ISO 9001:2015 AICTE-CII: GOLD Category Institute NAAC-'A' Grade Institute (CGPA: 3.21) NIRF-2020 Rank Band: 201-250

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
కాకతీయ ప్రౌద్యోగికీ ఎవం విజ్ఞాన సంస్థాన, వరంగల - ౫౦౬ ౦౧౫ తెలంగాన, భారత
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

PG – M.Tech.
(COMMUNICATION ENGINEERING AND SIGNAL PROCESSING)

PRR -20

SYYLABI, SCHEME OF INSTRUCTION & EVALUATION

(I Semester to IV Semester)

(Applicable from the Academic Year 2020-21)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME
M.TECH. (COMMUNICATION ENGINEERING AND SIGNAL PROCESSING)

PRR-20

SEMESTER-I

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE							ESE	Total Marks
								I²RE - TA				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PC	P20SP101	Professional Core-1: Advanced Communication Theory	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20SP102	Professional Core-2: DSP Processors and Architectures	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20SP103	Professional Elective-I/ MOOC-I	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20SP104	Professional Elective-II/ MOOC-II	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20SP105	Professional Core Lab-I: Advanced Communication Theory Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20SP106	Professional Core Lab-II: Advanced DSP Processors Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
7	MC	P20MC107	Research Methodology & IPR	2	-	-	2	8	8	8	6	10	20	60	40	100
8	AC	P20AC108	Audit Course-I	2	-	-	1	8	8	8	6	10	20	60	40	100
			Total:	16	-	8	19	48	48	48	36	60	120	480	320	800

[L= [Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-I/ MOOC-I	Professional Elective-II/ MOOC-II	Audit Course 1
P20SP103A: Wireless Sensor Networks	P20SP104A: Adaptive Signal Processing	P20AC108A: English for Research Paper Writing
P20SP103B: Array Signal Processing	P20SP104B: Real Time Operating Systems	P20AC108B: Sanskrit for Technical Knowledge
P20SP103C: FPGA based Wireless Communication System	P20SP104C: Advanced Cellular and Mobile Communications	P20AC108C: Constitution of India
P20SP103D: MOOCs	P20SP104D: MOOCs	P20AC108D: Pedagogy Studies

Total Contact Periods/Week: 24 **Total Credits: 19**

Additional Learning: Students are advised to do MOOCs to bridge the gap in the curriculum as suggested by the Department Academic, Advisory Committee (DAAC). The credits earned by the student through MOOCs will be printed in the semester grade sheet.

P20SP101: ADVANCED COMMUNICATION THEORY

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: coherent and non coherent detection in AWGN channels
LO2: linear and nonlinear modulation, carrier and timing synchronization
LO3: linear and nonlinear equalizers, maximum likelihood detection and OFDM
LO4: MIMO channel capacity, Alamouti space-time block codes and linear and nonlinear detection

UNIT – I (9)

Communicating with Points: Coherent detectors for 2d constellations, coherent detectors for multi-dimensional orthogonal constellations, bi-orthogonal constellations, simplex constellations, noncoherent detectors for multi-dimensional orthogonal constellations, non coherent detectors for M-ary PSK, coherent detectors for colored noise, coherent detectors for flat fading channels

UNIT –II (9)

Transmission of Signals through Distortion less Channels: Transmitter, power spectral density of the transmitted signal, receiver, pulse shapes with zero isi, application of matched filer in CDMA, discrete-time receiver implementation. carrier and timing synchronization – data-aided carrier phase estimation, non-data-aided carrier phase estimation, error-rate analysis, data-aided timing synchronization, non-linear modulation – CPFM with full response rectangular filters

UNIT– III (9)

Transmission of Signals through Distorting Channels: Receivers based on equalization – linear equalization – symbol-spaced equalizers, finite length equalizer, the steepest descent algorithm, the least mean square (LMS) algorithm, linear equalization – fractionally-spaced equalizers. non-linear equalization – the predictive decision feedback equalizer (DFE), the conventional DFE, receivers based on MLSE – symbol-spaced MLSE, fractionally-spaced MSLE. multicarrier communication – channel loading, the discrete multitone (DMT)

UNIT - IV (9)

MIMO Systems: MIMO channel capacity- capacity of i.i.d Rayleigh fading MIMO channels, introduction to space-time codes – code design criteria, alamouti space-time codes, SER analysis for Alamouti space-time code over fading channels,introduction to MIMO detection – maximum likelihood (ML) detector, linear sub-optimal detectors, sphere decoding. overview to massive MIMO.

Text Book(s):

[1] Vasudevan K. *Digital communications and signal processing*. Hyderabad: Universities Press; 2010.

[2] Kshetrimayum Rakhesh Singh, *Fundamentals of MIMO wireless communications,* Cambridge University Press, 2017

Reference Book:

[1] M Salehi and J Proakis*, Digital Communications,* Mc-Graw Hill Education, 2007.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: inspect coherent and noncoherent detection in white and colored Gaussian noise
CO2: analyze linear and nonlinear modulation schemes in frequency-flat channels
CO3: examine the signal detection in frequency-selective channels
CO4: analyze MIMO channel capacity and linear and nonlinear detection schemes in MIMO systems

Course Articulation Matrix (CAM): P20SP101: ADVANCED COMMUNICATION THEORY						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP101.1	2	1	2	2	2
CO2	P20SP101.2	2	1	2	2	2
CO3	P20SP101.3	2	1	2	2	2
CO4	P20SP101.4	2	1	2	2	2
P20SP101		**2**	**1**	**2**	**2**	**2**

P20SP102: DSP PROCESSORS AND ARCHITECTURES

Class: M.Tech. I – Semester

Specialization: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: architecture of Digital signal Processors
LO2: programmable DSP TMS320C5XX family
LO3: implementation of Basic DSP algorithms
LO4: various interfacings to DSP processors

UNIT – I (9)

Architectures for Programmable DSP Devices: Basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, speed issues, features for external interfacing

Execution Control and Pipelining: Hardware looping, interrupts, stacks, relative branch support, pipelining and performance, pipeline depth, interlocking, branching effects, interrupt effects, pipeline programming models

UNIT –II (9)

Programmable Digital Signal Processors: Commercial DSP devices, data addressing modes of TMS320C54XX, DSPs, data addressing modes of TMS320C54XX Processors, memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, on-chip peripherals, interrupts of TMS320C54XX processors, pipeline operation of TMS320C54XX processors

UNIT– III (9)

Implementations of Basic DSP Algorithms: The Q-notation, FIR filters, IIR filters, interpolation filters, decimation filters, PID controller, adaptive filters, 2-D Signal Processing, an FFT algorithm for DFT computation, a butterfly computation, overflow and scaling, bit-reversed index generation, an 8-point FFT implementation on the TMS320C54XX, computation of the signal spectrum

UNIT - IV (9)

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, external bus interfacing signals, memory interface, parallel i/o interface, programmed i/o, interrupts and i/o, direct memory access (dma), a multichannel buffered serial port (McBSP), McBSP programming, a CODEC interface circuit, CODEC programming, a CODEC-DSP interface example

DSP Chip Synthesis: Design recommendations, compilation and coding issues, joint simulation and synthesis issues, synthesis of FIR filter chip design, FFT filter chip design DSP processor design

Text Book(s):

[1] B. Venkataramani & M. Bhaskar, *Digital Signal Processor, Architecture, Programming and Applications,(2/e)*, McGraw- Hill,2010.

[2] S. Srinivasan & Avtar Singh, *Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X*, Brooks/Cole, 2004.

Reference Book(s):

[1] Sen M. Kuo & Woon-Seng S. Gan, *Digital Signal Processors: Architectures, Implementations, and Applications*, Prentice Hall, 2004.

[2] C. Marven & G. Ewers: *A Simple approach to digital signal processing*, Wiley Inter science, 1996.

[3] R.A. Haddad & T.W. Parson: *Digital Signal Processing: Theory, Applications and Hardware*, Computer Science Press NY, 1991.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: explain the architecture of Digital signal Processors

CO2: summarize the architectures of Programmable DSP TMS320C5XX family

CO3: develop the programs for implementation of Basic DSP algorithms

CO4: test with various interfacings to DSP processors

Course Articulation Matrix (CAM): P20SP102: DSP PROCESSORS AND ARCHITECTURES						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP102.1	1	1	1	3	1
CO2	P20SP102.2	3	1	1	2	2
CO3	P20SP102.3	3	3	3	2	2
CO4	P20SP102.4	3	3	3	3	2
P20SP102		**2.5**	**2**	**2**	**2.5**	**1.75**

P20SP103A: WIRELESS SENSOR NETWORKS

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: wireless Sensor Networks and applications
LO2: different Medium Access Control protocols of WSNs
LO3: network layer protocols of WSNs
LO4: time synchronization, energy saving & management strategies in WSNs

UNIT – I (9)

Introduction to Wireless Sensor Networks:- Components of a wireless sensor node, motivation for a network of wireless sensor nodes, classification of sensor networks, characteristics of wireless sensor networks, challenges of wireless sensor networks, comparison between wireless sensor networks and wireless mesh networks, limitations in wireless sensor networks, design challenges, hardware architecture

Applications:- Structural health monitoring, traffic control, health care, pipeline monitoring, precision agriculture, active volcano, underground mining node architecture: the sensing subsystem, the processor subsystem, communication interfaces, prototypes. operating systems: functional aspects, non-functional aspects, prototypes, evaluation

UNIT –II (9)

Basic Architectural Framework:- Physical layer, basic components, source encoding, channel encoding, modulation medium access control: wireless MAC protocols, characteristics of MAC protocols in sensor networks, contention-free MAC protocols, contention-based MAC protocols, and hybrid MAC protocols.

UNIT– III (9)

Network Layer: Routing metrics, flooding and gossiping, data- centric routing, proactive routing, on-demand routing, hierarchical routing, location-based routing, qos-based routing protocols node and network management: power management, local power management aspects, dynamic power management, conceptual architecture

UNIT - IV (9)

Time Synchronization: Clocks and the synchronization problem, time synchronization in wireless sensor networks, basics of time synchronization, time synchronization protocols localization: ranging techniques, range-based localization, range-free localization, event driven localization

Energy saving and management strategies: Energy-efficient power management, optical energy allocation in energy harvesting and sharing, energy-efficient techniques, awake-up receiver for online energy harvesting

Text Book(s):

[1] Waltenegus Dargie, Christian Poellabauer, *Fundamentals of Wireless Sensor Networks*: *Theory and Practice*, Wiley 2010.

[2] Mohammad S. Obaidat, Sudip Misra, *Principles of Wireless Sensor Networks*, Cambridge, 2014.

Reference Book(s):

[1] Ian F. Akyildiz, Mehmet Can Vuran , *Wireless Sensor Networks*, Wiley, 2010.

[2] C S Raghavendra, K M Sivalingam, Taieb Znati, *Wireless Sensor Networks*, Springer, 2010.

[3] C. Sivarm murthy & B.S. Manoj, *Adhoc Wireless Networks*, PHI-2004.

[4] Fei Hu, Xiaojun Cao, *Wireless Sensor Networks*, CRC Press, 2013.

[5] Feng ZHAO, Leonidas GUIBAS, Wireless *Sensor Networks*, ELSEVIER, 2004.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: elaborate the characteristics and applications of WSNs

CO2: classify various MAC protocols in WSNs

CO3: compare different Network LayerProtocol of WSNs

CO4: analyze the performance of time synchronization , energy saving & management in WSNs

Course Articulation Matrix (CAM): P20SP103A: WIRELESS SENSOR NETWORKS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP103A.1	2	1	2	2	1
CO2	P20SP103A.2	1	1	1	2	1
CO3	P20SP103A.3	1	1	2	1	1
CO4	P20SP103A.4	2	1	1	2	2
P20SP103A		**1.5**	**1**	**1.5**	**1.75**	**1.25**

P20SP103B: ARRAY SIGNAL PROCESSING

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: spatial signals array fundamentals and wave fields
LO2: sensor arrays, uniform linear arrays, random arrays
LO3: spatial domain filtering, spatial frequency transform
LO4: direction of arrival, non-parametric and sub space methods of beam forming

UNIT – I (9)

Introduction to Spatial Signals: Spatial Signals, Array fundamentals, Signals in space and time, Signal models, Spatial frequency, Propagation Signal Direction Vs Spatial Frequency, Wave fields, Far field and Near field signals

UNIT – II (9)

Sensor Arrays: Spatial sampling, spatial sampling theorem, aliasing in spatial frequency domain, sensor arrays, uniform linear arrays (ULA) basic idea of direction of arrival using uniform linear array, array transfer (steering) vector, array steering vector for ULA, planar and random arrays, broadband arrays

UNIT– III (9)

Spatial Frequency: Spatial frequency, spatial frequency transform, spatio-temporal filter, spatial spectrum, spatial domain filtering, spatial smoothing, smoothing filters, sharpening filters, spatially white signal

UNIT - IV (9)

Direction of Arrival Estimation: Conventional beam forming, tapered and optimum beam forming, eigen analysis, interference cancellation, side lobe canceller, non parametric methods - beam forming and capon methods, resolution of beam forming, subspace methods: maximum likely hood estimation, pisaranko's method, music, minimum norm and esprit techniques and algorithms. spatial smoothing, applications of array signal processing in signal analysis

Text Book(s):

[1] Don H. Johnson and Dan E. Dugeon, *Array Signal Processing: Concepts and Techniques*, PHI, 2010.
[2] Prabhakar S. Naidu, *Sensor Array Signal Processing*, 2/e, CRC Press, 2009.

Reference Book(s):

[1] Simon Haykin, Array *Signal Processing*, PHI, 1984.
[2] Bernard Widrow, S. D. Stearns, *Adaptive signal processing*, Pearson Education.
[3] L Sibul, *Adaptive Signal Processing*, Ed., IEEE Press, 1987.

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: interpret signals in space and time
CO2: develop implementation of sensor arrays, uniform linear arrays and random arrays
CO3: apply spatial frequency transform to design spatial domain filters
CO4: estimate direction of arrival using different beam forming methods

Course Articulation Matrix (CAM): P20SP103B: ARRAY SIGNAL PROCESSING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP103B.1	2	1	1	1	1
CO2	P20SP103B.2	2	1	1	1	1
CO3	P20SP103B.3	2	1	1	1	1
CO4	P20SP103B.4	2	1	1	1	1
P20SP103B		**2**	**1**	**1**	**1**	**1**

P20SP103C: FPGA BASED WIRELESS COMMUNICATION SYSTEMS

Class: M. Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop student's knowledge in /on

LO1: FPGA based linear convolution and its applications in wireless communication

LO2: nonlinear convolution implemented using FPGA

LO3: various advancements in the FPGA based fast linear convolution

LO4: different stages of design verification for FPGA based DSP system

UNIT-I (9)

FPGA and Digital Signal Processing: Introduction, emerging trends in wireless communications, convolutions in wireless communications, FPGAs in wireless communications State-of-the-Art FPGAs, FPGA-based DSP basics, FPGA-based DSP system design, FPGA-based linear convolution: introduction, linear convolution basics, fpga implementation architectures, applications in wireless communications

UNIT-II (9)

FPGA-based Nonlinear Convolution: Introduction, nonlinear convolution basics, time domain perspective, frequency domain perspective, static and dynamic processing, FPGA implementation architectures: model simplifications and variations, direct synthesizable architecture, LUT-assisted architecture, architecture comparison, applications in wireless communications: digital up conversion and digital down conversion, frequency pre- equalization and post-equalization, poly-phase filter-based interpolation for RF-DAC

UNIT-III (9)

Advanced FPGA-based Fast Linear Convolution: Introduction, SISO-fast linear convolution: overlap save approach, overlap add approach, FFT basis, SISO-FLC complexity, MIMO-fast linear convolution: from SISO to MIMO, unit decomposition

and sub-function sharing, buffered segment-level interleaving and de-interleaving, compact MIMO-FLC FPGA IP-Core, extended MIMO-FLC FPGA IP-core applications in wireless communications

UNIT-IV (9)

FPGA-based DSP System Verification: Introduction, verification platforms, verification at the system level, verification at the chip level: SW and HW co-operated test-bench design, test- bench reconfigurable HW design in FPGA, verification stage-1: test-bench self-loop tests, verification stage-2: designed IP-Core in-the-Loop Test, verification stage-3: whole system in- the-loop test

Text Book(s):

[1] Lei Guan, *FPGA-based Digital Convolutions for Wireless Communications*. Springer Series in Wireless Technology, 2017.

[2] Kosai Raoof, Huaibei Zhou, *Advanced MIMO Systems*, Scientific Research Publishing, Inc. USA, 2009

Reference Book(s):

[1] M. W. Numan, M. T. Islam and N. Misran, *An efficient FPGA-based hardware implementation of MIMO wireless systems,* 2010 7th International Symposium on Communication Systems, Networks & Digital Signal Processing (CSNDSP 2010), pp. 152-156.

[2] J. Dowle, S.H. Kuo, K. Mehrotra and V. McLoughlin, *An FPGA-Based MIMO and Space-Time Processing Platform*, EURASIP Journal on Applied Signal Processing, vol. 2006, pp. 1-14, 2006.

Course Learning Outcomes (COs):
On completion of this course, students will be able to...

CO1: build FPGA based wireless communication applications using linear convolution
CO2: inspect implementation of non-linear convolution using FPGA
CO3: interpret FPGA-based Fast Linear Convolution & its applications in wireless communication
CO4: elaborate design verification for FPGA based DSP system

Course Articulation Matrix (CAM): P20SP103C: FPGA BASED WIRELESS COMMUNICATION SYSTEMS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP103C.1	2	2	1	1	2
CO2	P20SP103C.2	2	1	2	1	1
CO3	P20SP103C.3	2	1	2	1	2
CO4	P20SP103C.4	2	2	1	1	1
P20SP103C		**2**	**1.5**	**1.5**	1	1.5

P20SP104A: ADAPTIVE SIGNAL PROCESSING

Class: M.Tech. I – Semester **Specialization:** CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: fundamentals of adaptive signal processing
LO2: gradient search algorithms like LMS, NLMS, SER, LRS & RLS
LO3: least squares algorithms and time domain adaptive filtering
LO4: kalman filter theory and its applications

UNIT-I (9)

Fundamentals of Adaptive Signal processing: General form of adaptive linear combiner, optimum wiener filtering, performance surface, principle of orthogonality, gradient and minimum mean-square error, input correlation matrix, eigenvalues and eigenvectors of correlation matrix and basic applications of adaptive filtering

UNIT-II (9)

Gradient Search Algorithms: Simple gradient search algorithm and its solution, learning curve, method of steepest descent-application: linear equalizer based on steepest descent; LMS gradient algorithm, application: linear equalizer based on LMS, sequential Regression (SER) algorithm and linear random search (LRS),least squares algorithm, recursive least squares (RLS) and exponentially weighted RLS

UNIT-III (9)

Linear Prediction: Forward linear prediction, backward linear prediction, levinson-durbin algorithm and cholesky factorization

Time domain Adaptive Filtering: FIR and IIR adaptive filter, frequency domain adaptive filter: block LMS, Fast LMS and DFT-LMS, computational complexity of time and frequency domain LMS algorithms

UNIT- IV (9)

Kalman Filter Theory: Recursive minimum mean square estimation of scalar random variables, statement of the Kalman filtering problem, innovation process, estimation of state using the innovation process, application of Kalman filters: time-varying channel estimation

Text Book(s):

[1] Bernard Widrow, S. D. Stearns, *Adaptive signal processing*, United States: Prentice Hall Signal Processing Series, 2005.

[2] Simon Haykin, *Adaptive Filter Theory*, 4th ed., New Delhi: PHI, 2002.

Reference Book(s):

[1] S. Thomas Alexander, *Adaptive signal processing–Theory and Applications,* New York: Springer-Verlag, 1986.

[2] Tulay Adali and Simon Haykin (Edited), *Adaptive Signal Processing Next Generation Solutions*, New York: Wiley, 2010.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: discuss the fundamentals of adaptive signal processing
CO2: examine the gradient search algorithms like LMS, NLMS, SER, LRS &RLS
CO3: elaborate the least squares algorithms and time domain adaptive filtering
CO4: design the Kalman filter

Course Articulation Matrix (CAM): P20SP104A: ADAPTIVE SIGNAL PROCESSING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP104A.1	1	1	1	1	1
CO2	P20SP104A.2	1	1	1	1	1
CO3	P20SP104A.3	2	2	2	1	1
CO4	P20SP104A.4	2	2	2	1	1
P20SP104A		**1.5**	**1.5**	**1.5**	**1**	**1**

P20SP104B: REAL TIME OPERATING SYSTEMS

Class: M.Tech. I – Semester **Specialization(s)**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: Unix operating systems compare Hard and Soft Real-time systems and illustrate the scheduling algorithms

LO2: techniques for task management in Real time operating systems

LO3: synchronization solutions in RTOS explain the techniques and tools to debug and compare various Real Time operating systems

LO4: exceptions, interrupts, tiny OS and embedded Linux

UNIT I (9)

Brief Review of Unix Operating Systems (Unix kernel–file system, concepts of–process, concurrent execution & interrupts. process management–forks& execution. programming with system calls, process scheduling. shell programming and filters). portable operating system interface (POSIX)–IEEE Standard1003.13&POSIXrealtimeprofile. POSIX versus traditional unix signals, overheads and timing predictability. hard versus soft real-time systems–examples, jobs& processors, hard and soft timing constraints, hard real-time systems, soft real-time systems

UNIT II (9)

Concept of embedded operating systems, differences between traditional OS and RTOS, real-time system concepts, RTOS kernel & issues in multitasking–task assignment, task priorities, scheduling, intertask communication & synchronization–definition of context switching, foreground isrs and background tasks. critical section–reentrant functions, interprocess communication(IPC)–IPC through semaphores, mutex, mailboxes, message queues or pipes and event flags

UNIT III (9)

VxWorks–POSIX real time extensions, time out features, task creation, semaphores(binary, counting), mutex, mailbox, message queues, memory management–virtual to physical address mapping,debugging tools and cross development environment–software logic analyzers, ICEs, comparison of RTOS–Vx Works, µC/OS-II and RT linux for embedded applications

UNIT IV (9)

Exceptions, interrupts, applications, processing of exceptions and spurious interrupts, real time clocks, programmable timers, timer interrupt service routines (ISR), soft timers, operations.

Case Studies:

RT linux, Micro C/OS-II, Vx Works, embedded linux, and tiny OS.

Text Book(s):

[1] Jane W.S. Liu, *Real Time Systems*, Pearson Education, Asia, 2001.

[2] Real *Time Concepts for Embedded Systems* – Qing Li, Elsevier, 2011.

Reference Book(s):

[1] W. Stallings, *Operating systems - Internals and Design Principles* , 6th Edition, Pearson.

[2] Rajkamal, *Embedded Systems: Architecture, Programming and Design*, Tata McGraw-Hill Education, 2011.

[3] W. Richard Stevens, Advanced Programming in the UNIX environment, 3rd edition, Pearson, 2013

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: elaborate the functionalities of Unix operating systems and compare Hard and Soft Real-time systems

CO2: develop task management techniques in Real time operating systems

CO3: design process synchronization solutions in RTOS explain the techniques and tools to debug and compare various Real Time operating systems

CO4: develop a real time operating system based on the study of Tiny OS and Embedded Linux.

Course Articulation Matrix (CAM): P20SP104B: REAL TIME OPERATING SYSTEMS						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP104B.1	1	1	-	1	1
CO2	P20SP104B.2	1	1	-	1	1
CO3	P20SP104B.3	1	1	-	1	1
CO4	P20SP104B.4	1	1	-	1	1
P20SP104B		**1**	**1**	**-**	1	1

P20SP104C: ADVANCED CELLULAR AND MOBILE COMMUNICATION

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: Global system for mobile, its network management and CDMA systems
LO2: 3G systems channelization and MAC Layer, RLC layer, PDCP layer, BMC layer and RRC Layer
LO3: Long term evolution,the mobile management entity and downlink/uplink transmission of OFDMA
LO4: Architecture and roaming concepts of voice over LTE

UNIT-I (9)

Global System for Mobile (GSM): GSM architecture, layer modeling (OSI Model), transmission, gsm channels and channel modes, multiple-access scheme, channel coding and interleaving, radio resource (RR) management, mobility management (MM), communication manaiement , network management (NM)

CDMA: Terms of CDMA systems, output power limits and control, modulation characteristics, joint detection (JD), authentication, encryption and privacy, malfunction detection, call processing, handoff procedure

UNIT-II (9)

3G Systems: WCDMA-UMTS (UTRA-FDD) physical layer,description of physical layer , transport channels ,physical channels, transmission characteristics ,user data transmission , physical layer's functions , WCDMA-ARIB physical layer , FDD mode , TDD mode, common physical layers for both FDD and TDD modes, WCDMA-TDD physical layer, WCDMA-TDD channel structure, channel mapping, spreading (channelization) codes, modulation and spreading, bandwidth requirement and capacity, UMTS network architecture, description, MAC layer, RLC layer, PDCP layer, BMC layer, RRC layer.

UNIT-III (9)

Long Term Evolution (LTE) and LTE Advanced Pro: Network architecture and interfaces, LTE mobile devices and the LTE Uu interface, the mobility management entity (MME), the serving gateway (S-GW), the PDN-gateway, the home subscriber server (HSS), FDD air interface and

radio network, OFDMA for downlink transmission, SC-FDMA for uplink transmission, Tte LTE channel model in the downlink direction, downlink management channels, system information messages ,the LTE channel model in the uplink direction, MIMO transmission, HARQ, management and power optimization

UNIT- IV (9)

Voice Over LTE (VoLTE): Overview, the session initiation protocol (SIP), the IP multimedia subsystem (IMS) and VoLTE, architecture overview, registration, VoLTE call establishment, LTE bearer configurations for VoLTE, dedicated bearer setup with preconditions, header compression and DRX, Speech codec and bandwidt**h** negotiation, DTMF tones, SMS over IMS, call forwarding settings and XCAP, single radio voice call continuity, radio domain selection, VoLTE interworking with GSM and UMTS, VoLTE emergency calls, VoLTE roaming, 5G initiatives, recent advances in mobile communication

Text Book(s):

[1] Martin Sauter, *from GSM to LTE advanced Pro and 5G*, John Wiley & Sons Ltd, 3rd edn., 2017.
[2] F. William C.Y.Lee,*Wireless and Cellular Telecommunications*, Mc-Grahill, 3rd edn.,2006.

Reference Book(s):

[1] Theodore Rappaport, *Wireless Communications: Principles and Practice,* 2nd ed., New York: Pearson, 2010.
[2] Ezio Biglieri, *MIMO Wireless Communications*, Cambridge: Cambridge University Press, 2009

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: describe GSM and CDMA systems & handoff procedures
CO2: explain WCDMA-UMTS (UTRA-FDD) Physical layer,channel mapping and spreading codes
CO3: elaborate on LTE channel model in the downlink direction and uplink direction
CO4: discuss about voice over LTE and interworking with GSM and UMTS & 5G initiatives

Course Articulation Matrix (CAM): P20SP104C: ADVANCED CELLULAR AND MOBILE COMMUNICATION						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP104C.1	2	1	1	2	1
CO2	P20SP104C.2	2	1	1	2	1
CO3	P20SP104C.3	2	1	1	2	1
CO4	P20SP104C.4	2	1	1	2	1
P20SP104C		**1**	2	1	1	2

P20SP105: ADVANCED COMMUNICATION THEORY LAB

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This laboratory course will develop students' knowledge in/on

LO1: maximum likelihood of signals in colored noise
LO2: discrete-time receiver implementation of linear and non-linear equalizers and maximum likelihood detection
LO3: ideal coherent detection of OFDM and DS-CDMA signals
LO4: start of frame and channel estimation in OFDM systems

LIST OF EXPERIMENTS:

1. Coherent detection in colored noise using a predictive Viterbi algorithm
2. Simulate a 4-user DS-CDMA
3. Timing synchronization using a matched filter
4. Linear symbol-spaced equalizer based on steepest descent method
5. Linear symbol-spaced equalizer based on LMS
6. The predictive decision feedback equalizer
7. The conventional decision feedback equalizer
8. Symbol-spaced maximum likelihood sequence detection
9. Ideal coherent detection of OFDM signals transmitted over Rayleigh frequency-selective fading channels
10. Fincke-Pohst sphere decoder for MIMO systems

Laboratory Manual:

[1] Advanced Communication Theory laboratory manual, *prepared by faculty of Dept. of ECE.*

Text Book(s):

[1] Vasudevan K. *Digital communications and signal processing*. Hyderabad: Universities Press; 2010

Course Learning Outcomes (COs):

On completion of this laboratory course, students will be able to ...

CO1: analyze the performance of maximum likelihood detector in colored noise
CO2: evaluate the performance of linear & non-linear equalizers and maximum likelihood detectors
CO3: design ideal coherent receiver for OFDM and DS-CDMA systems
CO4: implement matched filter for timing synchronization and sphere decoder for MIMO systems

Course Articulation Matrix (CAM): P20SP105: ADVANCED COMMUNICATION THEORY LAB						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP105.1	1	1	1	1	1
CO2	P20SP105.2	1	1	1	1	1
CO3	P20SP105.3	1	1	1	1	1
CO4	P20SP105.4	1	1	1	1	1
P20SP105		**1**	**1**	**1**	**1**	**1**

P20SP106: ADVANCED DSP PROCESSORS LAB

Class: M.Tech. I – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This laboratory course will develop students' knowledge in/on

LO1: MATLAB Programming and simulink, Assembly programming
LO2: implementation of DFT& FFT algorithms on DSK 6711
LO3: implementation of Digital Filters on DSK 6711
LO4: test the DSP applications on DSPs

LIST OF EXPERIMENTS
Implementation on DSK 6711

1. Generation of signals
    a. Generate - Unit step, Ramp, Impulse, Exponential and Sinusoidal Signals.
    b. Perform mathematical operations on signals.
    c. Perform scaling, shifting and delay operations on the sequences.
2. Correlation of two sequences
3. Convolution of two sequences.
4. Compute FFT
5. Program to observe the spectrum of a given signal.
6. Programs to perform decimation and sampling rate conversions.
7. Program to Design a FIR Filters. (All types of filters)
8. Program to Design a IIR Filters. (All types of filters)
9. MATLAB Simulink models on DSK 6711.
    a. Simple Mathematical operations on signals
    b. Audio Filtering.

Laboratory Manual:

[1] Advanced DSP Processors laboratory manual, *prepared by faculty of Dept. of ECE.*

Text Book(s):

[1] B. Venkataramani & M. Bhaskar, *Digital Signal Processor, Architecture, Programming and Applications,(2/e)*, McGraw- Hill,2010.

[2] S. Srinivasan & Avtar Singh, *Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X*, Brooks/Cole, 2004.

[3] Sen M. Kuo & Woon-Seng S. Gan, *Digital Signal Processors: Architectures, Implementations, and Applications*, Prentice Hall, 2004.

Course Learning Outcomes (COs):

On completion of this laboratory course, students will be able to ...

CO1: explain the architecture of Digital signal Processors
CO2: interpret the architectures of Programmable DSP TMS320C6711
CO3: develop the programs for implementation of Basic DSP algorithms
CO4: design a project on DSK6711

Course Articulation Matrix (CAM): P20SP106: ADVANCED DSP PROCESSORS LAB						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP106.1	1	1	1	3	1
CO2	P20SP106.2	3	1	1	2	2
CO3	P20SP106.3	3	3	3	3	3
CO4	P20SP106.4	3	3	3	3	3
P20SP106		**2.5**	**2**	**2**	**2.75**	**2.25**

P20MC107: RESEARCH METHODOLOGY AND IPR

Class: M.Tech. I – Semester

Specialization(s): SCE, DE, VE, PE, SE DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: research methodology, approaches, principles of experimental design and research plan

LO2: sampling design, data collection, data representation and statistical analysis

LO3: layout of a research report, technical paper writing, oral presentation and intellectual property

LO4: patent rights and developments in IPR.

UNIT-I (6)

Research Methodology: Meaning of research, objectives, motivation, types, approaches, research methods vs methodology, scientific method, research process, criteria for good research, literature review, research ethics, plagiarism, problems encountered by researchers in india

Defining the Research Problem and Research Design: Selecting a research problem, necessity and techniques in defining research problem, need for research design, features of good design, different research designs, basic principles of experimental design, developing a research plan

UNIT – II (6)

Sampling Design: Census and sample survey, implications, steps, criteria of selecting a sampling procedure, characteristics of a good sample design, types of sample designs, complex random sampling designs

Data Collection & Data Analysis: Collection of primary and secondary data, observation method, interview method, collection of data through questionnaires, schedules, data organization, methods of data grouping, diagrammatic and graphic representation of data, regression modeling, direct and interaction effects, ANOVA, F-test, time series analysis, autocorrelation and autoregressive modeling

UNIT – III (6)

Interpretation and Report Writing: Interpretation technique, precaution in interpretation, significance, steps and layout of report writing, types of reports, oral presentation, mechanics of writing a research report, precautions, format of the research report,synopsis,dissertation,thesis, references/bibliography/webliography, technical paper writing/ journal/ report writing, making presentation, use of visual aids.

Nature of Intellectual Property: Patents, designs, trade and copyright

Process of Patenting and Development: Technological research, innovation, patenting, development

UNIT – IV (6)

Patent Rights: Scope of patent rights, licensing and transfer of technology, patent information and databases, geographical indications.

New Developments in IPR: Administration of patent system, new developments in IPR, IPR of biological systems, computer software etc. traditional knowledge case studies, IPR and IITs.

Text Book(s):

[1] C.R Kothari and Gaurav Garg, "*Research Methodology, Methods & Techniques*", 4th ed., New Age International Publishers, 2019 (*Chapters 1, 2, 3, 6, 7, 11, 14*)

[2] Deborah Ebouchoux, "*Intellectual Property, The Law of Trademarks, Copyrights, Patents and Secrets*", 4th ed., Delmar, Cengage Learning, 2012 *(Chapter 1, 2, 3, 17, 18)*

[3] ***Anti-plagiarism policy of KITSW*** - A handout prepared by Dean, Research and Development, KITSW, Jan 2020.

[4] Frequently Asked Questions, Office of CGPDTM, INDIA 2020

[5] Patent-Office-Procedures: http://www.ipindia.nic.in/writereaddata/images/pdf/patent-office-procedures.pdf

References Book(s):

[1] Stuart Melville and Wayne Goddard, "*Research methodology: An Introduction for Science & Engineering Students*" 2nd ed.,JUTA, 2007.

[2] Robert P. Merges, Peter S. Menell, Mark A. Lemley, "*Intellectual Property in New Technological Age - I*", Clause 8, 2016.

[3] Dobera J Halbert, "*Resisting Intellectual Property*", Taylor & Francis Ltd.,1st ed.,2005.

[4] Ranjit Kumar, "*Research Methodology: A Step by Step Guide for beginners*", 3rd ed., Sage Publications India Pvt. Ltd, New Delhi, 2011.

[5] T. Ramappa, "*Intellectual Property Rights Under WTO*", 4th ed., .S. Chand, 2008

[6] R. Ganesan, "*Research Methodology for Engineers*", MJP Publishers, Chennai, 2011

[7] Patent application procedures: https://patentinindia.com/cost-patent-registration-india/

[8] http://www.ipindia.nic.in/history-of-indian-patent-system.htm

[9] Patent Law India: https://www.mondaq.com/india/patent/656402/patents-law-in-india--everything-you-must-know

[10] How to file patents: https://iptse.com/how-to-file-patents-understanding-the-patent-process-in-india/

[11] How Can I get a patent for my project: https://patentinindia.com/cost-patent-registration-india/

Course Learning Outcomes (COs):

On completion of this course, students will be able to

CO1: develop and formulate research problem using research methodology techniques.

CO2: utilize techniques of data modeling and analysis to solve research problem

CO3: choose an appropriate methodology to write a technical report and present a research paper

CO4: judge patent rights and adapt new developments in IPR for their patent publications

Course Articulation Matrix (CAM): P20MC107: RESEARCH METHODOLOGY &IPR						
CO		**PO 1**	**PO 2**	**PO 3**	**PSO 1**	**PSO 2**
CO1	**P20MC107.1**	2	2	1		
CO2	**P20MC107.2**	2	2	1		
CO3	**P20MC107.3**	2	2	1		
CO4	**P20MC107.4**	2	2	-		
P20MC107		**2**	**2**	**1**		

P20AC108A: ENGLISH FOR RESEARCH PAPER WRITING

Class: M.Tech. I – Semester

Specialization(s): SCE, DE, VE, PE, SE DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on

LO1: planning for quality research writing with improved level of readability
LO2: constituents and attributes of a research paper
LO3: specifications for research transcription and pedagogic skills for reporting research
LO4: guidelines for publishing research papers in quality journals

UNIT-I (6)

Skills for research writing: Planning and preparation, word order, breaking up long sentences, structuring paragraphs and sentences, being concise and removing redundancy

Improving level of readability: Avoiding ambiguity and vagueness,clarifyingwho did what, highlighting your findings, hedging and criticizing, paraphrasing and plagiarism

UNIT-II (6)

Constituents of a research paper: Abstract, styles of abstract, keywords, characteristics of poor abstract, assessing quality of abstract, introduction- outline in introduction, assessing quality of introduction, review of literature, ways of referring to authors in literature.

Attributes of a research paper: Methodology, use of tenses and articles in methodology, results, styles of reporting results, discussion, styles of writing discussions, conclusions, impact of writing conclusions, assessing quality of conclusions, final check-do's and don'ts

UNIT-III (6)

Specifications for research transcription: Structuring phrasing and summarizing of title and abstract, structuring phrasing and summarizing of introduction, critical review of literature, limitations of previous work and demonstration of innovation in proposed research

Pedagogic skills for reporting research: Structuring and justifying the methodology, structuring, reporting, interpreting and summarizing results, structuring, comparing, interpreting and summarizing discussions, styles of writing discussions, structuring, differentiating and summarizing of conclusions

UNIT-IV (6)

Quality assurance and corroboration of research: Indexing and harnessing useful phrases**,** adapting final check for readability, clarity in logical order of argumentation, checking for journal guidelines, consistency, accuracy, acknowledgements and spell-check

Text Books:

[1] Adrian Wallwork, *English for Writing Research Papers,* 2nded., New York, Dordrecht Heidelberg London, Springer books, 2016.

Reference Books:

[1] Goldbort R, *Writing for Science, London,* 2nd ed Yale University Press, 2006
[2] Day R, *How to Write and Publish a Scientific Paper,* 8th ed, Cambridge University Press, 2016
[3] Adrian Wallwork ,*English for Academic Research ,Grammar, Usage and Style,*2nd ed, Springer New York Dordrecht Heidelberg London, Springer Books ,2012.

Course Learning Outcomes (COs):

On completion of this course, the student will be able to…

CO1: develop essential skills for research writing with improved level of readability.
CO2: organize the constituents of research paper and derive conclusions with a final check of Do's and Don'ts
CO3: justify, interpret, compare and summarize results for proposed methodologies in research paper
CO4: adopt quality assurance methods like final check for readability, consistency and accuracy of a research paper.

Course Articulation Matrix (CAM): P20AC108A: ENGLISH FOR RESEARCH PAPER WRITING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20AC108A.1	1	2	2		
CO2	P20AC108A.2	1	2	2		
CO3	P20AC108A.3	1	2	2		
CO4	P20AC108A.4	1	2	2		
P20AC108A		**1**	**2**	**2**		

P20AC108B: SANSKRIT FOR TECHNICAL KNOWLEDGE

Class:M.Tech. I – Semester **Specialization(s)**: SCE, DE, VE, PE,SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: proficiency in illustrious Sanskrit, the scientific language in the world
LO2: depth of grammar in sanskrit
LO3: deeper insight into tenses used in sanskrit
LO4: concepts related to various technical fields

UNIT – I (6)

Introduction: Alphabets, vowels, consonants, māheśvara sutras, combined alphabets, verbs, basic words

UNIT –II (6)

Study of grammar I: Singular/dual/plural, nominative case, accusative case, instrumental case, dative case, ablative case, genitive case, locative case

UNIT– III (6)

Study of grammar II: Nouns and adjectives, indeclinable, present tense, past tense, future tense, order and request, prefixes, number word, combinations ablative case, genitive case, locative case and cases

UNIT - IV (6)

Technical concepts related to various fields: Technical concepts of mathematics, chemistry, electrical science, mechanics & mechanical science, metallurgy, aeronautics, marine science, measurement of time, astronomy, architecture, botany, agriculture, hygiene &health

Text Book(s):

[1] Dr.Vishwas,*Abhyaspustakam,* 1st ed. New Delhi: Samskrita-Bharti Publication, 2014
[2] Suresh Soni, *India's Glorious Scientific Tradition,* 1st ed. NewDelhi: Ocean books (P) Ltd, 2008 (Unit IV)

Reference Book(s):

[1] VempatiKutumbshastri, *Teach Yourself Sanskrit*, 1st edn., New Delhi: Prathama Deeksha Rashtriya Sanskrit Sansthanam, 2012

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: understand to read and write basic Sanskrit language
CO2: identify the usage of grammar in the ancient Indian language
CO3: make use of tenses in Sanskrit language
CO4: analyze the ancient Sanskrit literature on Science and Technology

Course Articulation Matrix (CAM): P20AC108B: SANSKRIT FOR TECHNICAL KNOWLEDGE						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC108B.1	2	1	1		
CO2	P20AC108B.2	2	1	1		
CO3	P20AC108B.3	2	1	1		
CO4	P20AC108B.4	2	1	1		
P20AC108B		**2**	**1**	**1**		

P20AC108C: CONSTITUTION OF INDIA

Class: M. Tech. I – Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: state policy and parliamentary form of government, council of ministers
LO2: necessity of act of information technology and its powers, cyber security and its laws
LO3: consumer protection act, rights of consumer-deficiency in service
LO4: crimes against women, different legislations, process of investigation and right to information act

UNIT – I (6)

Constitutional Law: Constitution meaning and significance-constitutional history-status of fundamental rights-role of fundamental duties-implementation of the directive principles of the state policy-parliamentary form of government-president-prime minister-council of ministers-federal structure in constitution-relations between central and state-amendment of constitution –procedure and kinds of amendments.

UNIT –II (6)

Law of information technology: Evolution-genesis and necessity of information technology act-features and various authorities under it act-their powers-impact of other related enactments-e-commerce laws in india-digital and electronic signatures in indian laws-e-contracts and its validity in india-cyber tribunals-definition and necessity of cyber security-computer and cyber security-e-mail security-database security-operating system security-advance computers-network and mobile security techniques- sensitive personal data and information in cyber laws-cyber crimes-hacking-phishing –stalking-cyber terrorism.

UNIT– III (6)

Corporate Law: Definition and essentials of valid contract - corporate incorporation and management-directors of company-company secretary-corporate governors-different system of corporate governors-corporate governance and social responsibility-emerging trends-corporate and social environment responsibility-competition law-objectives competition commission of india-consumer protection act-consumerism-rights of consumer-deficiency in service-unfair trade practices-e-contracts etc.

UNIT - IV (6)

Criminal Law: Definition of crime--crimes against women including cyber crimes-criminal justice systems-protection for women for atrocities-different legislations like constitution, indian penalcode, human rights, domestic violence, equality in rights, dowry prohibition, prevention of child marriage, prevention of sexual harassment against woman at work place, protection of children some sexual harassment – investigation – compliant - process of investigation – fir, panchanama, closure report, charge sheet etc - procedure of search

Right to Information Act: Freedom of information - indian constitution and right to information - legislating the right to information - salient features of the right to information act 2005 - public authority under rti act - nature of rti, exemptions and limitations - composition, powers and functions of the information commissions - right to information and implementation issues

Text Book(s):

[1] M.P.Jain, Indian *Constitutional Law*, Vol.1, Wadhwa & Co, Nagpur, 2003

[2] Vakul Sharma, *Information Technology – Law and Practice,* Universal Law Publishing, 3rd Ed.2011

[3] Gower and Davies, *Principles of Modern Company Law,*Sweet and Maxwell Publishing, 10th Ed.

[4] Ratan Lal and Dhiraj Lal: *Indian Penal Code*, Wadhwa & Co., 36th Ed. 2000

[5] O.P.Srivastava: *Principles of Criminal Law,* Eastern Book Company, 6th Ed. 2016

[6] KM Shrivastava, *The Right to Information: A Global Perspective*, Lancer Publisher, New Delhi (2013)

Reference Book(s):

[1] H.M.Seervai, *Constitutional Law of India, Vol.3,* N.M.Tripathi , 4th Ed., 1997

[2] G.C.V.Subba Rao, *Indian Constitutional Law*, S.Gogia& Co., Hyderabad

[3] Dr.S.R.Myneni, *Information Technology Law (Cyber Laws),* Asia Law House, Hyderabad, 1st Ed. 2018.

[4] J.M. Thomson: *Palmer's Company Law, Vol.4, 21st Ed. Wildy & Sons Ltd.*

[5] P.S.Achutan Pillai: *PSA Pillai's Criminal Law*, Butterworth Co., 2000.

[6] K.D.Gour: *Criminal Law*, *Cases and Materials*, 9th Ed. LexisNexis, 2019.

[7] Sairam Bhat, *Right to Information and Good Governance*, National Law School of India University, 2016.

[8] Dheera Khandelwal and KK Khandelwal , A Commentary and Digest on the *Right to Information Act, 2005,* 2nd Ed., 2014.

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: develop the knowledge in state policy and parliamentary form of government
CO2: make use of information technology act and cyber security
CO3: utilize the consumer protection act and rights consumer
CO4: perceive the legislations and understand the process of investigation and right to information act

Course Articulation Matrix (CAM): P20AC108C : CONSTITUTION OF INDIA						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC108C.1	1	1	1		
CO2	P20AC108C.2	1	1	1		
CO3	P20AC108C.3	1	1	1		
CO4	P20AC108C.4	1	1	1		
P20AC108C		**1**	**1**	**1**		

P20AC108D: PEDAGOGY STUDIES

Class: M. Tech. I –Semester

Specialization(s):SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop student's knowledge in/on

LO1: terminology of pedagogy studies, role of curriculum, relation between teaching and learning
LO2: effectiveness of pedagogical practices and teaching strategies
LO3: student centeredapproaches of learning
LO4: factors supporting effective pedagogy, research gaps and future directions of potential areas

UNIT-I (6)

Methodology: Aims and rationale, policy background, conceptual framework and terminology, theories of learning- behaviourism, constructivism, social constructivism, critical theory, difference between curriculum and syllabus, curriculum, importance of curriculum for students and teachers, role played by the curriculum

Teaching- Learning Process: Introduction, concept of pedagogy, principles of teaching, maxims of teaching, phases of learning, relationship between teaching and learning, factors of teaching and learning in classroom situation, difference between teaching and learning

UNIT-II (6)

Overview of pedagogical practices in developing countries: Overview and aims, pedagogy approaches, pedagogy as practice, pedagogy as ideas, pedagogy and equity, curriculum, teacher education - initial teacher education, continuing professional development, training unqualified teachers, **e**ffectiveness of pedagogical practices, pedagogic theory and pedagogical strategies, teachers' attitudes and beliefs

Strategies of Teaching: Features, characteristics, advantages and limitations of lecture method, demonstration method, experimental method and discussion method

UNIT-III (6)

Student Centred Approaches: Features, characteristics, advantages and limitations of constructivist approach of learning, discovery method of learning, enquiry method, project based learning (PBL), activity based learning (ABL)

Practical Approaches: Features of experiential learning and teacher's role, peer tutoring, field visits and process of organizing, e-learning tools, strengths and weaknesses.

UNIT-IV (6)

Role of teacher education, school curriculum, guidance materials in supporting effective pedagogy: Professional development, alignment with classroom practices and follow-up support, peer support, support from the head teacher and the community, curriculum and assessment, barriers to learning:limited resources and large class sizes

Research gaps and future directions: Research design, contexts, pedagogy, teacher education, curriculum and assessment, dissemination and research impact

Textbook(s):

[1] Dr. S. K. Bhatia, Dr. Sonia Jindal, *A Textbook of curriculum, pedagogy and evaluation*, 1st ed., New Delhi: Paragon International Publishers, 2016.

[2] Jo Westbrook, NaureenDurrani, Rhona Brown, David Orr, John Pryor, Janet Boddy, Francesca Salvi, *Pedagogy, Curriculum. Teaching Practices and Teacher Education in Developing Countries*, Education Rigorous Literature Review, Center for International Education, University of Sussex, December 2013.

Reference book(s):

[1] Ackers J, Hardman F, *Classroom interaction in Kenyan primary schools*, Compare, 31 (2): 245-261, 2001.

[2] Agrawal M, *Curricular reform in schools: The importance of evaluation*, Journal of Curriculum Studies, 36 (3): 361-379, 2004.

[3] Akyeampong K, *Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1.* London: DFID, 2003.

[4] Akyeampong K, Lussier K, Pryor J, Westbrook J, *Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?* International Journal Educational Development, 33 (3): 272–282, 2013.

[5] Alexander RJ, *Culture and pedagogy: International comparisons in primary education.* Oxford and Boston: Blackwell, 2001.

[6] Chavan M, *Read India: A mass scale, rapid, 'learning to read' campaign,* 2003.

[7] www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Learning Outcomes (COs):

On completion of this course, the students will be able to…

CO1: describe the significance of curriculum, relationship between teaching and learning

CO2: justify the effectiveness of pedagogical practicesof teaching and compare the lecture, demonstration, experimental and discussion methods of teaching strategies

CO3: analyse the role of student centered approaches in learning of a student and identify suitable approaches for the improvement

CO4: exemplify the role of professional development, curriculum, assessment for effective pedagogy and identify the research gaps in allied areas

Course Articulation Matrix(CAM): P20AC108D: PEDAGOGY STUDIES						
CO		**PO 1**	**PO 2**	**PO 3**	**PSO 1**	**PSO 2**
CO1	P20AC108D.1	-	1	-	-	-
CO2	P20AC108D.2	1	1	1	-	-
CO3	P20AC108D.3	1	1	1	-	-
CO4	P20AC108D.4	1	1	1	-	-
P20AC108D		**1**	**1**	**1**	**-**	**-**

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
M.TECH. (COMMUNICATION ENGINEERING AND SIGNAL PROCESSING)

SEMESTER-II

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE							ESE	Total Marks
								I²RE - TA				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PC	P20SP201	Professional Core-3: Software Defined Radio	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20SP202	Professional Core-4: Machine Learning for Signal Processing	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20SP203	Professional Elective-III/ MOOC-III	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20SP204	Professional Elective-IV/ MOOC-IV	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20SP205	Professional Core Lab-III: Software Defined Radio Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20SP206	Professional Core Lab-IV: Artificial Intelligence and Machine Learning Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
7	PROJ	P20SP207	Mini Project with Seminar	-	-	4	2	-	-	-	-	-	-	100	-	100
8	AC	P20AC208	Audit Course-II	2	-	-	1	8	8	8	6	10	20	60	40	100
			Total:	14	-	12	19	40	40	40	30	50	100	520	280	800

[L= [Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-III/ MOOC-III	Professional Elective-IV/ MOOC-IV	Audit Course-II
P20SP203A: 5G Communication Systems	P20SP204A: Multi rate systems & filter banks	P20AC208A: Stress Management by Yoga
P20SP203B: IoT and Applications	P20SP204B: Real Time Embedded Systems	P20AC208B: Value Education
P20SP203C: Radar Signal processing	P20SP204C: Millimeter Wave Communication	P20AC208C: Personality Development through Life Enlightenment Skills
P20SP203D: MOOCs	P20SP204D: MOOCs	P20AC208D: Disaster Management

Total Contact Periods/Week: 26 **Total Credits: 19**

Additional Learning: Students are advised to do MOOCs to bridge the gap in the curriculum as suggested by the Department Academic, Advisory Committee (DAAC). The credits earned by the student through MOOCs will be printed in the semester grade sheet.

P20SP201: SOFTWARE DEFINED RADIO

Class: M.Tech. II - Semester Specialization: CESP

TeachingScheme:

L	T	P	C
3	-	–	3

ExaminationScheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course LearningObjectives(LOs):

This course will develop students' knowledge on /in…

LO1: design principles of software defined radio
LO2: business modelsfor Software-Defined Radio
LO3:radio frequency implementation issues in SDR
LO4: various techniques available to solve the problem of flexible and linear transmitter

UNIT–I (9)

Introduction to Software Radio Concepts: The need for software radios, definition of software radio, characteristics and benefits of a software radio, design principles of a software radio, software requirements and re-configurability, software defined radio architectures, required hardware specifications, digital aspects of a SDR, current technology limitations, impact of superconducting technologies on future SDR systems

UNIT–II (9)

Business Models for Software-Defined Radio- Introduction ,Base-Station Model , Impact of OBSAI and CPRI™ , Handset Model, New Base-Station and Network Architectures- Separation of Digital and RF , Tower-Top Mounting , BTS Hoteling, Smart Antenna Systems- Introduction , Smart Antenna System Architectures , Power Consumption Issues , Calibration Issues

UNIT–III (9)

Radio Frequency Implementation Issues: The purpose of the RF front-end, dynamic range: the principal challenge of receiver design, RF receiver front-end topologies, enhanced flexibility of the RF chain with software radios, importance of the components to overall performance, transmitter architectures and their issues, noise and distortion in the RF chain, ADC and DAC distortion

UNIT – IV (9)

Flexible Transmitters and PAs: Introduction, Differences in PA Requirements for Base Stations and Handsets- Comparison of Requirements , Linearisation and Operational Bandwidths, Linear Upconversion Architectures- Analogue Quadrature Upconversion, Quadrature Upconversion with Interpolation, Interpolated Bandpass Upconversion, Digital IF Upconversion, Multi-Carrier Upconversion, Weaver Up conversion, Constant-Envelope Upconversion Architectures- PLL-Based Reference or Divider Modulated Transmitter , PLL-Based Directly-Modulated VCO Transmitter

Text Books:

[1] Jeffrey H. Reed, *Software Radio: A Modem Approach to Radio* Engineering, Pearson, 2002

[2] P. Kenington, RR- *and Baseband Techniques for Software Defined Radio,* Artech House,2005

Reference Books:

[1] Tony J Rouphael, RF and DSP for SDK, Elsevier Newnes Press, 2008.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

[1] discuss software design aspects and reconfigurability of SDR
[2] analyze the business models of software defined radio
[3] elaborate radio frequency implementation issues in SDR
[4] discuss various techniques available to solve the problem of flexible and linear transmitter

Course Articulation Matrix (CAM): P20SP201: SOFTWARE DEFINED RADIO

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP201.1	1	2	2	1	2
CO2	P20SP201.2	1	2	2	1	2
CO3	P20SP201.3	1	2	2	1	2
CO4	P20SP201.4	1	2	2	1	2
P20SP201		**1**	**2**	**2**	1	**2**

P20SP202: MACHINE LEARNING FOR SIGNAL PROCESSING

Class: M.Tech. II – Semester

Specialization(s): CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: classification techniques used in machine learning

LO2: filter design, sampling Shannon-whittaker interpolation & quantization

LO3: non-linear,non-gaussian & non-parameter Bayesian signal processing using ML

LO4: deep learning algorithms for signal processing

UNIT-I (9)

Statistical machine learning: Feature and kernel functions mixture modelling, gibbs sampling for the mixture model classification logistic regression support vector machines (SVM) classification loss functions and misclassification regression: linear regression bayesian and regularized linear regression, linear-in parameters regression, nonparametric, nonlinear regression. variable selection, clustering: k-means and variants, soft k-means, mean shift and variants, semi-supervised clustering and classification, classification techniques – decision trees and random forest, naïve bayes, dimensionality reduction: PCA, probabilistic PCA and nonlinear dimensionality reduction

UNIT-II (9)

Filter Design: LTI signal processing - Rational filter design: FIR, IIR filtering, fourier filtering of very long signals, kernel regression as discrete convolution, exploiting statistical stability for linear-gaussian DSP, the kalman filter (KF), time-varying linear systems

Discrete signals,Sampling,Quantization and Coding: Discrete-time sampling, bandlimited sampling, uniform band limited sampling: shannon-whittaker interpolation, generalized uniform sampling, quantization, lossy signal compression, audio and compressive sensing

UNIT-III (9)

Nonlinear and non-Gaussian signal processing: Running window filters, maximum likelihood filters, change point detection recursive filtering, global nonlinear filtering, hidden markov models(HMMs), junction tree (JT) for efficient hmm computations, viterbi decoding,baum-welch parameter estimation, model evaluation

and structured data classification, viterbi parameter estimation,avoiding numerical under flow in message passing, homomorphic signal processing

Nonparametric Bayesian machine learning and signal Processing: Preliminaries, exchangeability and de finetti's theorem, representations of stochastic processes, partitions and equivalence classes, gaussian processes (GP)- dirichlet processes (DP)- the dirichlet distribution, defining the dirichlet and related processes, infinite mixture models (DPMMs)

UNIT-IV (9)

Deep Learning: Neural networks and back propagation, introduction to deep learning - convolutional and recurrent networks, pre-training and practical considerations in deep learning, understanding deep networks, applications in natural language processing, audio signal classification: time series analysis, LSTMs

deep learning for wireless applications

Text Books:

[1] Max. A Little, *Machine learning for Signal Processing, Great Clarendon Street*, Oxford, OX2 6DP, United Kingdom, 2019.

[2] I. Goodfellow, Y, Bengio, A. Courville, *Deep Learning*, MIT Press, 2016.

Reference Books:

[1] Li Deng, *Deep Learning : Methods and Applications*, Microsoft Technical Report.

[2] D. Yu, L. Deng, *Automatic Speech Recognition - Deep learning approach-*, Springer, 2014.

[3] F. Camastra, Vinciarelli, *Machine Learning for Audio, Image and Video Analysis*, Springer,2007

[4] C.M. Bishop, *Pattern Recognition and Machine Learning*, 2nd Edition, Springer, 2011.

[5] U Dinesh Kumar and Manaranjan Pradhan, *Machine Learning using Python*, New Delhi: John Wiley & sons, 2019.

Course Learning Outcomes(COs):

Upon completion of this course, students will be able to….

CO1: elaborate classification techniques used in machine learning

CO2: discuss filter design, sampling Shannon-whittaker interpolation & quantization

CO3: develop non-linear , non-gaussian & non-parameter Bayesian signal processing using ML

CO4: design signal processing applications using deep learning algorithms

Course Articulation Matrix (CAM): P20SP202: MACHINE LEARNING FOR SIGNAL PROCESSING						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP202.1	1	1	1	1	1
CO2	P20SP202.2	2	-	1	2	1
CO3	P20SP202.3	1	-	1	1	1
CO4	P20SP202.4	2	1	1	1	1
P20SP202		**1.5**	**1**	**1**	1.25	1

P20SP203A: 5G COMMUNICATION SYSTEMS

Class: M.Tech. II – Semester **Specialization(s)**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: implementation of OFDM & FBMC
LO2: uplink and downlink design aspects of NOMA
LO3: system model and pilot combination of FBMC for massive MIMO channels
LO4: millimeter wave MIMO transceiver architecture implementation

UNIT – I (9)

From OFDM to FBMC: Overview of 5G technology & requirements, the filter bank: the synthesis filters, the analysis filters, polyphase implementation, orthogonal frequency division multiplexing (OFDM) – cyclic prefix, guard band, frequency division multiple access (FBMC), comparison of FBMC and filtered OFDM – classical approaches to sidelobe suppression, performance, complexity, introduction to generalized frequency division multiplexing(GFDM)

UNIT –II (9)

Non-Orthogonal Multiple Access (NOMA): Concept and Design: Introduction concept – downlink NOMA, uplink NOMA, benefits and motivations, interface design – downlink NOMA, uplink NOMA, MIMO support – downlink NOMA, uplink NOMA, performance evaluations – downlink NOMA, uplink NOMA

UNIT– III (9)

Filter Bank Multicarrier for Massive MIMO: System model and FBMC formulation in massive MIMO – polyphase-based CMT in massive MIMO, FS-based CMT in massive MIMO,self-equalization property of FBMC in massive MIMO – numerical study of polyphase-based CMT in a massive MIMO channel, numerical study of FS-based CMT in a massive MIMO channel, comparison with OFDM, blind equalization and pilot decontamination

UNIT - IV (9)

Millimeter-Wave MIMO Transceivers: Theory, Design and Implementation: Introduction – millimetre-wave MIMO technology: background and promise. overview of millimetre-wave MIMO transceiver architectures, point-to-point single-user systems-sampled MIMO system presentation, beamspace MIMO system

representation, channel modelling, beam selection: low-dimensional beamspace MIMO channel, optimal transceiver, beamspace MIMO transceivers, point-to-multipoint multiuser systems – channel model, beamspace system model, beam selection: low-dimensional channel

Text Book(s):

[1] Luo, Fa-Long, and Charlie Jianzhong Zhang, *Signal processing for 5G: algorithms and implementations,* UK: John Wiley & Sons, 2016.

[2] Mumtaz Shahid, Jonathan Rodriguez and Linglong Dai," *MM wave massive MIMO:A Paradigm for 5G"* Academic press, 2016

Reference Book(s):

[1] Xiang Wei, Kan Zheng, and Xuemin Sherman Shen, *5G mobile communications*, Switzerland: Springer International Publishing AG, 2016.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: elaborate OFDM & FBMC and compare their in terms of PSD, out of band radiation & complexity

CO2: evaluate the performance of ongoing experimental trials in downlink & uplink NOMA

CO3: develop Filter Bank Multicarrier based Massive MIMO System

CO4: design Millimeter-wave MIMO transceivers

Course Articulation Matrix (CAM): P20SP203A: 5G COMMUNICATION SYSTEMS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP203A.1	2	2	1	2	2
CO2	P20SP203A.2	2	2	1	2	2
CO3	P20SP203A.3	2	2	1	2	2
CO4	P20SP203A.4	2	2	1	2	2
P20SP203A		**2**	**2**	**1**	**2**	**2**

P20SP203B: IoT AND APPLICATIONS

Class: M.Tech. II – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: logical design, network and communication aspects of IoT

LO2: IoT cloud computing platforms

LO3: IoT devices and its interfacing with Raspberry Pi

LO4: advance IoT devices applications and IoT wireless network and devices

UNIT – I (9)

Fundamentals of IoT: Introduction to internet of things (IoT) and its characteristics. physical design of IoT -things in IoT, IoT protocols. logical design of IoT- IoT functional blocks, IoT communication models, IoT communication APIS. IoT levels and deployment templates. IoT architecture & design methodology- IoT platform design methodology. IoT reference architecture- functional view, information view, deployment and operational view, other relevant architectural views

UNIT –II (9)

Cloud Application Architecture: Fundamental of cloud computing, mechanism, architecture, working with clouds, security mechanism. Cloud development environments for service development- amazon, azure, google app cloud platform in industry

UNIT– III (9)

Building Blocks of IoT Devices: IoT devices, raspberry Pi interfaces: programming raspberry Pi with C/C++/python, interfacing sensors, inter-integrated circuits, serial peripheral interface, analog temperature sensor, programing & debugging with Keil MDK, IoT interfacing-actuators, connecting raspberry Pi to IoT cloud platform

UNIT - IV (9)

Advanced IoT Applications: ARM architecture overview, STM32 ARM cortex M4 controllers, controlling LED, programming & debugging using Keil uVision. interfacing of sensors and other devices. Data exchange protocol-hypertext transfer protocols, message queuing telemetry transport, constrained application protocols. IoT wireless network device: Wi-Fi, bluetooth, LoRa, zigBee, IoT gateways, IoT

edge computing, and IoT fog computing. Case study- performance evaluation of semtech SX1272 LoRa module by coverage range test

Text Book(s):

[1] Arshadeep Bahga, Vijay Madisetti, *Internet of Things, A Hands-on Approach*, Universities Press Pvt. Ltd., 2015.

[2] Bauer M. et al, *Enabling Things to Talk: IoT Reference Architecture*, Springer, Berlin, Heidelberg, 2013. https://doi.org/10.1007/978-3-642-40403-0_8.

[3] Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013.

Reference Book(s):

[1] Srinivasa K.G, Siddesh G.M, Hanmantha Raju R, *Internet of Things*, New Delhi: Cengage Learning India, 2018.

[2] David Etter, *IoT (Internet of Things) Programming -A Simple and fast way of learning*, 2016.

[3] Lam, K. H., Cheung, C. C., Lee, W. C., *RSSI-Based LoRa Localization Systems for Large-Scale Indoor and Outdoor Environments*. IEEE Transactions on Vehicular Technology, 68(12), 11778-11791, 2019.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: examine the various categories of IoT enabling technologies
CO2: develop the cloud computing environment for IoT solutions
CO3: develop IoT applications on embedded platform using C/C++/Python
CO4: build and control IoT applications using advanced IoT devices

Course Articulation Matrix (CAM): P20SP203B: IoT AND APPLICATIONS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP203B.1	1	1	-	2	1
CO2	P20SP203B.2	1	1	-	1	2
CO3	P20SP203B.3	1	1	-	2	1
CO4	P20SP203B.4	1	1	-	1	2
P20SP203B		**1**	**1**	**-**	1.5	1.5

P20SP203C: RADAR SIGNAL PROCESSING

Class: M.Tech. II – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: radar signal models, target model, clutter models
LO2: ambiguity function and waveform design
LO3: moving target indicator and detection fundamentals
LO4: synthetic aperture radar principles and modes

UNIT – I (9)

Fundamentals of radar systems: Basic radar function, radar classifications, doppler shift, range equation, system structure. signal models: radar cross section of targets and clutter, multipath, statistical signal models, swerling models, advanced (compound) statistical signal models for clutter, convolutional models in range and angle, frequency domain models

UNIT –II (9)

Waveforms: The ambiguity function, basic waveforms: simple pulse, LFM, coherent pulse train. Coded waveforms: frequency, phase (biphase, costas), MCW, step-frequency, optimum waveforms for time delay, velocity, acceleration measurements, measurement accuracy, cramer-rao bounds. sampling and quantization: sampling complex bandpass signals, sampling rates in range, angle, doppler, space, I/Q imbalance and correction techniques, digital I/Q

UNIT– III (9)

Doppler processing: Matched filter (vector formulation), MTI as approximation to matched filter for unknown target velocity, DFT/pulse doppler approximation to matched filter for known target velocity, improvement factor, DPCA for airborne MTI. optimal detection: Neyman-pearson detection and the likelihood ratio, threshold detection, targets in gaussian noise, coherent and noncoherent integration; binary integration, optimal detectors for non-gaussian interference, CFAR

UNIT - IV (9)

Synthetic Aperture Radar: The SAR principle from aperture, doppler, chirp viewpoints. SAR overview: system issues, range migration, processor structure. SAR modes: strip map, spotlight, doppler beam sharpening, inverse SAR, spotlight SAR and polar format data collection, polar format processing, range migration and chirp

scaling algorithms for spotlight SAR. Autofocus: correlation, phase gradient algorithms, interferometric 3D SAR

Text Book(s):

[1] Richards, Mark , *Radar Signal Processing*, 2nd edition, IET and McGraw-Hill Education, 2014.

[2] Bernard Lewis, Wesley W.Sheldon, Frank F, Jr Kretschmer, *Aspect of Radar signal Processing*, Artech House, 1986.

Reference Book(s):

[1] Ramon Nitzberg, *Radar Signal Processing and Adaptive Systems*, Artech House, 1999.

[2] Simon Haykin , *Adaptive Radar Signal Processing*, John Wiley & sons, 2006.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: analyze signals and develop their statistical models for radar target and clutter models
CO2: formulate ambiguity function and various waveform design
CO3: analyze moving target indicator and different detection methods
CO4: elaborate synthetic aperture radar principles and its modes

Course Articulation Matrix (CAM): P20SP203C: RADAR SIGNAL PROCESSING						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP203C.1	1	1	1	2	2
CO2	P20SP203C.2	1	1	1	2	2
CO3	P20SP203C.3	1	1	1	2	2
CO4	P20SP203C.4	1	1	1	2	2
P20SP203C		**1**	**1**	**1**	**2**	**2**

P20SP204A: MULTI RATE SYSTEMS & FILTER BANKS

Class: M.Tech. II-Semester **Specialization:** CESP

Teaching Scheme :

L	T	P	C
3	-	-	3

Examination Scheme :

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: importance of sampling rate conversion &building blocks of multirate systems
LO2: fractional sampling rate conversion and implementation
LO3: maximally decimated filter banks
LO4: linear phase QMF banks and application

UNIT- I (9)

Introduction, overview of sampling and reconstruction, review discrete-time systems, digital filters oversampling techniques, DT processing of continuous time signals fundamentals of multi-rate systems, basic building blocks – up sampling, down sampling, aliasing

UNIT- II (9)

Mathematical framework for sampling rate change sampling rate change and - filtering, fractional sampling rate change Interconnection of multirate DSP blocks, multiplexer and de-multiplexer functionality, polyphase decomposition, noble identities, efficient implementation of sampling rate conversion

UNIT- III (9)

Maximally decimated filter banks:- introduction, errors created in QMF bank, alias free QMF system, power symmetric QMF banks, m-channel filter banks, polyphase representation, perfect reconstruction systems, para unitary perfect reconstruction (PR) filter banks :- introduction, lossless transfer matrices, filter bank properties induced by para unitariness, two channel fir par unitary QMF banks, two channel par unitary QMF lattice, m-channel FIR par unitary filter banks

UNIT- IV (9)

Linear phase perfect reconstruction QMF banks:- introduction, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice; cosine modulated filter banks: introduction, pseudo QMF bank, design of pseudo QMF bank, efficient polyphase structures, cosine modulated perfect

reconstruction systems. applications of multirate signal processing: analysis of audio, speech, image and video signals

Text Book(s):

[1] P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, New Delhi: Pearson-Education, 2004.

[2] Lin,Yuan-Pei,See-May Phoong and P.P Vaidyanathan, *filter bank transceivers for OFDM and DMT systems* ,Cambridge university press,2010

Reference Book(s):

[1] V. Oppenheim and R.W.Schafer, *Discrete time Signal Processing*, New Delhi: PHI, 1994.

[2] J. Proakis and D. Manolakis, *Digital Signal Processing: Principles, algorithms and applications*, New Delhi: Prentice-Hall, 1996.

Course Learning Outcomes (COs):

On completion of this course, students will be able to...

CO1: identify the importance of sampling rate conversion and building blocks of multi rate systems
CO2: analyze fractional sampling rate conversion and implementation
CO3: design maximally decimated filter banks
CO4: evaluate linear phase QMF banks and apply it in multi rate signal processing

Course Articulation Matrix (CAM): P20SP204A: MULTI RATE SYSTEMS & FILTER BANKS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP204A.1	1	1	-	2	2
CO2	P20SP204A .2	1	2	-	2	2
CO3	P20SP204A.3	1	1	-	2	2
CO4	P20SP204A.4	1	2	-	2	2
P20SP204A		**1**	**1.5**	**-**	**2**	**2**

P20SP204B: REAL TIME EMBEDDED SYSTEMS

Class: M.Tech. II – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: embedded system design methodologies and performance analysis
LO2: ARM processor architecture and its programming
LO3: embedded systems programming and its performance optimization
LO4: real time operating systems

UNIT – I (9)

Introduction to Embedded system Design: Complex systems and micro processors– embedded system design process ,design example: model train controller, design methodologies, design flows -requirement analysis ,specifications-system analysis and architecture design ,quality assurance techniques ,designing with computing platforms ,consumer electronics architecture ,platform-level performance analysis

UNIT –II (9)

Arm Processor And Peripherals : ARM architecture versions ,ARM architecture , instruction set, stacks and subroutines, features of the LPC 214X family , peripherals ,the timer unit, pulse width modulation unit ,UART – block diagram of ARM9 and ARM cortex M3 MCU

UNIT– III (9)

Embedded Programming: Components for embedded programs- models of programs- assembly, linking and loading – compilation techniques- program level performance analysis – software performance optimization – program level energy and power analysis and optimization – analysis and optimization of program size- program validation and testing

UNIT - IV (9)

Real Time Systems, Processes And Operating Systems: Structure of a real time system –– estimating program run times – task assignment and scheduling – fault tolerance techniques – reliability, evaluation – clock synchronisation. introduction – multiple tasks and multiple processes – multi-rate systems- pre-emptive realtime operating systems- priority based scheduling- inter-process communication mechanisms –evaluating operating system performance- power optimization strategies for processes –example real time operating systems-POSIX-

windows CE. Solar based electromagnetic breaking system using object sensor for automobiles, application of wireless medical monitoring system

Text Book(s):

[1] Marilyn Wolf, *Computers as Components - Principles of Embedded Computing System Design*, Third Edition (**chapters 1,2,5,6**) —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

[2] Jane W.S.Liu, *Real Time Systems*, Pearson Education, Third Indian Reprint, 2003.

Reference Book(s):

[1] Lyla B.Das, —*Embedded Systems: An Integrated Approach*‖ Pearson Education, 2013.

[2] Jonathan W.Valvano, —*Embedded Microcomputer Systems Real Time Interfacing*‖, Third Edition Cengage Learning, 2012.

[3]David. E. Simon, —*An Embedded Software Primer*‖, 1st Edition, Fifth Impression,Addison-Wesley Professional, 2007.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: discuss embedded systems architecture & its performance analysis
CO2: elaborate the concepts of Arm processor and its peripherals
CO3: compose various programs and test programs validation for embedded systems
CO4: develop the real-time applications using embedded-system

Course Articulation Matrix (CAM): P20SP204B: REAL TIME EMBEDDED SYSTEMS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP204B.1	1	1	-	1	-
CO2	P20SP204B.2	1	1	-	1	-
CO3	P20SP204B.3	1	1	-	1	-
CO4	P20SP204B.4	1	1	-	1	-
P20SP204B		**1**	**1**	**-**	1	-

P20SP204C: MILLIMETER WAVE COMMUNICATION

Class: M.Tech. II – Semester **Specialization(s)**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives(LOs):

This course will develop students' knowledge in/on

LO1: fundamentals of Millimeter wave communication system
LO2: Millimeter wave generation and amplification
LO3: various modulation techniques & components of Millimeter wave Communications system.
LO4: Millimeter wave MIMO systems &antenna design at Millimeter wave frequencies

UNIT – I (9)

Millimeter wave characteristics- Millimeter wave wireless, implementation challenges, radio wave propagation for millimeter wave: large scale propagation channel effects, small scale channel effects, outdoor and indoor channel models, emerging applications of millimeter wave communications

UNIT – II (9)

Millimeter wave generation and amplification: Peniotrons, ubitrons, gyrotrons and free electron lasers. HEMT, models for mm wave transistors, transistor configurations, analog mm wave components: amplifiers, mixers, VCO, PLL. Metrics for analog mm wave devices, consumption factor theory, trends and architectures for mm wave wireless, ADC's and DAC's

UNIT – III (9)

Modulations for Millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, millimeter wave link budget, transceiver architecture, transceiver without mixer, receiver without oscillator, millimeter wave calibration, production and manufacture, millimeter wave design considerations

UNIT – IV (9)

Millimeter wave MIMO systems: Massive MIMO communications, spatial diversity of antenna arrays, multiple antennas, multiple transceivers, noise coupling in MIMO system, potential benefits for mm wave systems, spatial, temporal and frequency diversity, dynamic spatial, frequency and modulation allocation

Antennas for Millimeter wave systems: Antenna beamwidth, polarization, advanced beam steering and beam forming, mm wave design consideration, on-chip and In package mm wave antennas, techniques to improve gain of on-chip antennas,

implementation for mm wave in adaptive antenna arrays, device to device communications over 5G systems, design techniques of 5G mobile

Text Book(s):

[1] K.C. Huang, Z. Wang, *Millimeter Wave Communication Systems*, Wiley-IEEE Press, March 2011.

[2] Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, *Millimeter Wave Wireless Communication*, Prentice Hall, 2014.

Reference Book(s):

[1] Xiang, W; Zheng, K; Shen, X.S; *5G Mobile Communications*: Springer, 2016.

Course Learning Outcomes(COs):

On completion of this course, students will be able to….

CO1: discuss the fundamental characteristics of Millimeter- wave technology

CO2: elaborate Millimeter wave generation and amplification

CO3: design of transceiver architecture for Millimeter communication Systems

CO4: design antennas for Millimeter wave communication Systems

Course Articulation Matrix (CAM): P20SP204C: MILLIMETER WAVE COMMUNICATION

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP204C.1	1	1	-	2	2
CO2	P20SP204C .2	1	2	-	2	2
CO3	P20SP204C.3	1	1	-	2	2
CO4	P20SP204C.4	1	2	-	2	2
P20SP204C		**1**	**1.5**	**-**	**2**	**2**

P20SP205: SOFTWARE DEFINED RADIO LAB

Class: M.Tech. II – Semester **Specialization(s)**: CESP

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This laboratory course will develop students' knowledge on /in…

LO1: analog communications including AM, FM and PM
LO2: digital communications including BPSK, QPSK, ISI
LO3: MIMO setup
LO4: smart antennas, beamforming techniques and adaptive space-time division multiplexing for MIMO systems

LIST OF EXPERIMENTS

SDR kit based experiments

1. Study of Amplitude modulation techniques
2. Study of Angle modulation
3. Study of binary phase shift keying (BPSK) modulation and demodulation
4. Study of QPSK modulation and demodulation
5. Study of inter symbol interference with eye diagram
6. Study of RF 2×2 MIMO setup
7. Study of Smart antennas
8. Study of Beamforming techniques for MIMO
9. Study of OFDM
10. Study of Adaptive space-time division multiplexing
11. Wireless communication systems applications using NI USRP SDR/Xilinx ZYNQ board

Laboratory Manual:

[1] Software defined radio laboratory manual, *prepared by faculty of Dept. of ECE*.

Text Book(s):

[1] Jeffrey H. Reed, *Software Radio: A Modern Approach to Radio Engineering*, Pearson, 2002.
[2] P. Kenington, *RF and Baseband Techniques for Software Defined Radio*, Artech House, 2005

Course Learning Outcomes (COs):

On completion of this laboratory course, students will be able to…

CO1: implement analog communication systems like AM and FM
CO2: implement digital communication systems like BPSK and QPSK
CO3: implement multiple input, multiple output (MIMO) system
CO4: implement smart antennas, beamforming techniques for MIMO systems

Course Articulation Matrix (CAM): P20SP205: SOFTWARE DEFINED RADIO LAB						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP205.1	1	1	1	1	1
CO2	P20SP205.2	1	1	1	1	1
CO3	P20SP205.3	1	1	1	1	1
CO4	P20SP205.4	1	1	1	1	1
P20SP205		**1**	**1**	**1**	**1**	**1**

P20SP206: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB

Class: M.Tech. II – Semester **Specialization(s)**: CESP

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This laboratory course will develop students' knowledge in/on
LO1: the python fundamentals
LO2: DataFrame and perform data analysis, DSP algorithms
LO3: building regressionn, clustering and classification techniques with example
LO4: apply the concepts of ML for signal processing

LIST OF PROGRAMS

1. Generation of Basic signals with Python
2. Computation of Linear and Circular convolution with Python.
3. Implementation of Regression Techniques
4. Frequency Response of a First order and Second Order System with Python
5. Computation of DFT and IDFT with Python
6. Design FIR filter to reject unwanted frequencies with python
7. Computation of FFT with Deep Learning
8. Computation of Auto correlation Python
9. Design of IIR LP, HP filter for reject unwanted frequencies with python
10. Classification of human activity with Machine Learning Algorithms.
11. Computation of Power Spectral Density Using Python
12. Speaker Reorganization using classification algorithms
13. Signal Processing applications using Machine learning

Laboratory Manual:

[1] Artificial intelligence and machine learning laboratory manual, *prepared by faculty of Dept. of ECE.*

Text Books:

[1] U Dinesh Kumar and Manaranjan Pradhan, *Machine Learning using Python, New Delhi: John Wiley & sons, 2019.*

[2] Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow*, 2nd edn., Canada: O'Reilly Media, Inc, 2019.

Course Learning Outcomes(COs):

Upon completion of this laboratory course, students will be able to….

CO1: apply the python fundamentals

CO2: perform the data analysis and data visualization

CO3: evaluate different Machine Learning Algorithms

CO4: implement ML and DL for real time applications

Course Articulation Matrix (CAM): P20SP206: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP206.1	2	-	1	--	-
CO2	P20SP206.2	2	-	1	--	-
CO3	P20SP206.3	2	-	1	-	1
CO4	P20SP206.4	2	1	1	-	1
P20SP206		**1.5**	**1**	**1**	-	1

P20SP207: MINI PROJECT WITH SEMINAR

Class: M.Tech. II - Semester **Branch:** CESP

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	100
End Semester Examination	---

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: implementing a project independently by applying knowledge to practice
LO2: literature review and well-documented report writing
LO3: creating PPTs and effective technical presentation skills
LO4: writing technical paper in scientific journal style & format and creating video pitch

Continuous Internal Evaluation (CIE) for Mini Project with Seminar:

1) The *Post Graduate Mini Project Evaluation Committee (PGMPEC)* shall be constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and three to five other faculty members representing various specializations in that particular programme as members.
2) Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.
3) *PGMPEC* shall allot a faculty supervisor to each student for guiding on
   (a) Selection of topic
   (b) Literature survey and work to be carried out
   (c) Preparing a report in proper format
   (d) Right conduct of research and academic activity to promote academic integrity
   (e) Use of anti-plagiarism software to detect plagiarism in the report and submission of Mini project report within acceptable plagiarism levels
   (f) Effective mini project oral presentation before the PGMPEC

   There shall be only Continuous Internal Evaluation (CIE) for seminar
4) The CIE for mini project is as follows:

Assessment	Weightage
Mini project Supervisor Assessment	**20%**
PGMPEC Assessment: *(i) Registration presentation* ***(10%)*** *(ii) Working model / process / software package / system developed* ***(20%)*** *(iii) Mini project report* ***(20%)*** *(iv) Mini project paper* ***(10%)*** *(v) Mini project video pitch* ***(10%)*** (vi) *Final presentation (with PPT) and viva-voce* ***(10%)***	**80 %**
Total Weightage:	**100%**

Note: It is mandatory for the student to

(i) appear for final presentation (with PPT) and viva-voce to qualify for course evaluation

(ii) write mini project paper in given journal format

(ii) create a good video pitch to present mini project

(a) **Mini Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest

(b) **Working Model**: Each student is requested to develop a working model/ process/ software package /system on the chosen work and demonstrate before the *PGMPEC* as per the dates specified by *PGMPEC*

(c) **Mini Project Report:** Each student is required to submit a well-documented mini project report as per the format specified by *PGMPEC*

(d) **Anti-Plagiarism Check:** The mini project report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *PGMPEC* as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact

5) The student has to register for the Mini project as supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce

ii) he/she fails to submit the report in prescribed format

iii) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines

6) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned

(b) The PGMPEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: apply knowledge to practice to design and conduct experiments and utilize modern tools for developing working models / process / system leading to innovation and entrepreneurship

CO2: demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

CO3: make an effective oral presentation through informative PPTs, showing knowledge on the subject and sensitivity towards social impact of the Mini project

CO4: write a "Mini project paper" in scientific journal style and format from the prepared Mini project report and create a video pitch on Mini project

Course Articulation Matrix (CAM): P20SP207: MINI PROJECT WITH SEMINAR						
CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20SP207.1**	**2**	**-**	**2**	**2**	**2**
CO2	**P20SP207.2**	**2**	**-**	**2**	**2**	**2**
CO3	**P20SP207.3**	**-**	**2**	**-**	**1**	**1**
CO4	**P20SP207.4**	**-**	**2**	**-**	**1**	**1**
P20SP207		**2**	**2**	**2**	**1.5**	**1.5**

P20AC208A: STRESS MANAGEMENT BY YOGA

Class: M.Tech. II–Semester

Specialization(s): SCE, DE, VE, PE, SE, DS,DC &CESP

TeachingScheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: awareness about different types of stress

LO2: yoga in the management of stress

LO3: positive health and overall wellbeing

LO4: prevention of stress related health problems by yoga practice

UNIT – I (6)

Stress: Definition of stress, types of stress - acute and chronic; stressors; definition of yoga from various sources, types of yoga – karma yoga, gnana yoga, bhakti yoga and raja yoga; concept of bhagavad gita; yoga versus exercise; basics of physiology and psychology; brain and its parts – central nervous system (CNS), peripheral nervous system (PNS), hypothalamic pituitary adrenal (HPA) axis; sympathetic and parasympathetic nervous systems; fight and flight mechanism; relationship between stress and yoga

UNIT –II (6)

Ashtanga Yoga: Do's and don'ts in life; yamas – ahimsa, satya, asteya, bramhacharya and aparigraha, niyama – shaucha, santosha, tapa, svadhyaya, ishvarapranidhana; asana,pranayama,pratyahara, dharana, dhyana, samadhi

UNIT– III (6)

Asana and Stress: Definition of asana from patanjali, origin of various names of asanas, various yoga poses and their benefits for mind and body,sequence of performing asanas - standing, sitting, lying down on stomach, lying down on back and inverted postures,activation of annamaya kosha, effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas

UNIT - IV (6)

Pranayama: Anulom and vilom pranayama, nadi shudhi pranayama, kapalabhati pranayama, bhramari pranayama, nadanusandhana pranayama.

Meditation Techniques: Om meditation, cyclic meditation, instant relaxation technique (IRT), quick relaxation technique (QRT), deep relaxation technique (DRT)

Text Book(s):

[1] "*Yogic Asanas for Group Training - Part-I*", Nagpur: Janardhan Swami Yogabhyasi Mandal.

[2] Swami Vivekananda, "*Rajayoga or Conquering the Internal Nature*", Kolkata: Advaita Ashrama (Publication Department).

Reference Book(s):

[1] Nagendra H.R and Nagaratna R, "*Yoga Perspective in Stress Management*", Bangalore : Swami Vivekananda Yoga Prakashan.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1*: differentiate yoga and exercise*

CO2*: explain eight steps of Ashtanga yoga*

CO3*: describe different yogasanas, and their benefits for mind and body*

CO4*: discuss the benefits of pranayama and meditation as an effective tool for stress management*

Course Articulation Matrix (CAM): P20AC208A: STRESS MANAGEMENT BY YOGA						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208A.1	1	1	-		
CO2	P20AC208A.2	1	1	-		
CO3	P20AC208A.3	1	1	-		
CO4	P20AC208A.4	1	1	-		
P20AC208A		**1**	**1**	**-**		

P20AC208B: VALUE EDUCATION

Class: M.Tech. II–Semester **Specialization(s)**: SCE, DE, VE, PE, SE, DS, DC &CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	40
End Semester Examination	60

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: value of education and self-development

LO2: importance of cultivation of values

LO3: personality and behavior development

LO4: character and competence

UNIT – I (6)

Values and self-development: Social values and individual attitudes; work ethics, indian vision of humanism, moral and non-moral valuation, standards and principles, value judgments

UNIT – II (6)

Importance of cultivation of values: Sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanliness, honesty, humanity, discipline, power of faith, national unity, patriotism, love for nature

UNIT – III (6)

Personality and Behavior Development: Soul and scientific attitude, positive thinking, integrity, discipline and punctuality, love and kindness, avoid fault thinking, free from anger, dignity of labor

Universal brotherhood and religious tolerance: true friendship, love for truth, happiness vs suffering; aware of self-destructive habits; association and cooperation; doing best for saving nature

UNIT – IV (6)

Character and Competence: Holy books vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind your mind,self-control, honesty, studying effectively

Text Book:

[1] S. K. Chakroborty, *Values and Ethics for organizations: Theory and practice*, New Delhi: Oxford University Press, 2000.

Reference Books:

[1] D. N. Grose, *A text book of Value Education,* New Delhi: Dominant Publishers and Distributors, 2005.

[2] Yogesh Kumar Singh and Ruchika Nath, *Value Education*, New Delhi: A. P. H. Publishing Corporation, 2005.

[3] S. P. Ruhela, *Human Values and Education*, New Delhi: Sterling Publishers Pvt. Ltd., 1986.

[4] V. Narayan Karan Reddy, *Man, Education and Values,* New Delhi: B. R. Publishing Corporation, 1979.

[5] Bharatwaj Tilak Raj, *Education of Human Values,* New Delhi,: 2nd Ed., Mittal Publications, 2001.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: illustrate social & moral values and inculcate Indian vision of humanism
CO2: develop sense of duty, national unity and love for nature
CO3: utilize positive thinking and develop universal brotherhood
CO4: build character & competence through holy books

Course Articulation Matrix (CAM): P20AC208B : VALUE EDUCATION

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20AC208B.1	-	1	-		
CO2	P20AC208B.2	-	2	-		
CO3	P20AC208B.3	-	1	-		
CO4	P20AC208B.4	-	2	-		
P20AC208B			1.5			

P20AC208C: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Class: M.Tech. II-Semester **Specialization(s)**: SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge on/in…

LO1*: holistic development of personality*
LO2*: accomplishment of day to day responsibilities and to achieve the highest goal*
LO3*: basic knowledge to maintain a stable mind, pleasing personality and determination*
LO4*: personality building towards becoming a role model*

UNIT – I (6)

Holistic development of personality: Neetisatakam - verses-19, 20, 21, 22(wisdom), verses-29, 31, 32 (pride& heroism), verses-26, 28, 63, 65(virtue), verses-52, 53, 59(don'ts), verses-71, 73, 75, 78(do's)

UNIT – II (6)

Approach to day to day work and duties: Shrimad bhagwad geeta - chapter2-verses 41, 47, 48 chapter3-verses 13, 21, 27, 35; shrimad bhagwad geeta - chapter6-verses 5, 13, 17, 23, 35, chapter18-verses 45, 46, 48

UNIT – III (6)

Statements of basic Knowledge: Shrimad bhagwad geeta - chapter2-verses 56, 62, 68 chapter12-verses 13, 14, 15, 16, 17, 18

UNIT – IV (6)

Personality of Role model: Shrimad bhagwad geeta - chapter2-verses 17, chapter3-verses 36,37,42 chapter4-verses 18,38,39, chapter18-verses 37,38,63

Text Book:

[1] Swami Swarupananda, *Shrimad Bhagavad Geeta*, Advaita Ashram (Publication Department), Kolkata: Printed in Sharada Press, Car Street, Mangalore.

Reference Books:

[1] Prof. Satyavrata Siddhantalankar, *Bhagavad Geeta* , New Delhi: Oriented Publishing
[2] P.Gopinath, *Bhartrihari's Three Satakam (Niti-sringar-vairagya),* New Delhi: Rashtriya Sanskrit Sansthanam

[3] Maharaja Bhadrihari , *Nithishatakam Translated by P.Jwala Dutta Sharma*, Dharm Diwakar Press, Moradabad, 1909, First Edition
[4] *world.com/section_personality_development.html*

Course Learning Outcomes (COs):
On completion of this course, students will be able to…
CO1: *build an holistic personality*
CO2: *develop himself to accomplish his responsibilities and achieve his highest goal in life*
CO3: *perceive basic knowledge to maintain stable mind, pleasing personality and determination*
CO4: *originate himself to become a role model thus leading mankind to peace and prosperity*

Course Articulation Matrix (CAM): P20AC208C: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEMENT SKILLS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208C.1	2	1	1		
CO2	P20AC208C.2	2	1	1		
CO3	P20AC208C.3	2	1	1		
CO4	P20AC208C.4	2	1	1		
P20AC208C		**2**	**1**	**1**		

P20AC208D: DISASTER MANAGEMENT

Class: M.Tech. II-Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: disaster management cycle and relation between disaster & development
LO2: risk / vulnerability assessment and reduction strategies
LO3: management strategies, approaches, frameworks and governance
LO4: disaster mitigation aspects and recovery strategies

UNIT – I (6)

Introduction to Disaster: Concepts of hazard, vulnerability & risks, natural and manmade disasters-earthquake, cyclone, floods , volcanoes, famine, displaced populations, industrial & transport accidents, slow and rapid onset disasters - famine, draught , epidemics , air crash, tidal waves & tsunami

Mitigation and Management techniques of Disaster: Basic principles of disasters management, disaster management cycle, political, social, economic impacts of disasters, gender and social issues during disasters, principles of psychosocial issues and recovery during emergency situations, impact of disaster on development, different stake holders in disaster relief, refugee operations during disasters, human resettlement and rehabilitation issues during and after disasters, intersectorial coordination during disasters, models in disasters

UNIT –II (6)

Disaster Risk and Vulnerability: Introduction to disaster risk and vulnerability, risk analysis techniques, process of risk assessment, analytical systems for risk assessment, natural hazard/ risk assessment, understanding climate risk, mapping of risk assessment, decision making for risk reduction, problems in risk assessment, strategies for risk reduction, community-based risk reduction, observation and perception of vulnerability, vulnerability identification, vulnerability types and dimensions, vulnerability and social and economic factors

Preparedness and Response:Disaster preparedness significance & measures, institutional mechanism for disaster preparedness, disaster preparedness policy & programmes, concept and significance of disaster preparedness plan, community based disaster preparedness plan, prediction, early warnings and safety measures of

disaster, resource mobilization, post disaster reliefs & logistics management, emergency support functions and coordination mechanism

UNIT– III (6)

Disaster Management and Governance: Institutional arrangements, disaster management strategies & approaches, community based disaster preparedness (CBDP) - components, teams, preparedness, linkages with development programmes

Disaster Response in India: Legal framework, national disaster management act, 2005, institutions for disaster management – NDMA, NIDM, role of government agencies, NCMC committee, crisis management group, need, media, community resilience, social & economic problems, funding mechanism

UNIT - IV (6)

Disaster Risk Mitigation: Background, strengthening, sendai framework and strengthening disaster risk governance, responsibility matrix

Disaster Recovery: Scope, approach, recovery process, steps involved in recovery process, early, mid& long-term recovery, reconstruction, coordination–central, state & private sectors and voluntary organizations,rehabilitation–economical and psychological

Text Books:

[1] Manual on *Natural Disaster Management in India*, M C Gupta, NIDM, New Delhi, 2016*(Chapters 1- 5,7,9 &10)*

[2] N. G. Dhawan, A. S. Khan, *Disaster Management and Preparedness*, 1st ed., New Delhi: CBS Publication, 2014.*(Chapters 1,2,3,4,6,7,8 &10)*

Reference Books:

[1]Ashok Kumar and Vipul Anekant, *Challenges to internal security of India*, Tata McGraw hill,2020

[2] Larry R. Collins, *Disaster management and Preparedness*, CRC Press, 2004

[3]Tony Moore and Raj Lanka, *Hand book of Disaster and Emergency Management*, 3rd ed., Elsevier, 2006.

[4]R. K. Dave, *Disaster Management in India: Challenges and Strategies*, Prowess Publishing, 2018

[5] M. M. Sulphey, *Disaster Management*, 1st ed.,Prentice Hall of India, 2016.

[6] M. Pandey, *Disaster Management*, 1st ed., Wiley India, 2014.

[7] R. B. Singh, *Natural Hazards and Disaster Management: Vulnerability and Mitigation*, Noida: Rawat Publications, 2006

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1:categorize disasters, analyse the phases of disaster management cycle and relation between disaster & development

CO2: perform risk / vulnerability assessment and devise response & preparedness strategies for risk / vulnerability reduction

CO3: identify the role of government and private agencies involved in disaster assistance

CO4: analyse the mitigation measures and recovery strategies to inculcate a culture of resilience

Course Articulation Matrix (CAM): P20AC208D: DISASTER MANAGEMENT						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20AC208D.1**	2	1	1		
CO2	**P20AC208D.2**	2	1	1		
CO3	**P20AC208D.3**	1	1	-		
CO4	**P20AC208D.4**	2	1	-		
P20AC208D		**1.75**	**1**	**1**		

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE:: WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)

PRR-20

SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME
M.TECH. (COMMUNICATION ENGINEERING AND SIGNAL PROCESSING)
SEMESTER-III

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE							ESE	Total Marks
								I²RE - TA				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PE	P20SP301	Professional Elective-V/ MOOC-V	3	-	-	3	8	8	8	6	10	20	60	40	100
2	OE	P20OE302	Open Elective-I/ MOOC-VI	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PROJ	P20SP303	Dissertation *Phase-I* /Industrial Project(*to be continued in IV – semester also*)	-	-	18	9	-	-	-	-	-	-	100	-	100
4	PROJ	P20SP304	Internship Evaluation			2	--	-	-	-	-	-	-	100	-	100
			Total:	6	-	20	15	16	16	16	12	20	40	320	80	400

[L= [Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-V/ MOOC-V	Open Elective-I/ MOOC-VI
P20SP301A: Statistical Signal Processing	P20OE302A: Business Analytics
P20SP301B: Coding Techniques	P20OE302B: Industrial Safety
P20SP301C: Image Processing and Computer Vision	P20OE302C: Operations Research
P20SP301D: MOOCs	P20OE302D: Cost Management of Engineering Projects P20OE302E: Composite Materials P20OE302F: Waste to Energy P20OE302G: Renewable Energy Sources P20OE302H: MOOCS

Total Contact Periods/Week: 26 **Total Credits: 15**

Additional Learning: Students are advised to do MOOCs to bridge the gap in the curriculum as suggested by the Department Academic, Advisory Committee (DAAC). The credits earned by the student through MOOCs will be printed in the semester grade sheet.

P20SP301A: STATISTICAL SIGNAL PROCESSING

Class: M.Tech. III – Semester **Specialization**: CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: statistical models for efficient processing
LO2: methods for parameter estimation
LO3: algorithms for estimation of various parameters of signals with different constraints
LO4: model-based signal processing methods in communications

UNIT – I (9)

Review of Probability, Random Process and Linear Algebra.

Estimation Theory: Overview of statistical signal processing, estimation in signal processing, the mathematical estimation problem, assessing estimator performance.

Parameter Estimation Theory: Principle of estimation and applications, properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimator (MVUE), MVUE through sufficient statistic, Cramer rao lower bound, efficient estimators

UNIT –II (9)

Methods for Parameter Estimation: The method of Maximum Likelihood (ML) estimator, properties of Maximum Likelihood Estimator (MLE); Bayesian estimation - mean square error and MMSE estimator, hit or miss cost function, Maximum A Posteriori (MAP) estimation, relation between ML and MAP estimators

UNIT– III (9)

Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear Minimum Mean-Square Error (LMMSE) estimation, orthogonality principle and Wiener Hoff equation, FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-Durbin algorithm, application –linear prediction of speech, Non-causal IIR wiener filter, causal IIR wiener filtering

UNIT - IV (9)

Iterative and adaptive implementation of FIR Wiener filter: Simple gradient search algorithm and its solution, learning curve, method of steepest descent; LMS gradient algorithm, convergence analysis and misadjustment. Comparison of steepest descent and LMS algorithms, normalized LMS

Expectation-Maximization Algorithm: Log-likelihood for the linear transformation, summary of the E-M algorithm, E-M Algorithm for exponential probability functions, log-likelihood function of complex data, E-step & M-step

Kalman filters: Gauss-markov state variable models; innovation and kalman recursion, steady-state behaviour of kalman filters

Text Book(s):

[1] Steven M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory,* Prentice Hall Signal Processing Series ,1993.

[2] M. H. Hayes, *Statistical Digital Signal Processing and Modeling,* John Wiley & Sons, Inc., New York, 1996.

Reference Book(s):

[1] D.G. Manolokis, V. K. Ingle and S. M. Kogan, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000.

[2] Bernard Widrow, S. D. Stearns, *Adaptive signal processing*, Pearson Education.

[3] Simon Haykin, *Adaptive Filter Theory*, PHI, New Delhi.

[4] Henry Stark, John W. Woods, *Probability, Statistics, and Random Processes for Engineers,* Pearson, Fourth Edition.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: develop the statistical models for efficient processing

CO2: formulate filtering problems from real life applications and design filtering solutions to estimate a desired signal from a given mixture by minimizing a cost function

CO3: design efficient algorithms for estimation of various parameters of signals with different constraints

CO4: apply adaptive techniques in real-time communication problems like channel estimation and channel equalization

Course Articulation Matrix (CAM): P20SP301A: STATISTICAL SIGNAL PROCESSING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20SP301A.1	1	1	1	2	2
CO2	P20SP301A.2	1	1	1	2	2
CO3	P20SP301A.3	1	1	1	2	2
CO4	P20SP301A.4	1	1	1	2	2
P20SP301A		**1**	**1**	**1**	2	2

P20SP301B: CODING TECHNIQUES

Class: M.Tech. III – Semester **Specialization:** CESP

Teaching Scheme:

L	T	P	C
3	–	–	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in /on

LO1: Linear block codes and dual codes & hamming bound, single bound and Gilbert-Varshamov bound
LO2: Codes over finite fields with BCH and RS codes
LO3: Coding over AWGN channels & encoding and decoding for convolutional codes and turbo codes
LO4: LDPC encoder and decoder & LDPC/Turbo codes in the wireless standards

UNIT–I (9)

Linear Block Codes: Introduction to coding theory, linear block codes, generator matrices, parity check matrices, vector space view of codes, dual codes; dual codes, self-orthogonal and self-dual codes, examples of dual codes, relation between parity-check matrix and dual code; minimum distance decoder, hamming distance, error correcting capability of codes, geometric view of decoding; syndrome decoder, relationship between minimum distance and parity-check matrix; construction of codes with d=3, hamming codes, extending codes, puncturing codes; shortening codes, hamming bound, singleton bound, gilbert-varshamov bound

UNIT – II (9)

Codes over Finite Fields (BCH and RS codes): Introduction to finite fields, BCH codes, construction of BCH codes for given minimum distance, vandermonde matrices, BCH bound, properties of BCH codes (cyclic), their representation as polynomials, dimension of BCH codes, examples of BCH codes, systematic encoding, syndrome decoding for BCH codes, error locators, reed-solomon (RS) codes, dimension, definition of distance, weight in GF(2^m), generator polynomial, minimum distance and binary expansion of RS codes, reed-solomon (RS) Codes: decoding overview, PGZ decoder for RS codes, reed-solomon codes in practice: erasure decoding, burst erasure correction, some modern decoders

UNIT – III (9)

Coding over AWGN channels: AWGN channels, coding gain, encoding and decoding in AWGN channels, bitwise MAP decoder, likelihood ratios, LLRs, ML

and map decoding for repetition codes, probability of decoding error, channel capacity, capacity for various schemes, E_b/N_o, coding Gain

Convolutional codes and turbo codes: Convolutional codes- feed forward convolutional encoder, trellis representation, viterbi decoder for convolutional codes, recursive convolutional encoders, puncturing, turbo encoders, turbo decoders, free distance of convolutional codes, trellises for block codes, code concatenation, Bit-wise MAP decoding and the BCJR algorithm

UNIT – IV (9)

Low-Density Parity check (LDPC) codes: Socket construction of regular LDPC codes, tanner graphs, neighborhoods and cycles in graphs, gallager a decoding algorithm for LDPC codes and its analysis, LDPC threshold, soft-decision message passing decoder for AWGN channels, density evolution for AWGN channels, summary of LDPC codes

LDPC/Turbo codes in the wireless standards: Turbo codes in the WiMax/3GPP standards, permutation polynomial interleavers, LDPC codes in the WiMax standard, protograph LDPC codes and their properties, implementation aspects of turbo codes: MAP decoder and MAXLOGMAP decoder for convolutional codes, design and architecture, Implementation aspects of LDPC codes: tanh processing versus minsum decoder, design and architecture

Text Book(s):

[1] Shu Lin and Daniel Costello, *Error Control Coding: Fundamentals and Applications*, 2nd edn., New Delh: Prentice Hall India Pvt. Ltd, 1983.

[2] Rudiger Urbanke and Thomas Richardson, *Modern coding theory*, 1st edn., New Delh: Cambridge University Press, 2008.

Reference Book(s):

[1] F. J. MacWilliams and N. J. A. Sloane, *The theory of error-correcting codes*, North-Holland Publishers.

[2] Selected topics from reputed International Journals.

[3] *https://nptel.ac.in/courses/117/106/117106031/*

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: design linear block code for error detection and correction
CO2: apply codes over finite fields with BCH & RS codes
CO3: analyze Coding over AWGN channels and design convolutional codes & turbo codes
CO4: design LDPC codes and develop LDPC & Turbo codes for wireless applications

Course Articulation Matrix (CAM): P20SP301B: CODING TECHNIQUES						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP301B .1	2	1	1	2	2
CO2	P20SP301B .2	2	2	1	2	2
CO3	P20SP301B .3	2	2	1	2	2
CO4	P20SP301B .4	2	2	1	2	2
P20SP301B		**2**	**1.75**	**1**	**2**	**2**

P20SP301C: IMAGE PROCESSING AND COMPUTER VISION

Class: M.Tech.III – Semester **Specialization:** CESP

Teaching Scheme:

L	T	P	C
3	–	–	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in /on

LO1: image processing system and the concepts of image transforms for intendedapplications
LO2: image filtering techniques for enhancement, de-noising and restoration applications
LO3: region based Image segmentation algorithms for solving real time imaging problems
LO4: structure from motion and dense motion algorithms & object recognition algorithms

UNIT–I (9)

Fundamentals of Image processing: Image acquisition process, fundamentals of image processing, components of image processing systems, sampling & quantization, pixel neighborhood properties (connectivity, path),
Image Transforms: Unitary transform and properties, 2D fourier transform, 2D FFT, discrete fourier transform (DFT), properties of DFT, 2D DCT and properties, walsh-hadamard transform, K-L transform, principal component analysis (PCA), wavelet transform (Definition, properties, mathematical function, mother wavelets)

UNIT – II (9)

Image Filtering: Image smoothing-linear shift-invariant low-pass filtering, bi-lateral filtering; image re-sampling and multi-resolution representations-image decimation, interpolation, wavelet representations; image-gradient estimation, edge and feature detection- estimation of the image gradient, estimation of the laplacian, canny edge detection; image enhancement- pixel-based contrast enhancement, spatial filtering for tone mapping and image sharpening; image de-noising and noise models, local adaptive filtering, image restoration-blur models

UNIT – III (9)

Image Segmentation: Introduction, types of segmentation, region based segmentation-thresholding, clustering (K-means and FCM), content selected from reputed international journals, active contours-snakes and level sets, split and merge-watershed, region splitting, region merging; mean shift and mode finding, normalized cuts, graph cuts and energy-based methods, application to medical image segmentation

UNIT – IV (9)

Structure from Motion: Triangulation, two-frame structure from motion, factorization, bundle adjustment, constrained structure and motion; dense motion estimation: translational alignment, parametric motion, spline based motion, optical flow, layered motion

Object Recognition: Object detection-face detection and pedestrian detection; face recognition-eigen faces, instance recognition-geometric alignment, large databases and application for location recognition; category recognition-recognition with segmentation and application for intelligent photo editing; context and scene understanding-learning and large image collections and application for image search

Text Book(s):

[1] R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 2nd ed., New Delhi: Prentice-Hall of India, 2004.

[2] Richard Szeliski, *Computer Vision: Algorithms and Applications,* London: Springer-Verlag Limited, 2011.

Reference Book(s):

[1] Jain A. K., *Fundamentals of Digital Image Processing*, 1st ed., New Delhi: Prentice-Hall of India, 1989.

[2] Forsyth D. and Ponce J, Computer Vision - A Modern Approach, 1st ed., New Delhi: Prentice-Hall of India, 2003 (Chapters 9).

[3] Ballard D. H. and Brown C. N., *Computer Vision*, Prentice Hall, 1st Ed., New Delhi: Prentice-Hall of India,1982

[4] Linda Shapiro and Stockman George, *Computer Vision*, 15th ed., New Delhi: Prentice-Hall of India, 2001

[5] Selected Research papers from International journals

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: analyze relationship between pixels in images and able to apply proper image transform techniques for the intended application

CO2: apply filtering techniques for image enhancement in both spatial and frequency domains

CO3: analyze various image segmentation algorithms

CO4: adapt object recognition algorithms in the field of Biometrics, Medical diagnosis and document processing

Course Articulation Matrix (CAM): P20SP301C: IMAGE PROCESSING AND COMPUTER VISION						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20SP301C .1	1	1	-	2	2
CO2	P20SP301C .2	1	1	-	2	2
CO3	P20SP301C .3	1	1	-	2	2
CO4	P20SP301C .4	1	1	-	2	2
P20SP301C		**1**	**1**	**-**	**2**	**2**

P20OE302A: BUSINESS ANALYTICS

Class: M.Tech. III – Semester **Specialization(s):** SCE, DE, VE, PE, SE DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on

LO1: fundamental concepts of business analytics and descriptive analytics
LO2: data collection and data visualization methods
LO3: text analysis and simulation methods in business analytics
LO4: social media, web and health care analytics

UNIT-I (9)

Introduction to Business Analytics: Introduction to business analytics, why analytics, business analytics: the science of data-driven decision making, business context, technology data science, descriptive analytics, predictive analytics, prescriptive analytics descriptive, predictive, and prescriptive analytics techniques, big data analytics, web and social media analytics, machine learning algorithms, framework for data-driven decision making, analytics capability building, roadmap for analytics capability building, challenges in data-driven decision making and future

Descriptive Analytics: Introduction to descriptive analytics, data types and scale, structured and unstructured data, cross-sectional, time series and panel data, types of data measurement scales, population and sample, measures of central tendency, percentile, decile and quartile, measures of variation

UNIT-II (9)

Data Collection: Introduction, the value of data, data collection preliminaries, data collection methods, data types, problem formulation preliminaries, challenges in data collection, data collation, validation and presentation, data collection in the retailing industry

Data Visualization: Introduction, motivating example, methods of data visualization, software and data visualization

UNIT-III (9)

Text Analytics: Introduction, motivating text analysis, methods of text analysis, natural language processing

Simulation: Introduction, motivating examples, simulation modeling method and case studies

UNIT-IV (9)

Applications of Business Analytics: Introduction, what is social media and web analytics, display advertising in real time, A/B experiments for measuring value of digital media and handling e-retailing challenges, strategies for mobile devices, the future of social media analytics

Health Care Analytics: Introduction, methods of health care analytics

Textbooks:

[1]. U Dinesh Kumar, Business Analytics: *The Science of Data-Driven Decision Making*, 1st ed., 2017. (Units-I)

[2]. Bhimasankam Pochiraju, Sridhar S, *Essentials of Business Analytics: A Textbook*,1st ed. Springer Nature Switzerland, 2019. (Units-II, III, IV).

Reference Books:

[1]. R N Prasad, Seema Acharya, *Fundamentals of Business analytics: Big Data*, 2nd ed. Wiley Publications, 2017.

[2]. Foster Provest, Tom Fawcett, *Data Science for Business*, 1st ed. USA: O'Reilly, 2013.

Course Learning Outcomes (COs):

On completion of this course, the students will be able to

CO1: describe the concepts of business analytics and descriptive analytics

CO2: apply the data collection and data visualization methods in business analytics

CO3: categorize text analysis and simulation methods in business analytics

CO4: apply social media & web analytics and health care analytics in real world problems

Course Articulation Matrix(CAM): P20OE302A: BUSINESS ANALYTICS						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302A.1	-	-	-		
CO2	P20OE302A.2	1	1	-		
CO3	P20OE302A.3	1	1	-		
CO4	P20OE302A.4	2	2	-		
P20OE302A		**1.33**	**1.33**	-		

P20OE302B: INDUSTRIAL SAFETY

Class: M. Tech. III Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives(LOs):

This course will develop students' knowledge in/on

LO1: need for safety in industries

LO2: fundamentals of maintenance engineering

LO3: causes for wear& corrosion and method of lubrication

LO4: faults tracing in equipments and importance of preventative maintenance

UNIT –I (9)

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948; for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, safety color codes, fire prevention and firefighting, equipment and methods

UNIT –II (9)

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, primary and secondary functions and responsibility of maintenance department, types of maintenance, types and applications of tools used for maintenance, maintenance cost & its relation with replacement economy, service life of equipment

UNIT –III(9)

Prevention of Wear and Corrosion : Wear- types, causes, effects, wear reduction methods, lubricants; types and applications, lubrication methods, general sketch, working and applications- screw down grease cup, pressure grease gun, splash lubrication, gravity lubrication, wick feed lubrication, side feed lubrication, ring lubrication, definition, principle and factors affecting the corrosion, types of corrosion, corrosion prevention methods

UNIT –IV(9)

Fault tracing and Preventative maintaince : Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment - machine tool, pump, air compressor, internal combustion engine, boiler, electrical motors, types of faults in machine tools and their general causes, periodic and preventative maintenance; advantages of preventative maintenance, Repair cycle importance

Textbook(s):

[1] John Ridley and John Channing., *Safety at work*, 6th ed., UK: Elsevier Butterworth-Heinemann,2003.[Unit 1& Unit 2] chapter [2,3,5,6,7,8]

[2] Amit Gupta., "Industrial Safety and environment" Laxmi Publications (P) LTD., New Delhi., 2006., 1973., [Unit3 & Unit 4] chapters [10,11,12,13,14,15,16,17]

Reference Books:

[1] R. Keith Mobley Editor, Lindley R. Higgins Darrin J. Wikoff., *Maintenance Engineering Handbook*, 7th ed., New York: Mc Graw Hill International, 2008

[2] Mohammed Ben–Daya.,UdayKumar., Prabhakar Murthy D.N., *Introduction to Maintenance Engineering*, New Delhi: Wiley India Pvt. Ltd., 2016.

Course Learning Outcomes(COs):

Upon completion of this course, students will be able to….

CO1: summarize the principles of industrial safety and maintenance

CO2: describe the functions of maintenance department and list the types of maintenance & tools used for maintenance

CO3: identify the causes for wear ,tear& corrosion and suitable lubrication method for a given application

CO4: describe the significance of decision-tree and apply it for problems in equipment to detect and classify the faults and need of preventative maintenance.

Course Articulation Matrix (CAM) : P20OE302B: INDUSTRIAL SAFETY

COs		PO1	PO2	PO3	PSO 1	PSO 2
CO1	P20OE302B.1	1	1	1		
CO2	P20OE302B.2	1	1	1		
CO3	P20OE30B.3	1	1	1		
CO4	P20OE302B.4	1	1	1		
P20OE302B		**1**	**1**	**1**		

P20OE302C: OPERATIONS RESEARCH

Class: M.Tech. III – Semester

Specialization(s): SCE, DE, VE, PE, SE DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: linear programming problems
LO2: non linear optimization problem
LO3: sequencing, scheduling and network model
LO4: decision making theory and queuing models

UNIT – I (9)

Linear Programming Problem (LPP): Mathematical formulation of LPP, solution of linear programming problems-simplex method, artificial variable technique, duality in LPP and dual simplex method, sensitivity analysis

UNIT –II (9)

Non-Linear Programming Problem (NLPP): Classification of NLPP, unconstrained optimization techniques- iterative methods - random search methods, steepest decent method, conjugate gradient method, fibonacci method and golden section method

Constrained Optimization Techniques-- Lagrange's method and kuhn-tucker method

UNIT– III (9)

Sequencing and Scheduling: Sequencing and scheduling of n jobs one, two and three machine problems, scheduling of n jobs through k machines problem

Project Network: Network construction - CPM and PERT, resource analysis in network problems

UNIT - IV (9)

Decision Analysis and Game Theory: Introduction, decisions under uncertainty-laplace criterion, max-min criterion, savage criterion and hurwitz criterion, game theory-introduction, two person zero sum games and the maximin-minimax principle, mixed strategy games- graphical method and linear programming method, dominance property

Queuing Theory- Elements and operating characteristics of a queuing system, poisson queuing systems, study of single server queuing model with infinite capacity

Text Books:

[1] Kanti swarup, P.K.Gupta, Man Mohan, *Operations Research,* S. Chand & Sons, New Delhi. 16th edn., 2013. (Chapters: 2, 4, 5, 6, 12, 16, 17, 21, 25, 27)

[2] S.S. Rao, *Optimization Techniques,* New Age International, New Delhi, 3rd edn., 2013. (Chapters: 6)

Reference Book(s):

[1] H.A. Taha, *Operations Research an Introduction,* Prentice Hall of India, 6th Edn., 2006

[2] N.D Vohra, *Quantitative Techniques in Management*, 3rd edn, TMH, 2010

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: model engineering real time problems and solve them using various LPP techniques

CO2: optimize the engineering problems using NLPP methods

CO3: apply the tools and techniques to solve sequencing and scheduling problems and project network models

CO4: analyze conflicting situations using game theory and solve various queuing model parameters

Course Articulation Matrix (CAM): P20OE302C: OPERATIONS RESEARCH						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20OE302C.1	2	1	1		
CO2	P20OE302C.2	2	1	1		
CO3	P20OE302C.3	2	1	1		
CO4	P20OE302C.4	2	1	1		
P20OE302C		**2**	**1**	**1**		

P20OE302D: COST MANAGEMENT OF ENGINEERING PROJECTS

Class: M.Tech. III-Semester **Specialization(s):** SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):
This course will develop students' knowledge on /in…

LO1: cost concepts, objectives of costing system, project management
LO2: standard costing, cost control and reduction
LO3: cost behavior, profit planning and types of budgets
LO4: quantitative techniques for cost management

UNIT-I (9)

Overview of Cost Accounting: Cost concepts in decision making, objectives of a costing system, different costs of projects - relevant cost, differential cost, incremental cost, opportunity cost, activity based Costing

Project: Meaning, Types of projects, benefits of project management, project life cycle

UNIT-II (9)

Standard Costing: Meaning, advantages and limitations, standard costing in manufacturing and process industries, standard costing and standardized costing, standard cost and estimated cost

Cost Control and Reduction: Cost control meaning, distinction between cost control and cost reduction, advantages and disadvantages of cost control and cost reduction, cost control techniques, essential for success of cost controls and cost reduction programme, areas of cost reduction, tools and techniques of cost reduction

UNIT-III (9)

Cost Behavior and Profit Planning: Marginal cost, absorption cost, break-even analysis, cost-volume-profit (CVP) analysis, profit-volume (PV) ratio, sales ratio, margin of safety

Budgets: Budgetary control, flexible budget, performance based budgets, zero based budgets

UNIT-IV (9)

Quantitative Techniques for Cost Management: Linear programming problems (LPP includes graphic method and simplex method), transportation problems, assignment problems

Text Book(s):

[1] S.P. Jain, K.L.Narang, *Advanced Cost Accounting*, New Delhi: Kalyani Publishers, 2014 (Chapter 7, 10 ,11 13, 14, 16 &27)

[2] N.D. Vohra, *Quantitative Techniques in Management*, 3rd ed. New Delhi: Tata McGraw Hill Book Co. Ltd. 2007 (Chapter 2,3, 5 and 6)

References Book(s):

[1] Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting*, 3rd ed. New Delhi: Prentice Hall India Learning Private Limited, 2004.

[2] Harold Kerzner, *Project Management: A systems approach to Planning, Scheduling and Controlling,* 10th ed. New Delhi: John Wiley & Sons Inc., 2009.

[3] V K Kapoor, *Operations Research,* New Delhi: Sultan Chand & Sons, 2013.

[4] Charles T. Horngren and George Foster, *Cost Accounting A Managerial Emphasis*, New Delhi: Prentice Hall of India, 1991.

Course Learning Outcomes (COs):

On completion of this course, the student will be able to…

CO1: interpret overview of cost accounting and project management

CO2: distinguish standard costing in manufacturing and process industries, estimate cost control and reduction

CO3: estimate cost behavior, profit planning and budget

CO4: apply quantitative techniques for linear programming, transportation and assignment problems

Course Articulation Matrix (CAM): P20OE302D: COST MANAGEMENT OF ENGINEERING PROJECTS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302D.1	1	1	1		
CO2	P20OE302D.2	1	1	1		
CO3	P20OE302D.3	2	1	1		
CO4	P20OE302D.4	2	1	1		
P20OE302D		**1.5**	**1**	**1**		

P20OE302E : COMPOSITE MATERIALS

Class: M.Tech. III-Semester **Specialization(s):** SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives(LOs):

This course will develop students' knowledge in/on…

LO1: composite material properties and applications

LO2: properties and applications of fibers and rule of mixture

LO3: manufacturing and applications of metal matrix, ceramic matrix and carbon-carbon composites

LO4: polymer matrix composites, manufacturing and applications

UNIT- I (9)

Composite Materials: Definition, classification, characteristics, advantages, applications, functional requirements of reinforcement and matrix, effect of reinforcement on composite performance - size, shape, distribution and volume fraction

UNIT-II (9)

Reinforcements: Preparation - layup, curing, fibers-glass, carbon, kevlar, boron, properties and applications- fibers, whiskers, particle reinforcements, mechanical behavior of composites, rule of mixtures, inverse rule of mixtures, isostrain and isostress conditions

UNIT-III (9)

Manufacturing of Metal Matrix Composites: Casting – solid state diffusion technique, cladding – hot isostatic pressing, properties and applications

Manufacturing of Ceramic Matrix Composites: Liquid metal infiltration – liquid phase sintering, properties and applications

Manufacturing of Carbon/carbon Composites: Knitting, braiding, weaving, properties and applications

UNIT-IV (9)

Manufacturing of Polymer Matrix Composites: Preparation of molding compounds and prepregs, manufacturing of polymer matrix composites - hand layup, autoclave, filament winding, compression molding and reaction injection molding, properties and applications

Text Book(s):

[1] Chawla K.K., *Composite Materials*, 4th ed., New York: Springer, Verlag, 2019. (*Chapters 1, 2, 5, 6, 7 & 8*)

Reference Book(s):

[1] Agarwal, B.D. and Broutman, L. J., *Analysis and Performance of Fiber Composites*, 4th ed., USA: John Wiley & Sons, 2017.

[2] Strong A.B., *Fundamentals of Composite Manufacturing*, 2nded., SME, 2007.

[3] Sharma S.C., *Composite materials*, 1sted., New Delhi: Narosa Publications, 2000.

[4] Mathews F.L. and Rawlings R.D., *Composite materials: Engineering and Science*, 1st ed., England: Chapman and Hall, 1994.

[5] Krishnan K., Chawla *Composite Materials Science and Engineering*, India: Springer Private Limited, 2009.

[6] P.K. Mallick, *Fiber Reinforced Composite materials, Manufacturing and Design*, New York: CRC Press, Taylor and Francis Group, 2010.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: classify composite materials and explain their applications

CO2: outline properties and applications of reinforcements.

CO3: categorize manufacturing methods for metal matrix composite, ceramic matrix composite, carbon/carbon composite and their properties.

CO4: compare manufacturing methods of polymer matrix composites.

Course Articulation Matrix (CAM) P20OE302E: COMPOSITE MATERIALS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302E.1	1	1	1		
CO2	P20OE302E 2	1	1	1		
CO3	P20OE302E.3	1	1	1		
CO4	P20OE302E.4	1	1	1		
P20OE302E		**1**	**1**	**1**		

P20OE302F: WASTE TO ENERGY

Class: M.Tech. III-Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: concept of waste to energy

LO2: production of energy form waste.

LO3: technologies for waste to energy.

LO4: standards for waste to energy plants and carbon credits.

UNIT – I (9)

Introduction: Principles of waste management and waste utilization, waste management hierarchy and 3R principle of reduce, reuse and recycle, waste as a resource and alternate energy source

Waste Sources & Characterization: Waste production in different sectors such as domestic, industry and agriculture, classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous), characterization of waste for energy utilization

UNIT – II (9)

Technologies for Waste to Energy: Biochemical conversion – energy production from organic waste through anaerobic digestion and fermentation, thermo-chemical conversion – combustion, incineration and heat recovery, pyrolysis, gasification, plasma arc technology

Waste to Energy Options: Landfill gas, collection and recovery, refuse derived fuel (RDF) – fluff, briquettes, pellet, Alternate Fuel Resource (AFR) – production and use in cement plants, thermal power plants and industrial boilers, conversion of wastes to fuel resources for other useful energy applications, energy from plastic wastes – non-recyclable plastic waste for energy recovery, energy recovery from wastes and optimization of its use, benchmarking and standardization, energy analysis

UNIT – III (9)

Energy production: Waste activities – collection, segregation, transportation and storage requirements, location and siting of 'waste to energy' plants, industry specific applications – in-house use – sugar, distillery, pharmaceuticals, pulp and paper, refinery and petrochemical industry

Centralized and Decentralized Waste to Energy Plants: Centralized and decentralized energy production, distribution and use, comparison of centralized and decentralized systems and its operations

UNIT-IV (9)

Waste to Energy & Environmental Implications: Environmental standards for waste to energy plant operations and gas clean-up, savings on non-renewable fuel resources

Carbon Credits: Carbon foot print calculations and carbon credits transfer mechanisms

Text Books:

[1] *Waste to Resources: A Waste Management Handbook*, NewDelhi: TERI Press,2014. (Unit – I, III & IV)

[2] Sunil Pandey, *Industrial and Urban Waste Management in India*, New Delhi : TERI Press, 2015 (Unit –II)

Reference Books:

[1] Banwari Lal and Patwardhan ,*Wealth from Waste: Trends and Technologies*, New Delhi :TERI Press, 2014.

[2] S.N Mukhopadhyay, *Fundamentals of waste and Environmental Engineering*, New Delhi: TERI Press, 2016.

[3] Gazette Notification on Waste Management Rules 2016.

[4] CPCB Guidelines for Co-processing in Cement/Power/Steel Industry.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: outline the operations of waste sources and alternate energy sources

CO2: adopt waste to energy technologies

CO3: list the stages of waste to energy production

CO4: appraise environmental standards and estimate carbon foot print.

Course Articulation Matrix(CAM): P20OE302F: WASTE TO ENERGY						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20OE302F.1	1	1	1		
CO2	P20OE302F.2	1	1	1		
CO3	P20OE302F.3	1	1	1		
CO4	P20OE302F.4	1	1	1		
P20OE302F		1	1	1		

P20OE302G: RENEWABLE ENERGY SOURCES

Class: M.Tech. III – Semester

Specialization(s): SCE, DE, VE, SE, DS, DC & CESP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on

LO1: different types of renewable energy sources and principles of solar energy systems
LO2: principles of wind energy and geothermal energy systems
LO3: harnessing energy from oceans and biomass
LO4: working of fuel cells and different types of energy storage systems

UNIT-I (9)

Introduction: Conventional and non-conventional sources of energy – brief description of different renewable energy sources

Solar energy: Introduction to prospects of solar PV systems: photovoltaic effect and electrical equivalent circuit of a PV cell, dependence of a PV cell characteristic on temperature, solar cell output characteristics, flat plate and concentrating collectors, solar applications-solar heating/cooling technique, solar distillation, drying, street lighting, domestic lighting, solar PV pumping systems

UNIT-II (9)

Wind energy: Principles of wind power, evaluation of wind intensity, operation of a wind turbine and wind power curve, different types of wind turbine generators, topography and classification of wind turbines and its applications

Geothermal Energy: Origin and types of geothermal energy, operational difficulties, liquid dominated systems

UNIT-III (9)

Energy from Oceans: Ocean temperature differences, ocean waves, energy from the waves, introduction of tidal power, basic principle of tidal power, components of tidal power plants

Bioenergy: Introduction, Bio-mass conversion technologies, photo synthesis, biogas generation, biogas from power plant wastes, methods of maintaining biogas production, utilization of biogas, biogas gasification

UNIT-IV (9)

Chemical energy sources: Introduction to fuel cells, principle of operation of fuel cell, classification of fuel cells, advantages, disadvantages and applications of fuel cells

Types of energy storage systems: Introduction, Mechanical energy storage systems, batteries, ultra-capacitors, super conducting magnetic storage, applications

Case study on present scenario of energy generation in India

Text book(s):

[1] Rai G.D, *Non-Conventional Energy Sources*, 4th ed., New Delhi: Khanna Publishers, 2010.

Reference book(s):

[1] B.H. Khan, *Non-conventional Energy Resources*, 2nd ed., New Delhi: McGraw Hill Publishers, 2006.
[2] Felix A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*, New York: John Wiley & Sons, 2006.
[3] Bansal N. K. Kaleeman and M. Miller, *Renewable Energy Sources and Conversion Technology*, New Delhi: Mc Graw-Hill Publishers, 2006.
[4] Duffie and Beckman, *Solar Energy Thermal Process*, New York: John Wiley & Sons, 2006.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: compare conventional and non-conventional energy resources; describe solar cell characteristics and discuss applications of solar energy
CO2: compute power output of wind and describe principle of geothermal energy system
CO3: describe harnessing of electric power from oceans and biomass
CO4: describe principle of operation of fuel cells and list different types of energy storage systems

Course Articulation Matrix(CAM): P20OE302G: RENEWABLE ENERGY SOURCES						
CO		**PO 1**	**PO 2**	**PO 3**	**PSO1**	**PSO2**
CO1	P20OE302G.1	2	1	1		
CO2	P20OE302G.2	2	1	1		
CO3	P20OE302G.3	2	1	1		
CO4	P20OE302G.4	2	1	1		
P20OE302G		**2**	**1**	**1**		

P20SP303: DISSERTATION PHASE-I /INDUSTRIAL PROJECT

Class: M.Tech. III - Semester **Branch:** CESP

Teaching Scheme:

L	T	P	C
-	-	18	9

Examination Scheme:

Continuous Internal Evaluation	100
End Semester Examination	--

Course Learning Objectives (LOs):
This course will develop students' knowledge on /in…
LO1: selecting problem based Dissertation title in one of the areas of specialization
LO2: literature review and well-documented report writing
LO3: effective technical presentation skills with creating PPTs and speaking with technical knowledge
L04: creating video pitch

Registration Presentation: The Registration Dissertation Presentation shall include a brief report and presentation focusing the identified topic, literature review, time schedule indicating the main tasks, and expected outcome.

Progress Presentation-I: At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before the *Department Post Graduate Review Committee* (DPGRC).

Evaluation for Dissertation / Industrial Project:

Dissertation work shall be normally conducted in two stages: Dissertation *Phase-I* in third semester and Dissertation *Phase-II* in fourth semester.

Dissertation *Phase-I*:

(i) The Department *Post Graduate Review Committee (DPGRC)* shall be constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and three to five other faculty members representing various specializations in that particular programme as members.

(ii) (a) Student shall take up independent Dissertation Phase-I on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their programme of study, which would supplement and complement the program assigned to each student

(or)

(b) Student shall take up industrial project (in any industry) relevant to the courses offered in their programme of study, which would supplement and complement the program assigned to each student

(iii) DPGRC shall allot a faculty supervisor to each student for guiding on
(a) Selection of topic

(b) Literature survey and 50% work to be carried out during phase-I

(c) Preparing a report in proper format

(d) Effective oral presentation on dissertation phase-I before the DPGRC

(e) Right conduct of research and academic activity to promote academic integrity

(f) Use of anti-plagiarism software to detect plagiarism in the report and submission of dissertation report within acceptable plagiarism levels

(iv) In case of students with industrial projects, internal guide shall be there to track the progress from time to time

(v) There shall be only Continuous Internal Evaluation (CIE) for Dissertation Phase-I

(vi) CIE for the Dissertation Phase-I in third semester is as follows:

Assessment	**Weightage**
Dissertation Phase-I Supervisor Assessment	**50%**
DPGRC Assessment: *(i) Registration Presentation* ***(10%)*** *(ii) Progress Report on Phase-I* ***(10%)*** *(iii) Video pitch on Phase-I* ***(10%)*** *(iv) Progress Presentation -I and viva voce* ***(20%)***	**50%**
Total Weightage:	**100%**

Note: It is mandatory for the student to

(i) appear for progress presentation -I and viva voce to qualify for course evaluation

(ii) create a good video pitch on dissertation phase-I

(a) **Dissertation Topic:** The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest

(b) **Working Model:** Each student is required to develop a working model/ process/software package/system, on the chosen work and demonstrate before the DPGRC as per the dates specified by DPGRC at the end of dissertation phase-II

(c) **Progress Report:** Each student is required to submit a well-documented progress report on dissertation phase-I as per format specified by DPGRC

(vii) The student has to register for the Dissertation Phase-I as supplementary examination in the following cases:

(a) he/she is absent for oral presentation and viva-voce

(b) he/she fails to submit the report in prescribed format

(c) he/she fails to fulfill the requirements of Dissertation Phase-I evaluation as per specified guidelines

(viii) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned

(b) The DPGRC, duly constituted by the HoD, shall conduct Dissertation Phase-I evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: select current topics in their specialization and allied areas from peer reviewed journals / technical magazines/ conference proceedings

CO2: demonstrate the skills for performing literature survey identify gaps, analyze the technical content and prepare a well-documented Dissertation report

CO3: create informative PPTs with effective oral presentation, showing knowledge on the subject and sensitivity towards social impact of the Dissertation

CO4: demonstrate Dissertation through effective video pitch

Course Articulation Matrix (CAM): P20SP303: DISSERTATION PHASE-I /INDUSTRIAL PROJECT

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20SP303.1**	**2**	**-**	**2**	**2**	**2**
CO2	**P20SP303.2**	**2**	**-**	**2**	**2**	**2**
CO3	**P20SP303.3**	**-**	**2**	**-**	**1**	**1**
CO4	**P20SP303.4**	**-**	**2**	**-**	**1**	**1**
P20SP303		**2**	**2**	**2**	**1.5**	**1.5**

P20SP304: INTERNSHIP EVALUATION

Class: M.Tech. III - Semester **Branch:** CESP

Teaching Scheme:

L	T	P	C
-	-	2	-

Examination Scheme:

Continuous Internal Evaluation	100 marks
End Semester Examination	--

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: selection of internship in one of the areas of course specialization
LO2: practical and real time subject application
LO3: writing well-documented report
LO4: effective technical presentation skills with creating PPTs

Guidelines for Internship:

(1) The students shall undergo 6-8 weeks internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs & NITs.

(2) The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of two weeks internship at every stage.

(3) The internship evaluation shall be done in the III semester of study and hence the students shall complete the prescribed period of internship before start of III semester (from end of I semester to commencement of III semester).

(4) The internship evaluation shall be done by *Department Post Graduate Evaluation Committee (DPGRC)*.

Evaluation for Internship:

There shall be only Continuous Internal Evaluation (CIE) for Internship Evaluation

(ix) CIE for the Internship in third semester is as follows:

Assessment	Weightage
Internship Supervisor's Evaluation: *a) Completion of Internship Assignment* ***(10%)*** *b) Quality of work in completing the Internship Assignment* ***(10%)*** c) *Attendance, punctuality and work hours* ***(10%)***	***30%***
DPGRC Assessment: *a) Duration (8 /6 weeks)* ***(15% / 10%)*** *b) Internship Report* ***(35%)*** *c) Oral Presentation (with PPT) and viva voce* ***(20%)***	***70%***
Total Weightage:	***100%***

Note: It is mandatory for the student to

(i) appear for oral presentation (with PPT) and viva voce to qualify for course evaluation

(a) Internship Report: Each student is required to submit a well-documented internship report as per format specified by DPGRC

(b) Anti-Plagiarism Check: The internship report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(c) Presentation: Each student should prepare PPT with informative slides and make an effective oral presentation before the DPGRC as per the schedule notified by the department

(x) The student has to register for the Internship as supplementary examination in the following cases:
(a) he/she is absent for oral presentation and viva-voce
(b) he/she fails to submit the report in prescribed format
(c) he/she fails to fulfill the requirements of Internship evaluation as per specified guidelines

(xi) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned
(b) The DPGRC, duly constituted by the HoD, shall conduct Internship evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: learn new concepts and apply them to the solution of engineering problems
CO2: function effectively on multidisciplinary teams and interface with other areas of organization
CO3: clearly communicate their ideas in writing and prepare a well-documented internship report
CO4: create informative PPTs and clearly communicate their ideas orally demonstrating technical knowledge

Course Articulation Matrix (CAM): P20SP304: INTERNSHIP EVALUATION

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20SP304.1**	**2**	**-**	**2**	**2**	**2**
CO2	**P20SP304.2**	**2**	**-**	**2**	**2**	**2**
CO3	**P20SP304.3**	**-**	**2**	**-**	**1**	**1**
CO4	**P20SP304.4**	**-**	**2**	**-**	**1**	**1**
P20SP304		**2**	**2**	**2**	**1.5**	**1.5**

SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME
M.TECH. (COMMUNICATION ENGINEERING AND SIGNAL PROCESSING)
SEMESTER-IV

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE							ESE	Total Marks
								I²RE - TA				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PROJ	P20SP401	Dissertation Phase – II	-	-	30	15	-	-	-	-	-	-	60	40	100
			Total:	-	-	30	15	-	-	-	-	-	-	60	40	100

[L= [Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Total Contact Periods/Week: 30 **Total Credits: 15**

COURSE CREDIT STRUCTURE

Semester	PRR-20 Curriculum	As per Model Curriculum
I	19	18
II	19	18
III	15	16
IV	15	16
Total:	**68**	**68**

COURSE WEIGHTAGE

Courses	% Weightage of Courses
Professional Theory	42.85 % (9/21)
Professional Lab	38.1 % (8/21)
Other	19.05 % (4/21)
Total:	**100 % (21/21)**

SEMESTER vs COURSE CATEGORY WEIGHTAGE

Number of Courses / Number of Credits (*Course Category wise*)

Semester	MC	PC	PE	OE	PROJ	AC	TOTAL
I	**1/2**	**4/10**	**2/6**	**-**	**-**	**1/1**	8/19
II	**-**	**4/10**	**2/6**	**-**	**1/2**	**1/1**	8/19
III	**-**	**-**	**1/3**	**1/3**	**2/9**	**-**	4/15
IV	**-**	**-**	**-**	**-**	**1/15**	**-**	1/15
Total	1/2	8/20	5/15	1/3	4/26	2/2	21/68
% Weightage of Course Category	2.94 % (2/68)	29.41 % (20/68)	22.05 % (15/68)	4.41 % (3/68)	38.23 % (26/68)	2.94 % (2/68)	100 % (68/68)

P20SP401: DISSERTATION PHASE-II

Class: M.Tech. IV - Semester **Branch:** CESP

Teaching Scheme:

L	T	P	C
-	-	30	15

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: recognize and formulate a problem to analyze, synthesize, evaluate, simulate and create a their project

LO2: design an innovative product by applying current knowledge and adopt to emerging applications of engineering and technology

LO3: creating PPTs and effective technical presentation and knowledge skills

LO4: writing technical paper in scientific journal style & format

Progress Presentation -II shall be conducted during the 5th /6th week of IV semester.

Progress Presentation -III shall be conducted during the 12th /13th week of IV semester.

Evaluation for Dissertation Work:

Dissertation *Phase-II*:

(i) Student has to continue the Dissertation work in 4th semester as Dissertation Phase-II

(ii) There shall be Continuous Internal Evaluation (CIE) for 60 marks and End Semester Examination for 40 marks.

(iii) The evaluation for Dissertation Phase-II is as follows:

Assessment	Weightage
Dissertation Supervisor Assessment (10%) *DPGRC* Assessment: *(i) Progress Presentation -II (10%)* *(ii) Progress Presentation -III (10%)* *(iii) Working model/process/software package/system developed (10%)* *(iv) Dissertation Video pitch (10%)* *(v) Dissertation Paper (10%)*	**60%**
End Semester Examination: *(i) Dissertation Report (20%)* *(ii) Oral presentation with PPT and viva-voce (20%)*	**40%**
Total Weightage	**100%**

Note: It is mandatory for the student to

(i) appear for oral presentation (with PPT) and viva-voce to qualify for course evaluation

(ii) write dissertation paper in given journal format

(ii) create a good video pitch on dissertation phase-I & II

(a) **Working Model:** Each student is required to develop a working model/ process/system on the chosen work and demonstrate before the DPGRC as per the dates specified by DPGRC at the end of dissertation phase-II

(b) **Dissertation Report:** Each student is required to submit a well-documented dissertation report as per the format specified by DPGRC

(c) **Anti-Plagiarism Check:** The dissertation report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(d) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the DPGRC as per the schedule notified by the department

(e) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her dissertation Phase-I & II. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (if any) and social impact

(iv) **Dissertation Synopsis Presentation (DSP):**

(a) Students, with the consent of supervisor, shall apply to the DPGRC for conduct of dissertation synopsis presentation (DSP). This shall normally happen when the supervisor feels that the student has done significant work to qualify for M.Tech. dissertation.

(b) Those students who clear DSP shall only be allowed to submit the dissertation report for end semester examination

(v) **Dissertation Report:**

After clearing DSP, student shall be required to submit two bound copies of dissertation report, one for the department and other for the Dissertation Supervisor. The Dissertation report shall be evaluated by the DPGRC and external examination shall be conducted on a pre-notified date.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation and entrepreneurship

CO2: design the hardware/software to demonstrate the principle of working to correlate the analytical simulation and experimental results

CO3: create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject and sensitivity towards social impact of the Dissertation

CO4: write a "Dissertation paper" in scientific journal style and format from the prepared Dissertation report and create a video pitch on Dissertation

Course Articulation Matrix (CAM): P20SP401: DISSERTATION PHASE-II

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	P20SP401.1	2	-	2	2	2
CO2	P20SP401.2	2	-	2	2	2
CO3	P20SP401.3	-	2	-	1	1
CO4	P20SP401.4	-	2	-	1	1
P20SP401		**2**	**2**	**2**	**1.5**	**1.5**