoelectronic Devices.

Course outcomes:

1. Understand the concept of energy bands in semiconductor.
2. Learn about excess carriers in semiconductor.
3. Analysis of different BJT & MOS circuits.
4. Analyse negative conductance in microwave devices.
5. Understand the concepts of opto electronics devices.

References/Text Books:

1. B.G. Streetman, "Solid State Devices", PHI
2. Donald Neamen, Dhrubes Biswas /"Semiconductor Physics And Devices"/TataMcGraw-Hill / 6th Ed.
3. A.S. Sedra & K.C. Smith. "Microelectronic circuits", Oxford University press.
4. Lectures of NPTEL.

PEC-II (NET 528)	EMBEDDED SYSTEMS	3L:1T:0P	4 credits

Course Objectives: To understand the concepts of programming of ARM, RIOS and hence to design the embedded system.

Syllabus

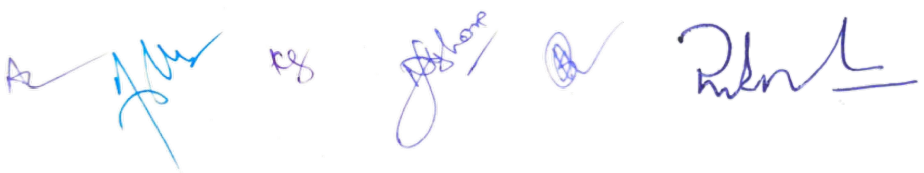
Introduction to Embedded systems & RTOS, Embedded processors (86, Motorola- PPC, ARM), Application areas, Devices & Architecture of ARM, PPC, X86, Review of memory Architecture, I/O, Timer Counter & Interrupts.
Introduction to DSP, Interface to Analog world, RTOS, Scheduler Algorithm (Rate monotonic, Deadline monotonic), Priority, Priority Inversion, Task, Threads, Processes, Memory Management, and Commercially available- RTOS
C for embedded Systems: Programming considerations like memory usage, runtime library usage, interrupt service routines. Booting process, memory mapping address space, external registers system registers, cache management etc. Device drivers for embedded systems. Interfacing C with assembly code- Inline assembly. Serial communications, networking stackprotocols for embedded systems.
Design &Tools: Design of an embedded application, Examples / Case Study.

Course outcome

1. Understand the basics of ARM Processors.
2. Study RTOS features along with DSP.
3. Learn C for embedded systems.
4. Understand case studies related to design of embedded systems.
5. Understand the application of embedded systems.

References/Text Books:

1. Burns, Alan and Wellings, Andy, " Real-Time Systems and Programming Languages", Second Edition. Harlow: Addison-Wesley-Longman.
2. Raymond J.A. Bhur and Donald L.Bialey, "An Introduction to real time systems:Design to networking with C/C++ ", Prentice Hall Inc. New Jersey.
3. Grehan Moore, and Cyliax, "Real time Programming: A guide to 32 Bit EmbeddedDevelopment. Reading" Addison- Wesley- Longman.
4. Heath, Steve, "Embedded Systems Design ", Newnes.
5. Embedded System Design: A Unified Hardware /Software Introduction, Frank



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PEC-II (NET 532)	IMAGE PROCESSING	3L:1T:0P	4 credits

Course Objectives: To understand the concepts of image processing and to apply for 3D vision, geometry and radiometry.

Syllabus

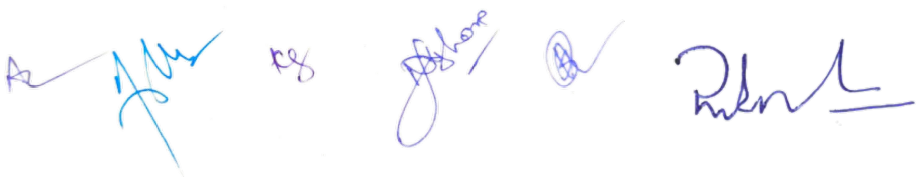
Human visual system and image perception, monochrome & colour vision models, colour representation, image sampling & quantization, 2-D systems, image transform image coding, stochastic models for image representation, image enhancement restoration & reconstruction, image analysis using multi resolution techniques.

Course Outcome

1. Understand the digitization, segmentation shape representation of images.
2. Have the basic knowledge of data structure for image processing.
3. Apply these concepts on image transforms and image enhancement.
4. Also analyze image data compression on different image representation techniques.
5. Apply the concepts on 3D vision, geometry and radiometry.

References/Text Books:

1. Gonzales & Woods, "Digital, Image Processing", Addison Wesley
2. A.K Jain, Image Processing , Wiley Eastern.
3. W.K. Pratt, "Digital Image Processing"
4. A. Rosenfelf and A.C. Kak, "Digital Image Processing"
5. V. Bhaskaran & K. Konstantinides, "Image and Video Compression Standards".



PEC-II (NET 534)	**VLSI IMPLEMENTATION OF DIGITAL PROCESSORS**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the concepts of digital signal processing and to apply different architectural transformation techniques for the enhancement of digital signal processing.

Syllabus

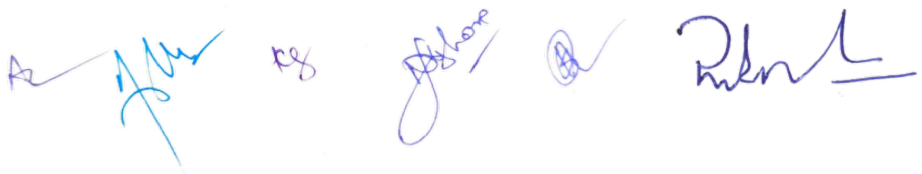
Basics concepts of Digital Signal Processing, Iteration bound, Pipelining and parallel processing, Retiming, Unfolding and folding algorithms, Systolic Architecture Design Fast convolution, Algorithmic Strength Reduction in Filters and Transforms, Pipelined and parallel recursive and adaptive filters

Course Outcome

1. Represent the signal flow graph, data flow graph and dependence graph of DSP algorithms.
2. To apply the pipelining and parallel processing to speed up the DSP algorithms.
3. Apply the concept of retiming the DSP algorithms for trade off the speed and power.
4. Apply the concepts unfolding and folding the DSP algorithms.
5. Design the Systolic Architecture of the DSP algorithms.

References/Text Books:

1. VLSI Digital Signal Processing Systems-Design and Implementations by Keshab K.Parhi; John Wiley & Sons, Inc.
2. Digital Signal Processors-Architectures, Implementations and Applications by Sen M. Kuo and Woon-seng S. Gan; Pearson Education, Inc.
3. Digital Signal Processing and Applications with the C6713 and C6416 DSKby Rulph Chassaing



PEC-II (NET 522)	**RF SYSTEMS**	**3L:1T:0P**	**4 credits**

Course Objectives: To understand the concepts of microwave component, transmission line circuit, resonators, filter configuration matching techniques & amplifier. Also analyze mixer & oscillators working.

Syllabus

Introduction: Importance of RF and Microwave Concepts and Applications- and Units Frequency Spectrum, RF and Microwave Circuit Design, Dimensions - RF Behavior of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors, General Introduction, Types of Transmission Lines-Equivalent Circuit representation.

Resonators: Basic resonator and filter configurations-special filter realization-filter implementation coupled filter.

RF diode and BJT: RF diodes-bipolar junction transistor - RF field effect transistor-high electron mobility transistors-diode models-transistor models-measurement of active devices-scattering parameter device characterization.

Impedance matching: Impedance matching using discrete components-micro-strip line matching networks amplifier classes of operation and biasing networks.

Characteristics of Amplifiers: Characteristics of amplifier-amplifier power relations-stability consideration-constant gain-broadband, high power, and multistage amplifiers.

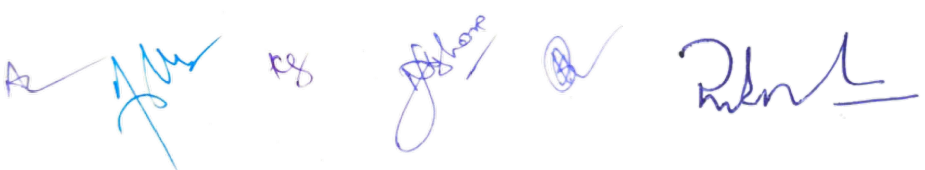
High frequency oscillators: Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixer.

Course outcome

1. Understand the basic concept and behavior of microwave components and different typesof transmission Lines-Equivalent Circuit representation.
2. Understand concept of resonator and filter configurations.
3. Know about working of RF diode and BJT.
4. Understand different matching techniques and Characteristics of amplifier.
5. Analyzing working principle of high frequency oscillators and basic characteristics of mixer.

References/Text Books:

1. Reinhold Ludwig, Gene Bogdanov**,** "RF circuit design, theory and applications", Pearson Asia Education.
2. D. Pozar, "Microwave Engineering", John Wiley & Sons, New York.
3. Bahil and P. Bhartia, "Microwave Solid State Circuit Design", Wiley-Interscience.RF Microelectronics by Behzad Razavi



3rd Semester

Seminar (NET 561)

Course Outcome

1. Have depth knowledge of one area of Electronics & Communication.
2. Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in terms of journals, conference proceedings.
3. Grasp the knowledge of challenging issues in their chosen field of research.
4. Show his ability to present and defend his research work to a panel of experts.
5. Understand how to do critical analysis of any research article.

Indutrial Training / Minor Project (NET 681)

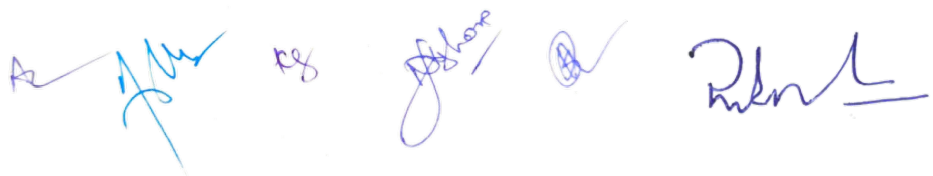
Course Outcome

1. Identify skills and capabilities that intersect effectively with the needs of industry.
2. Apply and practice good communication skills in the workplace setting.
3. Reflect and evaluate on experiences that might lead to future employment.
4. Report research findings in written and verbal forms.
5. Demonstrate and apply research skills to complete a project.

Dissertation (Part-I) (NET 691)

Course Outcome

1. Ready to collect information, analyse it and propose a novel solution for the same.
2. Understand the purpose of Research i.e., to use the technology and research for bettermentof the society and also publish his/her work.
3. Understand the interdisciplinary nature of research as a technical product can never berealized without collaboration of multiple disciplines.
4. Gain the skill to communicate the research work by oral presentations, by scientificarticles and by M. Tech. Thesis.
5. Understand the basic ethics of research and issues like plagiarism.



4th Semester

Dissertation (Part-II) (NET 692)

Course Outcome

1. Ready to collect information, analyse it and propose a novel solution for the same.
2. Understand the purpose of Research i.e., to use the technology and research for bettermentof the society and also publish his/her work.
3. Understand the interdisciplinary nature of research as a technical product can never berealized without collaboration of multiple disciplines.
4. Gain the skill to communicate the research work by oral presentations, by scientificarticles and by M. Tech. Thesis.
5. Understand the basic ethics of research and issues like plagiarism.

K. gaurav 07/07/23.
(Dr. Kumar Gaurav)
Assistant Professor

07/07/2023
(Dr. Nand Kishore)
Assistant Professor

7.7.23
(Dr. Ashutosh Singh)
Professor

07/07/2023
(Dr. K. Raj)
Professor

(Shri Amit Kumar)
Member BoS

(Shri Vishal Khare)
Member BoS

(Prof. S. Wairya)
Member BoS (ONLINE)

(Prof. M. J. Akhtar)
Member BoS

(Prof. M. K. Meshram)
Member BoS

07/07/2023
(A. K. Shankhwar)
Professor & Head