Master of Technology (Wireless Sensor Network)
2 Years Degree Program

Program Educational Objectives (PEOs)

- To prepare the students with good understanding of the respective subjects with design, analytical and problem solving skills.
- To train the students with knowledge of latest design trends.
- To inculcate in students the sense of ethics, morality, professionalism, creativity, leadership, independent thinking, self confidence, good communication skills and prepare them to become successful engineers who can work worldwide in industries and research & development laboratories.
- To introduce the research world to them so that they feel motivated for higher studies and innovation not only in their own domain but multidisciplinary domain.
- To recognize social needs and contribute effectively through self learning.

Program Outcome (POs):-

- The graduates will be able to apply the concepts of Engineering mathematics through Laplace, z-transform, linear algebra, probability and statistics, differential equations etc. and basic knowledge of engineering physics and chemistry.
- The graduates will be able to understand, interpret the problem, design and perform the experiments to meet the desired solution of the problem within the context of electronics and communication engineering.
- The graduates will have a good understanding of professional and ethical responsibility.
- The graduates will be able to express themselves effectively through written and oral communication.
- The graduates will have a good understanding and knowledge in applying the engineering solutions to society.
- The graduates will have a good understanding for the need of life long learning and will be able to work in teams.

- The graduates will show good proficiency in applying the techniques and knowledge of modern engineering skills in tackling contemporary technological challenges.
- The graduates will have good background for admission to post graduate programs (in same domain), management degree programs and also research programs in various organizations of national and international repute.
- The graduates will be able to participate and succeed in competitive examinations.
- Adapt transform in industry by understanding the need of independent and lifelong learning

Sanjeev Agrawal Global Educational University (SAGE), Bhopal

School Of Engineering & Technology

M Tech(Wireless Sensor Network)

First Year – Semester First																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
MA20M101	Advanced Mathematics	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
WS20M101	Wireless & Mobile Communication	3	1		4	3	30	05	05	10	50	100	-	-	-	100
WS20M102	Wireless Sensor Network	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
	DSE – I	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
	DSE – II	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
WS20M103	Wireless & Mobile Communication	-	-	4	2	/	-	-	-	-	-	-	20	30	50	50
WS20M104	Wireless Sensor Network	-	-	4	2	2	-	-	-	-	-	-	20	30	50	50
PB20M101	Project based learning	-	-	4	2	2	-				-	-	50	50	100	100
WS20M105	Embedded Sensor Networks	-	-	4	2	2	-				-	-	20	30	50	50
-	-	**Total**			26	-	-					500			250	750

Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

First Year – Semester Second																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
WS20M201	Fundamentals of Remote Sensing & Image Interpretation	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
WS20M202	Remote Sensing & GIS	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
WS20M203	Advanced Digital Signal Processing	3	1	-	4	3	30	05	05	10	50	100	-	-	-	100
	DSE – III	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
	DSE – IV	3	-	-	3	3	30	05	05	10	50	100	-	-	-	100
GE20B201	Generic Electives I	2	-	-	2	2	30	05	05	10	50	100	-	-	-	100
WS20M204	Advanced Digital Signal Processing	-	-	4	2	3	-	-	-	-	-	-	20	30	50	50
PB20M201	Project based learning	-	-	4	2	2	-				-	-	50	50	100	100
WS20M205	Programming Wireless Sensor Networks	-	-	4	2	-	-				-	-	20	30	50	50
-	-	Total			26	-	-					600			200	800

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Second Year – Semester Third																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
PB20M301	MOOC –1	-	-	8	4	-	-	-	-	-	-	-	50	50	100	100
PB20M302	MOOC - 2	-	-	8	4	-	-	-	-	-	-	-	50	50	100	100
WS20M301	Dissertation Phase-I	-	-	24	12	2	-				-	-	200	200	400	400
-	-	**Total**			20		-					-	-		-	600

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Second Year – Semester Fourth																
Course Code	**Course Title**	**Contact Hours per Week**			**Credits**	**ETE Duration (Hours)**	**Theory**						**Practical**			
		L	**T**	**P**			**MSE**	**ASG**	**TA**	**ATTD**	**ESE**	**Total**	**CE**	**ESE**	**Total**	**Grand Total**
WS20M401	Dissertation Phase-II	-	-	32	16	2	-				-	-	250	250	500	500
-	-	**Total**			16		-					-	-		-	500

MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, ESE- End Sem Exam ,CE-continuous Evolution

Master of Technology (Wireless Sensor Network)

2 Years Degree Program

Curriculum Components

Components	Credits
Program Core (11Courses)	**34**
Program Electives (Discipline Specific Electives) (04Courses)	**12**
Generic Electives (01 Courses)	**02**
Project Based Learning (PBL)/MOOCs (04 courses)	**12**
Project (02 Courses)	**28**
Total	**88**

Distribution of credits across all components

SEM No.	Programme Core	Discipline Specific Electives (DSE)	Generic Electives (GE)	Project Based Learning (PBL)/ MOOCs	Project	Total Credit
I.	18	6	-	2	-	**26**
II.	16	6	2	2	-	**26**
III.	-	-	-	8	12	**20**
IV.	-	-	-	-	16	**16**
Total	**34**	**12**	**02**	**12**	**28**	**88**

M Tech (Wireless Network Sensor)

List of Program (Discipline Specific) Electives (DSE)

First Year – Semester One (DSE-I)	
Course Code	Course Title
WS20M106	Satellite Communication
WS20M107	Internet of Things
WS20M108	Voice & Data Network
First Year – Semester One (DSE-II)	
Course Code	Course Title
WS20M109	Embedded System Design
WS20M110	Remote Sensing & GIS
WS20M111	Navigation Guidance & Control
First Year – Semester Second (DSE-III)	
Course Code	Course Title
WS20M206	Application of Remote Sensing in Geosciences
WS20M207	Remote Sensing & GIS for Agriculture & Forestry
WS20M208	Advanced Remote Sensing Techniques
First Year – Semester Second(DSE-IV)	
Course Code	Course Title
WS20M209	High Performance Networks/ Pattern Recognition
WS20M210	Pattern Recognition & Machine Learning
WS20M211	Advanced Microprocessor & Micro Controller

Generic Electives

List of Generic Electives

S.NO	Code	Nomenclature of the course	Offering School
1.	GE20M01	Java Programming	School of Engineering & Technology
2.	GE20M02	Python Programming	School of Advance Computing
3.	GE20M03	Matlab Programming	School of Engineering & Technology
4.	GE20M04	C++ Programming	School of Engineering & Technology
5.	GE20M05	R Programming	School of Advance Computing
6.	GE20M06	CAD/CAM Software	School of Engineering & Technology

Sanjeev Agrawal Global Educational (SAGE) University, Bhopal

Syllabus

For

M.Tech

WIRELESS SENSOR NETWORK

I Semester

School of Engineering & Technology

Code	Advanced Mathematics	Total Lecture:45 Tutorial: 15
MA20M101		3-1-0=4

Course Objectives

This course is design to develop coherent understanding of various areas of Advanced Mathematics. Principle course objectives are:

- To introduce students to the theoretical distributions, sampling distributions and their applications
- To introduce the students to the solution of partial differential equation
- Demonstrate an understanding to the theory and applications of linear algebra
- To extend the concept of the computer algorithms related to dimensionality reduction and feature extraction.
- To introduce the concepts of Stochastic process and Markov process transition.

UNIT	Contents	Hours
1	Probability, compound probability and discrete random variable. Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.	10
2	Solution of Partial Differential Equation (PDE) by separation of variable method, numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods, Elementary properties of FT, DFT, WFT, Wavelet transform, Haas transform.	9
3	Finite differences: forward, backward and central difference operators, polynomial interpolation: equally spaced and unequally spaced data; Numerical Differentiation, Numerical integration- Trapezoidal and Simpson1/3rd and 3/8th rules; Initial value problems - Taylor series method, Euler and modified Euler methods, Runge- Kutta methods.	9
4	Solution of Linear systems– Gaussian elimination method, LU factorization method, Cholesky's factorization method. Linear least-squares problems - Normal equations, QR method (or Gram Schmidt Ortho- normalization), Singular value decomposition (SVD) for linear least-squares problems, numerical rank determination via SVD, Principal Component Analysis.	9
5	Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Application of Eigen value problems in Markov Process, Markov chain. Queuing	8

	system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS).	
Course Outcomes		
At the end of the course the students should be able to:		
CO1	Be able to understand probability, sampling distribution and discrete random variable.	
CO2	Understand the terms and their applications of Solution of Partial Differential Equations	
CO3	Understand the numerical methods and their use in obtaining approximate solutions to otherwise intractable linear/non-linear system of equations and differential equations.	
CO4	Analyse the fundamental use of matrices in the computer algorithms related to dimensionality reduction and feature extraction.	
CO5	Implement Stochastic process, Markov process transition probability transition probability matrix and Markov process.	
Text Book	• S C *Gupta* & V K *Kapoor*, 2014, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi. • Gilbert Jimmie, 2010, Gilbert, Linear Algebra And Matrix Theory, Elsevier India. • Dr B S Grewal, 2014, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, 10th Edition, Khanna Publishers.	
Reference Books	• Rohatgi, V.K., and Saleh, A.K.Md. Ehsanes, 2009, An introduction to probability and statistics. Second Edition, Wiley India. • L. N. Trefethen and David Bau, 1997, Numerical Linear Algebra, SIAM, Philadelphia.	

Code	Wireless & Mobile Communication	Total Lecture:45 Tutorial: 15
RS20M101		3 – 1 – 0 = 4

Course Objectives-

- To provide an overview of Wireless Communication networks area and its applications in communication engineering.
- To appreciate the contribution of Wireless Communication networks to overall technological growth.
- To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.
- To enable students to compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks.
- To enable students to code division multiple access

Unit	Contents	Hours
1	Cellular Communication Fundamentals, Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channelassignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS),2.75 G Standards: EDGE	10
2	Spectral efficiency analysis based on calculations for Multiple access technologies, TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas, Wireless network planning (Link budget and power spectrum calculations)	10
3	Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency sElective, Doppler Spread; Fast and Slow fading.	10
4	Equalization, Diversity, Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.	8

5	Code Division Multiple Access, Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels. Higher Generation Cellular Standards: 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Understand fundamentals of wireless communications.
CO 2	Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
CO 3	Demonstrate basic skills for cellular networks design.
CO 4	Apply knowledge of TCP/IP extensions for mobile and wireless networking.
CO 5	Apply knowledge of Code Division Multiple Access
Text Books	• V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008. • V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009
Reference Books	• T.S.Rappaport, "Wireless Communications Principles and Practice", 2n William • C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.d edition, PHI,2002

Code	Wireless Sensor Network	Total Lecture:45 Tutorial: 15
RS20M102		3 – 1 – 0= 4

Course Objectives-

- To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
- Understand the medium access control protocols and address physical layer issues
- Learn key routing protocols for sensor networks and main design issues
- Learn transport layer protocols for sensor networks, and design requirements
- Understand the Sensor management ,sensor network middleware, operating systems.

Unit	Contents	Hours
1	Introduction and overview of Wireless Sensor Networks (WSN), Commercial and Scientific Applications of WSN, Category of Applications of WSN, Challenges for WSN, Enabling Technologies for WSN	10
2	Single node Architecture: Hardware Components, Energy Consumption of Sensor nodes, Operating Systems and Execution Environments, Examples of Sensor Nodes, Network Architecture: WSN Scenarios, Optimization Goals and figures of Merits, Design principles for WSNs, Service Interfaces for WSNs, Gateway Concepts.	10
3	Physical Layer: Wireless Channel and Communication Fundamentals, Physical Layer & Transceiver Design Considerations in WSN, MAC Protocols: Fundamentals, MAC Protocols for WSNs, IEEE802.15.4 MAC Protocol, Routing Protocols: Gossip and agent based unicast protocols, Energy Efficient Unicast, Broadcast and Multicast, Geographic Routing, Transport Control Protocols: Traditional Protocols, Design Issues, Examples of Transport Protocols, Performance of Transport Control Protocols.	10
4	Sensor Tasking and Control: Information-Based Sensor Tasking, Joint Routing Information Aggregation, Sensor Network Databases: Challenges, Query Interfaces, In-Network Aggregation, Data Centric Storage, Data Indices and Range queries, Distributed Hierarchical Aggregation, Temporal Data.	8
5	Operating Systems for Sensor Networks: Introduction, Design Issues, Examples of Operating Systems, Node Level Simulators, Performance and Traffic Management Issues: WSN Design Issues, Performance Modelling of WSNs, Emerging Applications and Future Research Directions.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Introduction to wireless networks, architectures and technologies.
CO 2	Wireless sensor network platforms: Hardware and Software.
CO 3	Communication architecture and protocols for WSN (MAC, Link, Routing)
CO 4	Energy management.
CO 5	Sensor data acquisition, processing and handling.
Text Books	• Kazem Sohraby,Daniel Minoli,Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John wiley & Sons. • Holger Karl, Andreas Willig, "Protocols and architectures for wireless sensor networks", John wiley & Sons.
Reference Books	• Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks; An Information Processing Approach", Elsevier. • C. S. Raghavendra, Krishna M. Shivalingam, Taieb Znati, "Wireless sensor networks", Springer Verlag. • H. Edgar, Jr. Callaway, "Wireless Sensor networks, Architectures and Protocols", CRC Press.

Code	Wireless & Mobile Communication Lab-1	Total Lecture:30
RS20M103	**List of Experiments**	**0-0-2=2**
1	Baseband Communication.	
2	Adaptive Linear Equalizer.	
3	Code Division Multiple Access (CDMA) – Multipath.	
4	Code Division Multiple Access (CDMA) – Multiuser.	
5	Global System for Mobile Communication (GSM) (Using WiCOMM-T – Wireless.	
6	Digital Communication Training system – SDR Platform).	
7	Spread Spectrum – DSSS Modulation & Demodulation.	
8	Free Space Propagation – Path Loss Model.	
9	Link Budget Equation for Satellite Communication.	
10	Carrier to Noise Ratio in Satellite Communication.	
11	Outdoor Propagation – Okumura Model.	
12	Outdoor Propagation – Hata Model.	
Note: Minimum of 10 experiments to be conducted.		

Code	Wireless Sensor Network Lab-II	Practical:30
RS20M104	**List of Experiments**	**0-0-2=2**
1	Applications and its simulation.	
2	Network Simulator installation of wireless sensor network.	
3	Write TCL script for transmission between mobile nodes.	
4	Write TCL script for sensor nodes with different parameters.	
5	Generate tcl script for udp and CBR traffic in WSN nodes.	
6	Generate tcl script for TCP and CBR traffic in WSN nodes.	
7	Implementation of routing protocol in NS2 for AODV protocol.	
8	Implementation of routing protocol in NS2 for DSR protocol.	
9	Implementation of routing protocol in NS2 for TORA protocol.	
10	Study other wireless sensor network simulators (Mannasim. Contiki.).	

Code	Embedded Sensor Networks	Practical:30
RS20M105	**List of Experiments**	**0-0-2=2**
1	C++ is slow.	
2	C++ produces bloated machine code.	
3	Objects are large.	
4	Virtual functions are slow.	
5	C++ isn’t ROMable.	
6	Class libraries make large binaries.	
7	Abstraction leads to inefficiency.	

Code	Discipline Specific Elective- I	Total Lecture:45
RS20M106	Satellite Communication	3 – 0 – 0 = 3

Course Objectives-

- To enable the student to become familiar with satellites and satellite services.
- Study of satellite orbits and launching
- Study of earth segment and space segment components
- Study of satellite access by various users.
- To understand students to tracking of satellites.

Unit	Contents	Hours
1	Introduction: Satellite communication, Brief History.	10
2	Orbits of satellite: Low, medium and Geo synchronous mam characteristics, Angle period, Returningperiod, Angle of Evaluation, Propagation Delay, Orbital Spacing.	10
3	Satellite Links: Delay transponders, Earth Stations, Antennas and Earth coverage, Altitude andeclipses	9
4	Earth space propagation effects: Frequency window, Free space loss, Atmospheric absorption,Rainfall Attenuation, Ionospheric scintillation, Telemetry, Tracking and command of satellites.	8
5	Detection: QPSK offset QPSK and MSK. Coherent and non-coherent detection, Error rateperformance.	8

Course Outcomes

At the end of the course the students should be able to:

CO 1	Define orbital mechanics and launch methodologies
CO 2	Describe satellite subsystems
CO 3	Design link power budget for satellites
CO 4	Compare competitive satellite services
CO 5	Explain satellite access techniques
CO 6	DTH and compression standards
Text Books	• J. Martin: Communication Satellite System, PH Englewood. • 2. D.C.Aggarwal: Satellite Communication, Khanna Publishers
Reference Books	• Tri Ha Digital Satellite Communication Tata McGraw Hill. • Harry and Yam Trees: Satellite Communication, IEEE Proceedings,

Code	Discipline Specific Elective- I	Total Lecture:45
RS20M107	Internet of Things	3 – 0 – 0 = 3

Course Objectives-

- Describe what IoT is and how it works today.
- Recognise the factors that contributed to the emergence of IoT.
- Design and program IoT devices.
- Use real IoT protocols for communication.
- Secure the elements of an IoT device.

Unit	Contents	Hours
1	Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting,IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer.	10
2	Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardwares, Examples of IoT infrastructure	10
3	MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols	9
4	IoTCommunicationPattern,IoTprotocolArchitecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA,Lifi,Widi)	8
5	Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop	8

Course Outcomes

At the end of the course the students should be able to:

CO 1	Having an ability to apply mathematics and science in engineering applications
CO 2	Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment
CO 3	Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information
CO 4	Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice
CO 5	Having adaptive thinking and adaptability in relation to environmental context and sustainable development

Text Books	Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, “Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model”, Springer Open, 2016
Reference Books	LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March,2008

Code	Discipline Specific Elective- I	Total Lecture:45
RS20M108	Voice & Data Network	3 – 0 – 0 = 3

Course Objectives-

- Understand voice and data concepts and applications and how they integrate with broadband business.
- Understand the technologies specific to voice and data transportation.
- Have a reference tool on voice and data business functions and technologies.
- Use this course to help prepare for SCTE's Broadband Premises Installer and Broadband Telecom Center Specialist certifications.
- Receive an industry-recognized NCTI certificate of graduation.

Unit	Contents	Hours
1	LabVIEW Graphical Programming, NI DAQmx, Data acquisition Toolbox to read data into MATLAB and Simulink and write data into DAQ device.	10
2	Acquire and generate analog signals.	10
3	Acquire and generate non-clocked digital data.	10
4	Generate Pulse Width Modulated signal	8
5	Acquire and generate audio signals	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude
CO 2	Ability to identify, formulate and solve engineering problems in the broad areas like Systems
CO 3	Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking
CO 4	Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.
CO 5	Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.
Text Books	• BehzadAhzani "Data Acquisition using LabVIEW" Packt Publishing, 2017 • Data Acquisition Toolbox – UseGuide, MathWorks, 2016

Reference Books	• Lab VIEW: A Developer's Guide to Real World Integration edited by Ian Fair weather, Anne Brumfield, 2011, CRC Press

Code	Discipline Specific Elective-II	Total Lecture:45
RS20M109	Embedded System Design	3-0-1=4

Course Objectives

- To introduce the Building Blocks of Embedded System
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in various processor scheduling algorithms.
- To introduce Basics of Real time operating system and example tutorials to discuss on
- To introduce one real time operating system tool.

Unit	Contents	Hours
1	Introduction to embedded system : Background and History of Embedded System, Defination and Classification, Programming language for embedded system: desirable characterstic of programming language for embedded system, low-level versus high-level language, main language implementation issue : control, typing. Major programming languages for embedded systems.Embedded System on a Chip (SOC) and the use of VLSI designed circuits	10
2	Processor and Memory Organization : Structural units in processor, Processor selection for an embedded system, Memory devices, Memory selection, Allocation for memory to program segments and blocks and memory map of a system, DMA, Interfacing Processor. I/O Devices-Device I/O types and examples V Synchronous – Iso-synchronous and Asynchronous Communication from serial devices – Examples of internal serial-communication devices –UART and HDLC –Parallel Port Devices –Sophisticated interfacing features in Device/ports –Timer and Counting Device	10
3	Microcontroller : Introduction to microcontrollers, Evolution, Microprocessors vs Microcontrollers, MCS-51 Family Overview, Important Feature, Architecture. 8051 Pin functions,Architecture, Addressing Modes, Instruction set, Instruction Types	10
4	Programming : Assembly Programming . Timer Registers, Timer modes, Overflow flags, clocking sources, timer counter interrupts, baud rate generation. Serial port register, mode of operation, initialization,accessing, multiprocessor communications, serial port baud rate	8
5	Interrupts: Interrupt Organisation, Processing interrupts, Serial port interrupts, External interrupts, interrupt service routines. Microcontroller specification, Microcontroller design, testing, timing subroutines, look up tables, serial data transmission	7

Course Outcomes	
At the end of the course the students should be able to:	
CO 1	Acquire a basic knowledge about fundamentals of microcontrollers.
CO 2	Acquire a basic knowledge about programming and system control to perform a specific task.
CO 3	Acquire knowledge about devices and buses used in embedded networking.
CO 4	Develop programming skills in embedded systems for various applications.
CO 5	Acquire knowledge about basic concepts of circuit emulators.
Text Books	• JohnB.Peatman, “Design with PIC Microcontroller”,Pearson Pub 2. Predko, “programming and customizing the 8051 microcontroller “ , TMH.
Reference Books	• Mazidi, “The 8051 microcontroller and embedded system” ,Pearson Pub. • Deshukh, “Microcontroller” ,TMH.

Code	Discipline Specific Elective-II	Total Lecture:45
RS20M110	Remote Sensing & GIS	3 – 0 – 0 = 3

Course Objectives-

- To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing .
- To acquire skills in storing, managing digital data for planning and development.
- To acquire skills in advance techniques such as hyper spectral, thermal and LiDAR scanning for mapping, modeling and monitoring.
- Introduce to students to Thematic interpretation
- Introduce to students to Integration of Remote Sensing and GIS.

Unit	Contents	Hours
1	Aerial photography and photogrammetry: basic principles, photographic systems, visual interpretation and mapping. Ground truth verification radiometer and its application. Basic concepts of remote sensing: Idealized remote sensing system. Physics of remote sensing, electromagnetic spectrum, black body concept, atmospheric windows, geometry of scanners, CCD arrays and platforms, history of space imaging characteristics of space platform like LANDSAT, SPOT, IRS, etc. Characteristics of sensors like MSS, TM, LISS I and LISS II. Outputs from various sensors.	10
2	Classification of digital data and information:Supervised, unsupervised. Extraction procedure for different applications and terrain evaluation. Thematic interpretation, transfer of interpreted thematic information to base map. Ground verification. Application of remote sensing: Civil Engineering, Earth Science, Forestry, Agriculture, Oceanography, Fisheries, Water resources, Town planning and land use/land cover mapping.	10
3	Geographic Information System Introduction: Map and use of maps through time, thematic and multiple theme maps, Development of GIS as an introduction and decision making system An Overview of GIS: Definition, Objectives and basic concepts, Contributing disciplines and technologies.	10
4	Digital Representation of Geographic Data: Technical issues related to digital representation of geographic data, Data quality and standards, Assessment of data quality, Managing spatial errors, Data standards and GIS development.	8

	Components of GIS: Computer hardware, peripherals and software	
5	Integration of Remote Sensing and GIS: Extracting metric information from Remotely Sensed images, Extracting thematic information from Remotely Sensed images, Integration of information from remote sensing in GIS . GIS application areas.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Analyse the principles and components of photogrammetry and remote sensing.
CO 2	Describe the process of data acquisition of satellite images and their characteristics
CO 3	Compute an image visually and digitally with digital image processing techniques.
CO 4	Explain the concepts and fundamentals of GIS.
CO 5	Compute knowledge of remote sensing and GIS in different civil engineering applications.
Text Books	• Paul R Wolf , Elements of photogrammetry –- Mc Graw-Hill • Lille sand & Kiefer, Remote sensing and image interpretation, John Wiley and Sons • Floyd F. Sabins Remote sensing principles and interpretation - - WH Freeman & Co.
Reference Books	• John R Jensen, Introductory digital image processing - - Prentice Hall • George Joseph, Fundamentals of Remote Sensing- -Universities Press-Technical • L R A Narayan Remote Sensing and its Applications- - Universities Press-Science/Reference • M. Anji Reddy, Remote Sensing and Geographic information systems – BS Publishers

Code	Discipline Specific Elective-II	Total Lecture:45
RS20M111	Navigation Guidance & Control	3 – 0 – 0 = 3

Course Objectives-

- This course covers the basics of Navigation, Guidance, and Control used in aerospace systems. Basically all the above three topics use basic control theory for their mathematical framework.
- This course covers all three topics under one course and is meant for undergraduate aerospace engineering students.
- Understand to students to back stepping algorithm.
- The course can also be used for first year graduate students in aerospace engineering to expose them to basics of control theory applied to aerospace engineering.
- Understand to students to flight control systems.

Unit	Contents	Hours
1	Introduction to navigation, Guidance and control - definition, Historical background	10
2	Operating principles and design of guidance laws, Homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements , Implicit guidance schemes, Explicit guidance, Q guidance schemes	10
3	Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Gain scheduling concepts	10
4	Displacement Autopilot-Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm	8
5	Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Knowledge: In-depth knowledge of design and analysis of state estimators for navigation systems. Focus is placed on inertial navigation systems and aiding techniques.
CO 2	Guidance and navigation systems for ship, aircraft and unmanned vehicles.

	Knowledge of inertial sensors and global navigation systems.
CO 3	Skills: Be able to model, simulate and implement navigation systems for unmanned underwater vehicles and aerial vehicles
CO 4	ships, aircraft and satellites. Understand how Kalman filters and nonlinear observers are used to estimate position, velocity and attitude of moving objects.
CO 5	General competence: Skills in applying this knowledge and proficiency in new areas and complete advanced tasks and projects.
Text Books	• P.T. Kabamba and A.R. Girard, Fundamentals of Aerospace Navigation and Guidance, Cambridge Aerospace Series, 2014. • John H Blakelock , ' Automatic control of Aircraft & Missiles', Wile -Inter Science Publication, 2nd edition, May 1990.
Reference Books	• R.B. Underdown & Tony Palmer, 'Navigation', Black Well Publishing; 2001. • Merrilh I. Skolnik, ' Introduction to Radar Systems', 3rd edition, Tata Mc Graw Hill, 2001. • George M. Siouris, Missile Guidance and Control Systems, Springer, 2004.

Sanjeev Agrawal Global Educational (SAGE) University, Bhopal

Syllabus

For

M.Tech

WIRELESS SENSOR NETWORK

I Semester

School of Engineering & Technology

Code	Fundamentals of Remote Sensing & Image Interpretation	Total Lecture:45 Tutorial: 15
RS20M201		3 – 1– 0 =4

Course Objectives-

- This course focuses on the principles of remote sensing and image processing and their applications.
- It concentrates on aerial photography but includes satellite imagery.
- It details the physical principle upon which a variety of photographic and non-photographic sensors operate describes the existing satellite systems used for remote sensing describes the principles behind image interpretation and provides instruction with computer programs.
- To introduce students to Meteorological satellites.
- To introduce students to hyperspectral sensing.

Unit	Contents	Hours
1	Remote sensing – history & development, definition, concept and principles 1.2 Energy resources, radiation principles, EM Radiation and EM Spectrum 1.3 Black body radiation, laws of radiation 1.4 Interaction of EMR with atmosphere and earth's surface	10
2	Platforms – types and their characteristics 2.2 Satellites and their characteristics – geo-stationary and sun-synchronous 2.3 Earth Resources Satellites -LANDSAT, SPOT, IRS, IKONOS satellite series 2.4 Meteorological satellites – INSAT, NOAA, GOES	10
3	Sensors – types and their characteristics, across track (whiskbroom) and along track (pushbroom) scanning 3.2 Optical mechanical scanners – MSS, TM, LISS, WiFS, PAN 3.3 Concept of resolution – spatial, spectral, temporal, radiometric 3.4 Basic concept and principles of thermal, microwave and hyperspectral sensing	10
4	Basic principles, types, steps and elements of image interpretation 4.2 Techniques of visual interpretation and interpretation keys 4.3 Multidate, multispectral and multidisciplinary concepts 4.4 Instruments for visual interpretation	8
5	Remote sensing data products and their procurement 5.2 Ground truth collection – spectral signatures 5.3 Commonly used ground truth equipments - use of radiometers 5.4 Display forms – computer printouts, thematic maps, dot density maps	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Describe and explain basic concepts in remote sensing Describe the various satellites used in the collection of remotely sensed data
CO 2	Recognize and measure real-world features on aerial photographs
CO 3	Demonstrate the principle behind image correction Perform analysis on remotely sensed data
CO 4	sensing Describe the various satellites used in the collection of remotely sensed data
CO 5	To introduce students to Meteorological satellites.
Text Books	• Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester • Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
Reference Books	• Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore • Demers, M. N. (2000): Fundamentals of Geographic Information Systems, Jhn Wiley and Sons, New DelhiBurrough, P. A. and McDonnell, R. A. (2000): Principles of GeographicalInformation Systems, Oxford University Press, New York • Heywood, I., Cornelisus, S., Carver, S. (2011): An Introduction to Geographical Information Systems, Pearson Education, New Delhi • . Ahmed, E. L. Rabbany (2002): Introduction to Global Positioning Systems, Artech House, Boston

Code	Remote Sensing & GIS	Total Lecture:45 Tutorial: 15
RS20M202		3 – 1 – 0 = 4

Course Objective-

- To provide background knowledge and understanding of principles of RS, RS Sensors and systems.
- overview of information retrieval of earth surface features using multi-resolution, multi-scale and multi-temporal imagery.
- Introduction of image processing.
- To introduce students to Delineation of degraded forest.
- To introduce students to Commonly used ground truth equipments.

Unit	Contents	Hours
1	Crops acreage and yield estimation: Introduction – Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy – crops identification and crop inventory – crop acreage estimation – vegetation indices – Yield modeling – crop production forecasting through digital analysis – crop condition assessment – command area monitoring – land use and land cover analysis – Microwave RS for crop inventory – Case studies	10
2	Soil mapping and conservation: Introduction – soil genesis, Soil morphological characters, Soil pedology – Soil survey, Types and methods of soil surveys – Soil classifications – Hydrological Soil grouping – Characteristics of saline & alkaline Soils – Factors influencing soil reflectance properties – principle component analysis and orthogonal rotation transformation-Soils mapping using RS data - Problem soil identification and mapping – land evaluation – Soil sedimentation & erosion – Soil loss assessment –Soil conservation – Case studies.	10
3	Damage assessment: Detection of pest & diseases – Flood mapping and Assessments of crop loss – Remote sensing capabilities & contribution for drought management – Land degradation due to water logging & Salinity – crop stresses reflectance properties of stressed plants and stress detection.	10
4	Forestry: Introduction – Forest taxonomy – inventory of forestlands – forest types and density mapping using RS techniques – Forest stock mapping – factors for degradation of forest– Delineation of degraded forest - Forest change detection and monitoring – Forest fire mapping & damage assessment – LiDAR remote sensing for Forest studies.	8
5	Integrated surveys: Introduction – Integrated surveys for agriculture & forest development – RS & GIS for drawing out action plans – water shed approach – Rule of RS & GIS for watershed management – Land use planning for sustainable development – Precision forming - Case studies.	7

Course Outcomes

At the end of the course, the student will be able to:

CO 1	Analyse the principles and components of photo grammetry and remote sensing.
CO 2	Thermal and Microwave Remote Sensing, Different types of data products
CO 3	Troubleshoot issues with projections and coordinate systems.
CO 4	Collect data independently in the field and integrated it with a GIS.
CO 5	Design and carry out or manage a GIS-based or remote sensing-based independent project.
Text Books	• Shunlin liang , Advances in land RS: System, modeling invention and applications, 2001. • Joe Boris dexon, Soil mineralogy with environmental application, Library of congress catalog, 2004. • James B, Introduction of Remote sensing, Third edition Campbell, third edition Guilford Press, 2002.
Reference Books	• John G. Lyon, Jack MCcarthy, Wetland & Environmental application of GIS,1995. • Margareb Kalacska, G. Arturosanchez, Hyper spectral RS of tropical and sub tropical forest, 2005.

Code	Advanced Digital Signal Processing	Total Lecture:45 Tutorial: 15
RS0M203		3 – 1– 0 =4

Course Objective-

- This is a graduate-level advanced digital signal processing (DSP) course that is designed to provide students with a broad perspective on the DSP field.
- The course will cover various advanced topics in DSP, including: multirate signal processing and filter banks; timefrequency analysis.
- To understand students to short time Fourier transform (STFT), and wavelet transform; linear prediction and optimum linear filters; adaptive filtering; compressed sensing and sparse recovery.
- To understand students to Frequency domain sampling, properties of DFT.
- To understand students to Radix-2 decimation in time domain and decimation in frequency domain algorithms.

Unit	Contents	Hours
1	Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems. Discrete time systems, analysis of discrete time linear invariant systems, implementation of discrete time systems, correlation of discrete time systems ,ztransforms, linear time invariant systems as frequency sElective filters. Sampling	10
2	The Discrete Fourier transforms its properties and applications. Frequency domain sampling, properties of DFT, linear filtering methods based on DFT, Frequency analysis of signals using the DFT,Radix-2 decimation in time domain and decimation in frequency domain algorithms	10
3	Design of Digital filters, Design of FIR filters, Design of IIR filters, frequency transformation	10
4	Multirate digital signal processing, Decimation, interpolation, sampling rate conversion, filter John G. Proakis 6 design and implementation for multirate conversion, sampling rate conversion by an arbitrary factor, applications of multirate signal processing.	8
5	Linear prediction and optimum linear filters, Forward and backward linear prediction, solution of the normal equations, wiener filters.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Know the analysis of discrete time signals.
CO 2	To study the modern digital signal processing algorithms and applications.
CO 3	Have an in-depth knowledge of use of digital systems in real time applications
CO 4	Apply the algorithms for wide area of recent applications.
CO 5	The course will cover various advanced topics in DSP, including: multirate signal processing and filter banks
Text Books	• Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithms and Application, PHI. • Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.
Reference Books	• .Samuel D Stearns, "Digital Signal Processing with examples in Matlab. " CRC Press • . ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab, " Springer. • .Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005.

Code	Advanced Digital Signal Processing Lab-III	Total Lecture:30
RS20M204	**List Of Experiments**	**0-0-2=2**
1	To find DFT / IDFT of given DT signal.	
2	Program to obtain Linear Convolution of two finite length sequences 8.	
3	Program for Computing auto correlation.	
4	To find frequency response of a given system(transfer function/ difference equation).	
5	Implementation of FFT of given sequence.	
6	Determination of Power Spectrum of a given signal.	
7	Implementation of LP FIR filter for a given sequence.	
8	Implementation of HP FIR filter for a given sequence.	
9	Implementation of LP IIR filter for a given sequence.	
10	Implementation of HP IIR filter for a given sequence.	
11	Generation of Sinusoidal signal through filtering.	
12	Generation of DTMF signals .	
13	Implementation of Decimation Process.	
14	Implementation of Interpolation Process.	
15	Implementation of I/D sampling rate converters.	
16	Impulse Response of First Order and Second Order Systems.	

Code	Programming Wireless Sensor Networks	Total Lecture:30
RS20M205	**List Of Experiments**	**0-0-2=2**
1	Applications and its simulation.	
2	Network Simulator installation of wireless sensor network	
3	Write TCL script for transmission between mobile nodes.	
4	Write TCL script for sensor nodes with different parameters.	
5	Generate tcl script for udp and CBR traffic in WSN nodes.	
6	Generate tcl script for TCP and CBR traffic in WSN nodes.	
7	Implementation of routing protocol in NS2 for AODV protocol.	
8	Implementation of routing protocol in NS2 for DSR protocol.	
9	Implementation of routing protocol in NS2 for TORA protocol.	
10	Study other wireless sensor network simulators (Mannasim. Contiki).	

Code	Discipline Specific Elective-III	Total Lecture:45
RS20M206	Applications Of Remote Sensing In Geo science	3-0-0=3

Course Objective-

- Remote sensing is becoming an important and useful tool in mapping large,
- remote areas and has many applications in geosciences such as geologic and geo-structural mapping,
- mineral and water exploration, hydrocarbon exploration, natural hazards analysis, and geomorphology.
- To understand students to Object oriented GIS data modeling for urban design.
- To understand students to Resolution Satellite Remote Sensing

Unit	Contents	Hours
1	Urban Mapping and Spatial Analysis: Urban process, the physical structure and composition of urban areas, Urbanisation process, growth trend, problems of urbanisation, information requirements for perspective planning, Scale and resolution concepts and interpretation techniques for urban and regional analysis, urban GIS, spatial analytical techniques, statistics and visualization, conceptual modelling of urban processes; Urban Sprawl: Change detection in Land Use Land Cover monitoring physical growth of urban area, trends in urban sprawl and associated problems.	10
2	Urban Planning: Plans – planning needs, types of plans, urban and regional planning; LU/LC mapping Urban Planning: Zoning of Land Use, Zonal Land Use Plan, Object oriented GIS data modeling for urban design, landscape architecture, urban infrastructure, Site selection for urban development, site suitability analysis for utilities and civic amenities, interim master plan, Master Plan	10
3	Urban Disaster and Emergencies Management: Mapping vulnerable zones with respect to earth quake, flood, fire, terrorist attacks, and finding optimum routes for ambulances, and emergency services, GIS modeling for Hazard risk and emergencies management	10
4	Large Scale Mapping and Cadastral Information System: Technologies for Large Scale Mapping (LSM) of urban areas – Aerial Photography - High- Resolution Satellite Remote Sensing - Electronic Distance Measurement (EDM) -Total Station -	8
5	Differential Global Positioning System (DGPS) – Issues in Large Scale Mapping – Selecting appropriate technologies and methodologies. Concept of Cadastre, History of cadastral survey, Cadastral survey methods and survey maintenance, cadastral map reproduction, development of cadastral information system.	7

Course Outcomes

At the end of the course the students should be able to:	
CO 1	Demonstrate detailed, integrated knowledge of the application and history of remote sensing.
CO 2	Discuss the nature of electromagnetic radiation and its interaction with the earth's surface and atmosphere.
CO 3	Demonstrate a critical understanding of the differences between remote sensing systems and be aware of their characteristics and limitations.
CO 4	Competently interpret, process and evaluate remotely sensed images and be able to use remote sensing to achieve self-defined goals.
CO 5	To understand students to Resolution Satellite Remote Sensing.
Text Books	• Remote Sensing of Geology Prof. R.P.Gupta
Reference Books	• Gemorphological process Savindra Singh • Remote Sensing in Geosciences Nitin K. Tripathi & Vishwanath Bajpai • Earth Surface System Richard J. Huggett

Code	Discipline Specific Elective-III	Total Lecture:45
RS20M207	Remote Sensing & GIS for Agriculture & Forestry	3-0-0=3

Course Objective-

- Expose participants in GIS and RS applications in Water management in agriculture Understand GIS and RS applications in disease/pest management.
- Understand participatory method in agriculture resource management in context of GIS Publish dynamic and interactive agricultural based map in the internet.
- Understand students to – Forest taxonomy.
- Understand students to Remote sensing capabilities & contribution for drought management.
- Understand students to RS & GIS for watershed management.

Unit	Contents	Hours
1	Crops Acreage And Yield Estimation: Introduction – Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy – crops identification and crop inventory – crop acreage estimation – vegetation indices – Yield modeling – crop production forecasting through digital analysis – crop condition assessment – command area monitoring – land use and land cover analysis – Microwave RS for crop inventory – Case studies	10
2	Soil Mapping And Conservation: Introduction – soil genesis, Soil morphological characters, Soil pedology – Soil survey, Types and methods of soil surveys – Soil classifications – Hydrological Soil grouping – Characteristics of saline & alkaline Soils – Factors influencing soil reflectance properties – principle component analysis and orthogonal rotation transformation-Soils mapping using RS data - Problem soil identification and mapping – land evaluation – Soil sedimentation & erosion – Soil loss assessment – Soil conservation – Case studies.	10
3	Damage Assessment: Detection of pest & diseases – Flood mapping and Assessments of crop loss – Remote sensing capabilities & contribution for drought management – Land degradation due to water logging & Salinity – crop stresses reflectance properties of stressed plants and stress detection.	10
4	Forestry: Introduction – Forest taxonomy – inventory of forestlands – forest types and density mapping using RS techniques – Forest stock mapping – factors for degradation of forest – Delineation of degraded forest - Forest change detection and monitoring – Forest fire mapping & damage assessment – LiDAR remote sensing for Forest studies.	8
5	Integrated Surveys: Introduction – Integrated surveys for agriculture & forest development – RS & GIS for drawing out action plans – water shed approach – Rule of RS & GIS for watershed management – Land use planning for sustainable development – Precision forming - Case studies.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Understand the basic concepts of GIS and Remote Sensing, Understand various integrations of GIS and RS Agriculture
CO 2	Understand how precision farming and how it's applied in Agriculture
CO 3	Understand Digital Image Processing Techniques in Agriculture Resource Management
CO 4	Understand Precision farming using GIS and RS for Crop management
CO 5	Understand students to RS & GIS for watershed management
Text Books	• John G. Lyon, Jack MCcarthy, Wetland & Environmental application of GIS,1995. • Margareb Kalacska, G. Arturosanchez, Hyper spectral RS of tropical and sub tropical forest, 2005.
Reference Books	• Shunlin liang , Advances in land RS: System, modeling invention and applications, 2001. • Joe Boris dexon, Soil mineralogy with environmental application, Library of congress catalog, 2004. • James B, Introduction of Remote sensing, Third edition Campbell, third edition Guilford Press, 2002.

Code	Discipline Specific Elective-III	Total Lecture:45
RS20M208	Advanced Remote Sensing Technique	3 – 0– 0 =3

Course Objectives-

- Provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing
- To acquire skills in storing, managing digital data for planning and development.
- Understand students to temperature mapping with thermal scanner data.
- Understand students to Passive Microwave Remote Sensing.
- Understand students to Precision Remote Sensing.

Unit	Contents	Hours
1	Thermal radiation principles, processes and thermal properties of materials, thermal conductivity, thermal capacity, thermal inertia, thermal diffusivity, emissivity, sensing radiant temperatures, radiant versus kinetic temperatures, blackbody radiation, atmospheric effects, interaction of thermal radiation with terrain elements, IR detection and imaging technology, thermal sensors and scanners, airborne IR surveys, satellite thermal IR images, spatial resolution and ground coverage, thermal IR broad band scanner and multispectral scanner, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery, temperature mapping with thermal scanner data, thermal inertia mapping, apparent thermal inertia, applications of thermal remote sensing in geology, hydrogeology, urban heat budgeting.	10
2	Passive Microwave Remote Sensing: Basics –physics of RADAR waves, spectral characteristics of RADAR waves, microwave radiometers, passive microwave scanners and sensors, applications in atmosphere, ocean and land.	10
3	Precision Remote Sensing: Introduction, Spatial, Spectral, Temporal precision and their requirement.	10
4	Precision Remote Sensing: Introduction, Spatial, Spectral, Temporal precision and their requirement.	8
5	LIDAR Remote Sensing: Altimetric LiDAR: Physics of laser, spectral characteristics of laser, laser interaction with objects, Airborne Altimetric LiDAR: principle, Multiple return, Components of LiDAR system, INS technology, INS-GPS integration, measurement of laser range, calibration, flight planning, laser range to xyz coordinates, accuracy of various components of LiDAR, error analysis of data and error removal, raw data of DEM processing, filtering of data uses of return strength/waveform, data classification techniques, LiDAR data	7

	integration with spectral data, LiDAR Applications.	

Course Outcomes

At the end of the course the students should be able to:

CO 1	Understand spatial environment and society research and applications
CO 2	Synthesise and apply that knowledge to formulate new applications
CO 3	Pursue a guided investigation of a topic involving remote sensing and/or GIS
CO 4	Communicate the results of that investigation in seminar and written formats
CO 5	Understand students to Precision Remote Sensing.
Text Books	• Fawaz T Ulaby, Richard K Moore and Adrian K Fung, Microwave Remote Sensing active and passive, Vol. 1, • Addison – Wesly Publication company 1981, 1982, and 1986. • Philip N Slater, Remote Sensing, optics and optical systems. 1980 3. Robert M Haralick and Simmonet, Image processing for remote sensing 1983Robert N Colwell Manual of Remote sensing Volume1, American Society of Photogrammetry 1983.
Reference Books	• Travett J W Imaging Radar for Resources surveys, Chapman andHall, London 1986 • Remote sensing and Image Interpretation by Thomas M Lillesand and Ralph W. Keifer fourth Edition, 2002, 2003, John Wiley and Sons Inc. • Remote Sensing Geology by Ravi P Gupta, Second edition, 2003, Springer • Remote Sensing Principles and Interpretation by Floyd F Sabins, 1997, W H Freeman And Company

Code	Discipline Specific Elective-IV	Total Lecture:45
RS20M209	High Performance Networks	3 – 0– 0 =3

Course Objectives-

- Students will get an introduction about ATM and Frame relay.
- Students will be provided with an up-to-date survey of developments in High Speed Networks.
- Enable the students to know techniques involved to support real-time traffic and congestion control Students will be provided with different levels of quality of service (Q.S) to different applications.
- Students will get an Intelligent networks CATV.
- Students will get a signaling and Routing.

Unit	Contents	Hours
1	History of Communication Networks, Networking principles, Future networks Internet, Pure TAM Network, Cable Network, Wireless.	10
2	Applications, Traffic characterization and quality of services, Network services, High performance networks, Network Elements., Layered applications, Open data network model, Network architectures, Network bottlenecks.	10
3	Multicast IP, Mobile IP, TCP and UDP, Applications, FTP, SMTP. Internet success and limitations, Performance of TCP/IP Networks, Performance of circuit switched networks.	10
4	SONET, DWDM, FTH, DSL, Intelligent networks CATV.	8
5	Main features of ATM, Addressing, signaling and Routing, ATM header structure, ATM AAL, Internetworking with ATM.	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	Understand the communication networks principles and future networks.
CO 2	Understand the network services and layered architectures.
CO 3	Explain the wireless networks, Internet and different protocols
CO 4	Understand the circuit switched networks and ATM.
CO 5	Students will get an Intelligent networks CATV.
Text Books	• Jean Walrand and Pravin variya , " High performance Communication networks", 2nd edition, Harcourt and Morgan Kauffman, London 2000 • Andrew S. Tanenbaum, "Computer networks", PHI Private limited, new Delhi

Reference Books	• Gerd Keiser, MC Graw Hill International edition, optical fiber communication , third edition John M Senior, PHI limited, optical fiber communication , third edition • Leon Gracia, Widjaja, " Communication Networks", Tata Mc Graw –Hill, New Delhi, 2000. 4. Behroz a. Forouzan, "Data communication and networking ", Tata MC Graw – Hill, New Delhi • Sumit Kasera, Pankaj Sethi, " ATM Networks", Tata Mc Graw- Hill, New Delhi , 2000

Code	Discipline Specific Elective -IV	Total Lecture:45 Tutorial: 00
RS20M210	Pattern Recognition & Machine Learning	3 – 0– 0 =3

Course Objectives-

- Student will understand the concepts, theory and computational algorithms needed for several real world recognition tasks such as text, speech, characters, objects etc.
- Student will understand the concepts Unsupervised learning and Clustering
- Simulate and understand how machine will have power to accomplish these tasks and can aim at developing several examples based learning tasks in several domains ranging from medical, economical, engineering to industrial needs.
- Student will understand the concepts Deep Neural nets.
- Student will understand the concepts Ensemble/ Adaboost classifier.

Unit	Contents	Hours
1	PR overview-Feature extraction-Statistical Pattern Recognition-Supervised & Unsupervised Learning; Bayes decision Theory, Linear discriminant functions	10
2	Parametric methods, ML and MAP estimation-Bayes estimation. Non parametric methods; Parzen windows & k NN approaches.	10
3	Dimensionality reduction (PCA) & Fishers linear discriminant. Linear perceptron and Neural Networks. Introduction to Deep Neural nets. Kernel methods and Support vector machine.	10
4	Unsupervised learning and Clustering. K-means and Hierarchical clustering. Linear & Logistic Regression.	8
5	Decision trees for classification. Ensemble/ Adaboost classifier. Expectation Maximization (EM). Applications to document analysis and recognition	7

Course Outcomes

At the end of the course the students should be able to:

CO 1	After successful completion of this course, student will be able to
CO 2	Understand machine learning concepts and range of problems that can behandled by machine learning.
CO 3	Compare and parameterize different learning algorithms.

CO 4	Compare and parameterize different learning algorithms.
CO 5	Student will understand the concepts Deep Neural nets.
Text Books	• Duda R O, Hart P E, and Stork D G, Pattern classification, John Wiley and Sons, 2001. • Christopher M B, Pattern Recognition and Machine Learning, Springer, 2006.
Reference Books	• Sergios T and Konstantinos K, Pattern Recognition, 4 th edition, Academic Press, 2008.

Code	Discipline Specific Elective-IV	Total Lecture:45
RS20M211	Advanced Microprocessor & Micro Controller	3 – 0– 0 =3

Course Objectives-

- This course aims at teaching primary concept of programing with machine language.
- It also aims to train the student for automated system design with the programing intelligence.
- The objective of this course is to become familiar with the architecture and the instruction set of an Intel microprocessor.
- The objective of this course is to become Assembly language programming will be studied as well as the design of various types of digital and analog interfaces.
- The accompanying lab is designed to provide practical hands-on experience with microprocessor software applications and interfacing techniques.

Unit	Contents	Hours
1	The ARM Microcontroller: Basic features and comparison of ARM, PIC, AVR, Arduino, Raspberry Pie Microcontrollers, Introduction to ARM microcontroller, Internal architecture, I/O pins, Ports, Timers, Interrupts, Memory organization, Concept of Pipelining, Types of hazards and their solutions.	15
2	ARM Microcontroller Programming: Programming model, Instruction classification and format, Addressing modes, Data transfer instructions, Arithmetic instruction, Logical group of instructions, Branching instructions, Assembly language programming of ARM.	15
3	Applications of ARM: ADC-DAC applications, PWM applications. Embedded C programming of ARM, few applications – GPIO, timer.	15

Course Outcomes

At the end of the course the students should be able to:

CO 1	Understand the generalized architecture of advanced microprocessors and advanced microcontrollers
CO 2	Develop algorithm/program of the advanced microcontrollers for a particular task
CO 3	Interface advanced microcontrollers with external peripherals
Text Books	• Douglas V.Hall, Microprocessor and Interfacing, Tata McGraw-Hill Education. • Barry B.Bray, The Intel Microprocessors Architecture, Programming and Interfacing, Pearson Publications.
Reference	• Steve Furber, ARM System-On-Chip Architecture, Pearson Publications. • Rob Toulson and Tim Wilmshurst, Fast and Effective Embedded system design-

Books	Applying the ARM, Elsevier.