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.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
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 & COMMUNICATION ENGINEERING

PG – M.Tech. (DIGITAL COMMUNICATIONS)

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. (DIGITAL COMMUNICATIONS)

SEMESTER-I

S. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE –TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PC	P20DC101	Professional Core-1: Advanced DSP Processors	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20DC102	Professional Core-2: Modern Communication Techniques	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20DC103	Professional Elective-1/ MOOC-1	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20DC104	Professional Elective-2/ MOOC-2	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20DC105	Professional Core Lab-1: Advanced DSP Processors Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20DC106	Professional Core Lab-2: Modern Communication Techniques 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-1	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-1/ MOOC-1	Professional Elective-2/ MOOC-2	Audit Course-1
P20DC103A: Cognitive Radio	P20DC104A: Statistical Signal Processing	P20AC108A: English for Research Paper Writing
P20DC103B: Smart Antennas	P20DC104B: Information and Coding Theory	P20AC108B: Sanskrit for Technical Knowledge
P20DC103C: Probability Theory and Linear Algebra	P20DC104C: Advanced Cellular and Mobile Communication	P20AC108C: Constitution of India
P20DC103D: MOOCs	P20DC104D: MOOCs	P20AC108D:Pedagogy Studies

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 in the DAC. The credits will be provided in the grade sheet.

P20DC101: ADVANCED DSP PROCESSORS

Class: M.Tech. I – Semester **Specialization**: Digital Communications (DC)

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 on/in…

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: Introduction, basic architectural features, DSP computational building blocks, bus architecture and memory, data addressing capabilities, address generation unit, programmability and program execution, features for external interfacing. VLIW architecture. Pipelining and performance, instruction level parallelism, dynamic scheduling, dynamic hardware prediction, memory hierarchy

UNIT-II (9)

TMS320C5X Processor: Architecture, assembly language syntax, addressing modes, assembly language instructions - pipeline structure, operation – block diagram of DSP starter kit, DSP starter kit support tools- code composer studio, support files, application programs for processing real time signals

UNIT-III (9)

Architecture of the C5x Processor - Instruction set, DSP development system: introduction, programming examples to test the DSK tools, application programs for processing real time signals

Architecture of TMS320C54X: Pipe line operation, architecture of TMS320C6X - architecture of MotorolaDSP563xx, application programs for processing real time signals, comparison of the features of DSP family processors

UNIT-IV (9)

Advanced Processors: Architecture of TMS320C54X: Pipe line operation, code composer studio, architecture of TMS320C6X, architecture of Motorola DSP563XX, comparison of the features of DSP family processors

ADSP Processors: Architecture of ADSP-21XX and ADSP-210XX series of DSP processors, addressing modes and assembly language instructions, application programs –filter design, FFT calculation

DSP Real Time system operating systems; Applications: a few case studies of application of DSPs in communication and multimedia

Text Book(s):

[1] B. Venkataramani & M. Bhaskar, *Digital Signal Processor, Architecture, Programming and Applications,*2nd ed., Tata McGraw-Hill, 2010.
[2] S. Srinivasan & Avtar Singh, *Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X,*1st Ed., Thomson/Brooks/Cole, 2004.
[3] Meyer-Baese, Uwe, *Digital Signal Processing with Field Programmable Gate Arrays,* 3rd ed., Springer-Verlag, 2007.
[4] Rulph Chassaing and Donald Reay, *Digital signal processing and applications with Tms320C6713 and TMS320C6416,* 1st ed.,Wiley, 2008.

Reference Book(s):

[1] Sen M. Kuo &Woon-Seng S. Gan, *Digital Signal Processors: Architectures, Implementations, and Applications,* 1st ed.,Prentice Hall, 2004.
[2] C. Marven & G. Ewers: *A Simple approach to digital signal processing,* 1st ed.,Wiley Inter science, 1996.
[3] R.A. Haddad & T.W. Parson: *Digital Signal Processing: Theory, Applications and Hardware,* 1st ed.,Computer Science Press NY, 1991.

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

CO1: identify the architecture of different programmable DSP devices
CO2: analyse various addressing modes of TMS320C54XX and examine real time signal processing using CCS
CO3: Assess the performance of various DSP algorithms on TMS320C6X digital signal processor
CO4: develop the models for real time applications on advanced DSPs

Course Articulation Matrix (CAM): P20DC101: ADVANCED DSP PROCESSORS						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC101.1	1	1	1	3	1
CO2	P20DC101.2	3	1	1	2	2

CO3	P20DC101.3	3	3	3	2	2
CO4	P20DC101.4	3	3	3	3	2
P20DC101		**2.5**	**2**	**2**	**2.5**	**1.75**

P20DC102: MODERN COMMUNICATION TECHNIQUES

Class:M.Tech. I- Semester **Specialization:** Digital Communications (DC)

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: *performance analysis of both coherent & non coherent detectors and coherent receiver in colored Gaussian noise*
LO2: *knowledge on equalization, maximum likelihood (ML) estimation and multicarrier communication*
LO3: *space time codes, MIMO detection and fundamentals of massive MIMO*
LO4: *OFDM, GFDM, FBMC and UFBMC*

UNIT–I (9)

Coherent & Noncoherent detectors: Coherent detectors for 2d constellations, coherent detectors for multi-dimensional orthogonal constellations, bi-orthogonal constellations, simplex constellations, noncoherent detectors for multi-dimensional orthogonal constellations, noncoherent detectors for *M*-ary PSK, coherent detectors for colored noise, coherent detectors for flat fading channels

UNIT–II (9)

Signal Transmission 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 conventional decision feedback equalizer. Receivers based on MLSE – symbol-spaced MLSE, Fractionally-spaced MSLE. Multicarrier Communication – Channel loading, The discrete multitone (DMT)

UNIT–III (9)

MIMO Systems: MIMO channel capacity-capacity of i.i.d rayleigh fading mimo channels, capacity of separately correlated rayleigh fading MIMO channel. 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

UNIT – IV (9)

Transmission and Design Techniques for 5G: An overview of 5G requirements, basic requirements of transmission over 5G, modulation techniques – orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), multiple accesses techniques – orthogonal multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA)

Text Book(s):

[1] Vasudevan.K, *Digital communications and signal processing*, Universities Press(India) Pvt. Ltd., 2018.

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

[3] Fa-Long Luo, Charlie (Jianzhong) Zhang, *Signal processing for 5G: Algorithms and implementations*, John Wiley & Sons Ltd., 2016.

Reference Book(s):

[1] Kamilo Feher, *Advanced Digital Communications: Systems and Signal processing Techniques*, SciTech Publishing Inc.,1997.

[2] George J. Miao,*Signal Processing for Digital Communications*, Artech House Publishers.,2006.

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

CO1: *discuss the performance analysis of both coherent & noncoherent detectors*
CO2: *design non-idealized digital communication system considering equalization, maximum likelihood (ML) estimation & multicarrier communication strategies*
CO3: *examine the effect of antenna correlation on the MIMO channel capacity and estimate the performance of ZF & MMSE techniques in terms of probability of error & outage probability*
CO4: *elaborate OFDM, GFDM, FBMC & UFMC*

Course Articulation Matrix (CAM): P20DC102: MODERN COMMUNICATION TECHNIQUES						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC102.1	2	2	1	2	2
CO2	P20DC102.2	2	2	1	2	2

CO3	P20DC102.3	2	2	1	2	2
CO4	P20DC102.4	2	2	1	2	2
P20DC102		**2**	**2**	**1**	**2**	**2**

P20DC103A: COGNITIVE RADIO

Class: M.Tech. I – Semester

Specialization: Digital Communications (DC)

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: components of cognitive radio and spectrum sensing
LO2: numerical optimization techniques for dynamic spectrum allocation and dynamic spectrum management
LO3: cognitive radio networks architecture and energy harvesting
LO4: architecture, design principles and architecture of software defined radio

UNIT – I (9)

Introduction to Cognitive Radio: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio, issues & challenges in cognitive radio

Spectrum Sensing: Spectrum sensing and identification, primary signal detection, energy detector, cyclo-stationary feature detector, matched filter, cooperative sensing, spectrum opportunity, spectrum opportunity detection, fundamental trade-offs: performance versus constraint, sensing accuracy versus sensing overhead

UNIT– II (9)

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols

UNIT - III (9)

Cognitive Radio Networks: Cognitive radio networks (CRN) architecture, terminal architecture of CRN, diversity radio access networks, routing in CRN, control of CRN, self-organization in mobile communication networks, security in CRN, cooperative communications, cooperative wireless networks, user cooperation and cognitive systems

Energy Harvesting Cognitive Radio: Energy harvesting cognitive radio, conventional cognitive radio, types of energy harvesting cognitive radio: from the secondary base station, from the primary user. from the ambient environment, information energy cooperation

UNIT - IV (9)

Software Defined Radio (SDR): Essential functions of the SDR, SDR architecture, design principles of SDR, traditional radio implemented in hardware and SDR, transmitter architecture and its issues, digital radio processing, reconfigurable wireless communication systems

Text Book(s):

[1] Ekram Hossain, Dusit Niyato, Zhu Han, "*Dynamic Spectrum Access and Management in Cognitive Radio Networks*", Cambridge University Press, 2009.

[2] Kwang-Cheng Chen, Ramjee Prasad "*Cognitive Radio Networks*", John Wiley & Sons Ltd., 2009.

[3] Yunfei Chen, "*Energy Harvesting Communications: Principles and Theories",* John Wiley & Sons, 2019.

Reference Book(s):

[1] Alexander M. Wyglinski, MaziarNekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks – Principles and Practice", Elsevier Inc., 2010.

[2] Jeffrey H. Reed "Software Radio" A Modern Approach to radio Engineering", Pearson Education Asia.

Course Learning Outcomes (COs):

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

CO1: discuss the cognitive radio and spectrum sensing

CO2: analyze dynamic spectrum allotment using different optimization techniques

CO3: elaborate the routing techniques and energy harvesting in cognitive radio networks

CO4: design communication systems applications using SDR

Course Articulation Matrix (CAM): P20DC103A: COGNITIVE RADIO						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC103A.1	1	1	1	1	1

CO2	P20DC103A.2	1	1	1	1	1
CO3	P20DC103A.3	1	1	1	1	1
CO4	P20DC103A.4	1	1	1	1	1
P20DC103A		**1**	**1**	**1**	**1**	**1**

P20DC103B SMART ANTENNAS

Class: M.Tech. I – Semester **Specialization**: Digital Communications (DC)

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: smart antennas, SDMA and architecture of smart antenna system, DOA estimation techniques-ML, TDOA techniques.
LO2: beam forming methods- maximum SNR beam former, MMSE, DMI and LCMV.
LO3: integration and simulation of smart antennas, Adaptive arrays, MANETS.
LO4: space time processing, ISI and CCI suppression.

UNIT – I (9)

Introduction to smart antennas: Need for smart antennas, smart antenna configurations, switched beam antennas, adaptive antenna approach, space division multiple access (SDMA), architecture of a smart antenna system: receiver, transmitter, benefits and drawbacks, mutual coupling effects

DOA estimation: Conventional and subspace methods, ML estimation techniques, estimation of the number of sources using eigen decomposition, direction finding and true ranging PL systems, elliptic and hyperbolic PL systems, TDOA estimation techniques

UNIT– II (9)

Beamforming fundamentals: Classical beamformer-statistically optimum beamforming weight vectors, the maximum SNR beamformer, multiple side lobe canceller and the maximum SINR beamformer–minimum mean square error (MMSE), direct matrix inversion (DMI), linearly constrained minimum variance (LCMV), adaptive algorithms for beam forming

UNIT - III (9)

Integration and Simulation of Smart Antennas: Overview, antenna design, mutual coupling, adaptive signal processing algorithms, DOA, adaptive beam forming, beam

forming and diversity combining for rayleigh-fading channel, trellis-coded modulation (TCM) for adaptive arrays, smart antennas systems for mobile adhoc networks (MANETS), protocol, simulations

UNIT - IV (9)

Space-Time Signal Processing: Introduction, discrete space time channel and signal models, space time beamforming, inter symbol and co-channel suppression, ISI suppression, CCI suppression, Joint ISI, space time processing for DS-CDMA. Literature review of research papers on smart antennas from reputed journals

Text Book(s):

[1] Constantine A Balanis, Panayiotis I. Loannides, *Introduction to smart antennas*, Morgan and Claypool publishers,1st ed.,2007.

[2] Joseph C Liberti., Theodore S Rappaport, *Smart Antennas for Wireless Communications-95 and Third Generation CDMA Applications*, PTR-PH publishers, 1st ed.,1989.

Reference Book(s):

[1] M.J. Bronzel, *Smart antennas*,John Wiley,

[2] T.S. Rappaport and J.C. Liberti, *Smart antennas for wireless communication*, Prentice Hall,1999.

[3] R. Janaswamy, *Radio wave propagation and smart antennas for wireless communication,* Kluwer,2001

[4] Lal Chand Gadara, *Smart Antennas,* CRC Press, LLC-20

Course Learning Outcomes (COs):

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

CO1: elaborate smart antenna systems, SDMA, DOA Techniques, ML estimation & PL Systems.
CO2: analyse maximum SNR beamformer, MMSE, DMI and LCMV.
CO3: elaborate on adaptive signal processing algorithms, TCM, MANETs & its simulation.
CO4: illustrate space time processing, ISI & CCI suppression.

Course Articulation Matrix (CAM): P20DC103B: SMART ANTENNAS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC103B.1	2	1	1	1	1
CO2	P20DC103B.2	2	1	1	1	1
CO3	P20DC103B.3	2	1	1	1	1
CO4	P20DC103B.4	2	1	1	1	1
P20DC103B		**2**	**1**	**1**	**1**	**1**

P20DC103C PROBABILITY THEORY AND LINEAR ALGEBRA

Class:M.Tech. I – Semester **Specialization:** Digital Communications (DC)

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: convergence and limit theorems of probability

LO2: discrete and continuous time Markov chains

LO3: vector spaces and orthogonality

LO4: eigen values, positive definite matrices, pseudo value decomposition and pseudo inverse

UNIT-I (9)

Convergence and Limit Theorems: Introduction to probability, random variable, random processes, infinite sequence of events, convergence of sequence of random variable; modes of convergence, weak law of large numbers, strong law of large numbers, limiting moment generating functions and central limit theorem

UNIT-II (9)

Markov Chains: Discrete time Markov chains – Markov property, state transition, Chapman Kolmogorov equations, classes and recurrence properties; Continuous time Markov chains – forward and backward equations, birth-death processes

UNIT-III (9)

Vector Spaces and Orthogonality: Vector spaces and sub spaces, the solution of m equations in n unknowns, linear independence, basis and dimension; perpendicular vectors and orthogonal subspaces, inner products and projections onto lines, projections and least squares approximations, orthogonal bases, orthogonal matrices and Gram-Schmidt orthogonalization

UNIT- IV (9)

Eigen Values and Singular Value Decomposition: Introduction, the diagonal form of matrix, complex matrices; tests for positive definiteness, semidefinite and infinite matrices – A=λMx, the singular value decomposition and the pseudoinverse

Text Book(s):

[1] Vijay K. Rohatgi and A.K. MD. Ehsanes Saleh, *An Introduction to Probability and Statistics*, 2nd ed., New York: Wiley-Inter Science Publication, 2011.

[2] Gilbert Strang, *Linear algebra and its applications*, 3rd ed., Asia: Thomson Learning, 1988.

Reference Book(s):

[1] Jyoti Prasad Medhi, *Stochastic Processes*, 3rd ed., New Delhi: New Age International, 2009.

[2] Sheldon M.Ross, *Introduction to Probability*, 10th ed., California: Models Academic Press, 2007.

[3] Kenneth Hoffman and Ray Kunze, *Linear Algebra*, 2nd ed., New Delhi: Prentice Hall, 1961.

Course Learning Outcomes (COs):

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

CO1: examine convergence & limit theorems of probability

CO2: model discrete& continuous time Markov chains

CO3: elaborate vector spaces & orthogonality

CO4: adapt singular value decomposition & pseudoinverse

Course Articulation Matrix (CAM): P20DC103C: PROBABILITY THEORY AND LINEAR ALGEBRA

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC103C.1	2	2	1	2	1
CO2	P20DC103C.2	2	2	1	2	1
CO3	P20DC103C.3	1	1	1	1	1
CO4	P20DC103C.4	1	1	1	1	1
P20DC103C		1.5	1.5	1	1.5	1

P20DC104A: STATISTICAL SIGNAL PROCESSING

Class: M.Tech. I – Semester
Specialization: Digital Communications (DC)

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: 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, 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

Course Articulation Matrix (CAM): P20DC104A : STATISTICAL SIGNAL PROCESSING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC104A.1	1	1	1	2	2
CO2	P20DC104A.2	1	1	1	2	2

CO3	P20DC104A.3	1	1	1	2	2
CO4	P20DC104A.4	1	1	1	2	2
P20DC104A		**1**	**1**	**1**	**2**	**2**

P20DC104B: INFORMATION AND CODING THEORY

Class:M.Tech.I – Semester **Specialization:** Digital Communications(DC)

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 on /in…

LO1: entropy, relative entropy & mutual information & channel capacity and differential entropy

LO2: various Gaussian channels& maximum entropy and spectral estimation

LO3: error control coding techniques for detect and correct errors& binary cyclic codes

LO4: encoding and decoding of convolutional codes and turbo codes

UNIT–I (9)

Basics of Information Theory : Introduction, measure of information, information content of message, joint entropy and conditional entropy, relative entropy and mutual information, relationship between entropy and mutual information; channel capacity-examples of channel capacity, symmetric channels, properties of channel capacity, channel coding theorem, zero-error codes, hamming codes; differential entropy-definitions, relation of differential entropy to discreteentropy, joint and conditional differential entropy, properties of differential entropy

UNIT – II (9)

Gaussian Channel: Gaussian channel: definitions, converse to the coding theoremfor Gaussian channels, bandlimited channels, parallel gaussian channels, channels with colored gaussian noise, gaussian channels with feedback, problems

Maximum Entropy: Maximum entropy distributions, examples, anomalous maximum entropy problem, spectrum estimation, entropy rates of a gaussian process, burg's maximum entropy theorem, problems

UNIT – III (9)

Error Control Coding: Introduction, examples of error control coding, methods of controlling errors, types of errors, types of codes, linear block codes: matrix description of linear block codes, error detection and error correction capabilities of linear block codes, single error correcting hamming codes

Binary Cyclic Codes: Algebraic structure of cyclic codes, encoding using an (n-k) bit shift register, syndrome calculation, error detection and correction; some important cyclic codes**-** golay codes, bch codes

UNIT – IV (9)

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

Text Book(s):

[1] Thomas M. Cover And Joy A. Thomas, *Elements ofInformation Theory*, 2nd ed., New Delhi: John Wiley India Pvt. Ltd, 2006.

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

Reference Book(s):

[1] Bernard Sklar, *Digital Communications – Fundamentals and Applications*, 2nd ed., New Delhi: Pearson Education, 2016

[2] Simon Haykin, *Digital communication*, 2nd ed., New Delhi: John Wiley India Pvt. Ltd, 2008.

[3] Selected topics from reputed International Journals

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

Course Learning Outcomes (COs):

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

CO1: analyze entropy, relative entropy, mutual information, channel capacity & differential entropy

CO2: classify gaussian channels and determine maximum entropy

CO3: apply linear block codes & binary cyclic codes to detect & correct channel errors

CO4: design encoding & decoding of convolution codes & turbo codes

Course Articulation Matrix (CAM): P20DC104B: INFORMATION AND CODING THEORY						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC104B .1	2	1	2	2	2

CO2	P20DC104B .2	2	2	2	2	2
CO3	P20DC104B .3	2	2	2	2	2
CO4	P20DC104B .4	2	2	2	2	2
	P20DC104B	**2**	**1.75**	**2**	**2**	**2**

P20DC104C: ADVANCED CELLULAR AND MOBILE COMMUNICATION

Class: M.Tech. I – Semester

Specialization: Digital Communications (DC)

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*: 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)

Evolution from 1G to 5G: 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 management, 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), Billing, Prepaid and quality of service, FDD air interface and radio network, OFDMA for downlink transmission, SC-FDMA for uplink transmission, the 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 band width negotiation, alerting tone, ringback tone and early media, port usage, message filtering and asserted identities, 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 ed.,2017.

[2] William C.Y.Lee,*Wireless and Cellular Telecommunications*, Mc-Grahill, 3rd ed.,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 & CDMA systems & handoff procedures

CO2: explain WCDMA-UMTS (UTRA-FDD) Physical layer, channel mapping & spreading codes

CO3: elaborate on LTE channel model in the downlink & uplink direction

CO4: discuss about voice over LTE and interworking with GSM & UMTS & 5G initiatives

Course Articulation Matrix: P20DC104C: ADVANCED CELLULAR AND MOBILE COMMUNICATION

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC104C.1	2	1	1	2	1
CO2	P20DC104C.2	2	1	1	2	1
CO3	P20DC104C.3	2	1	1	2	1
CO4	P20DC104C.4	2	1	1	2	1
	P20DC104C	**2**	**1**	**1**	**2**	**1**

P20DC105: ADVANCED DSP PROCESSORS LAB

Class: M.Tech. I – Semester **Specialization**: Digital Communications (DC)

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

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

LO1*: MATLAB Programming and Simulink, assembly programming and code composer studio*
LO2*: implementation of DFT& FFT algorithms on DSK*
LO3*: implementation of digital Filters on DSK*
LO4*: test the DSP applications on DSPs*

LIST OF EXPERIMENTS

1. MATLAB–DSK Interface Using RTDX
2. MATLAB–DSK Interface Using RTDX for Signal generation
3. MATLAB–DSK Interface Using RTDX for FIR Filter Implementation
4. MATLAB–DSK Interface Using RTDX for IIR Filter Implementation
5. Adaptive Filter for Sinusoidal Noise Cancellation
6. Adaptive Predictor for Cancellation of Narrowband Interference Added to a Desired Wideband Signal
7. DSK Interface Using RTDX with MATLAB Functions for FFT and Plotting
8. MATLAB Simulink models on DSK for signal generation
9. MATLAB Simulink models on DSK for Audio filtering
10. Mini-project based on the MATLAB/Simulink-DSK

Text Book(s):

[1] Lab Manual Prepared by Dept. Of ECE
[2] B. Venkataramani& M. Bhaskar, *Digital Signal Processor, Architecture, Programming and Applications,*2nd ed., McGraw- Hill,2010.
[3] S. Srinivasan & Avtar Singh, *Digital Signal Processing, Implementations using DSP Microprocessors with*

Examples from TMS320C54X, Brooks/Cole, 2004.

[4] 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 course, students will be able to ...

CO1: identify the development tools & blocks involved in DSP applications
CO2: elaborate the architecture of TMS320C67XX processor
CO3: develop the programs & models for implementation of DSP algorithms
CO4: design real time applications on DSK6711

Course Articulation Matrix (CAM): P20DC105: ADVANCED DSP PROCESSORS LAB						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC105.1	1	1	1	3	1
CO2	P20DC105.2	3	1	1	2	2
CO3	P20DC105.3	3	3	3	3	3
CO4	P20DC105.4	3	3	3	3	3
	P20DC105	**2.5**	**2**	**2**	**2.75**	**2.25**

P20DC106: MODERN COMMUNICATION TECHNIQUES LAB

Class: M.Tech. I – Semester **Specialization**: Digital Communications (DC)

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

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

LO1:ML detection of signals in colored noise
LO2:linear& nonlinear equalizers, ML detection and OFDM
LO3:linear& nonlinear detection in MIMO systems
LO4: simulation of modern communication techniques using NetSim and SDR

List of experiments:

1. Coherent detection in colored noise using a predictive Viterbi algorithm
2. Linear symbol-spaced equalizer based on LMS algorithm
3. Linear symbol-spaced equalizer based on steepest descent algorithm
4. The predictive decision feedback equalizer
5. The conventional decision feedback equalizer
6. Symbol-spaced maximum likelihood sequence estimation
7. Ideal coherent detection of OFDM signals transmitted over Rayleigh frequency-selective fading channels
8. Fincke-Pohst sphere decoder for MIMO systems
9. Alamouti space-time block code
10. Linear MMSE detector for MIMO systems
11. Advanced communication techniques using NetSim &software defined radio(SDR)

Text Book(s):

[1] Lab manual prepared by dept. of ECE
[2] Vasudevan K. *Digital communications and signal processing*. Hyderabad: Universities Press; 2010.
[3] Yong Soo Cho, Jaekwon Kim, Won Y. Yang, Chung G. Kang, *MIMO-OFDM wireless communications with MATLAB*, John Wiley & Sons (Asia) Pvt. Ltd.

Reference Book(s):

[1] Proakis, John G., Masoud Salehi, and Gerhard Bauch. *Contemporary communication systems using MATLAB*. Nelson Education, 2012.

Course Learning Outcomes (COs):

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

CO1:develop a noise predictive Viterbi algorithm

CO2: examine the performance of equalizers, ML detection & OFDM

CO3:design linear & nonlinear detection schemes for MIMO systems

CO4: develop applications of communication systems using NetSim& SDR

Course Articulation Matrix (CAM): P20DC106: MODERN COMMUNICATION TECHNIQUES LAB

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC106.1	1	1	1	2	2
CO2	P20DC106.2	1	1	1	2	2
CO3	P20DC106.3	1	1	1	2	2
CO4	P20DC106.4	1	1	1	2	2
P20DC106		**1**	**1**	**1**	**2**	**2**

P20MC107: RESEARCH METHODOLOGY AND IPR

Class: M.Tech. I – Semester

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

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 student's 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.

[2] Deborah Ebouchoux, "*Intellectual Property, The Law of Trademarks, Copyrights, Patents and Secrets*",4th ed., Delmar, Cengage Learning, 2012.

[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 & CSP

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: 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, clarifying who 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,*2nded., 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,*2nded., 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 & CSP

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: 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 & CSP

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: statepolicy 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 Pe nal Code*, Wadhwa & Co., 36thed., 2000

[5] O.P.Srivastava: *Principles of Criminal Law,* Eastern Book Company, 6thed.,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 , 4thed.,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, 1sted., 2018.

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

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

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

[7] Sairam Bhat, *Right to Informationand 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,* 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 & CSP

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 centered approaches 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 practices of 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**	**-**	**-**

PRR-20

M.TECH. (DIGITAL COMMUNICATIONS)
SEMESTER-II

S. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PC	P20DC201	Professional Core-3: Ad Hoc Wireless Networks and its Protocols	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20DC202	Professional Core-4: Machine Learning for Communication System	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20DC203	Professional Elective-3/ MOOC-3	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20DC204	Professional Elective-4/ MOOC-4	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20DC205	Professional Core Lab-3: Wireless Communication Networks Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20DC206	Professional Core Lab-4: Machine Learning Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
7	PROJ	P20DC207	Mini Project with Seminar	-	-	4	2	-	-	-	-	-	-	100	-	100
8	AC	P20AC208	Audit Course-2	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-3/ MOOC-3	Professional Elective-4/ MOOC-4	Audit Course-2
P20DC203A: FPGA Based Wireless Communication Systems	P20DC204A: Multirate DSP for Communication	P20AC208A: Stress Management by Yoga
P20DC203B: Advanced Embedded Systems	P20DC204B: RF Circuits	P20AC208B: Value Education
P20DC203C: Fiber Optic Communication and Networks	P20DC204C: Image and Video Processing	P20AC208C: Personality Development through Life Enlightenment Skills
P20DC203D: MOOCs	P20DC204D: MOOCs	P20AC208D: Disaster Management

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

Note: The students shall undergo mandatory Industrial training/ Internship for at least 6 to 8 weeks during summer vacation at Industry/R&D organization. Internship evaluation will be done during the III semester.

Additional Learning: Students are advised to do MOOCs to bridge the gap in the curriculum as suggested in the DAC. The credits will be provided in the grade sheet.

P20DC201: ADHOC NETWORKS AND ITS PROTOCOLS

Class: M.Tech. II – Semester **Specialization**: Digital Communications (DC)

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: concepts of wireless networks, its standards and MAC protocols
LO2: different routing protocols of Ad Hoc Wireless Networks
LO3: fundamentals of transport layer protocols and QoS issues in Ad Hoc Wireless Networks
LO4: energy management in Ad Hoc Wireless Networks

UNIT – I (9)

Wireless LAN Technologies: IEEE 802 architecture, IEEE 802.11 architecture and services, IEEE 802.11 medium access control, IEEE 802.11 physical layer, gigabit Wi-Fi, other IEEE 802.11 standards, IEEE 802.11I wireless LAN Security, applications of Ad Hoc wireless networks, issues in Ad Hoc WIRELESS NETWORKS

MAC Protocols for Ad Hoc Wireless Networks: Issues in designing, design goals of a MAC protocol, classifications of a MAC protocol, contention-based protocols, contention-based protocols with reservation mechanisms, scheduling mechanisms, and other MAC protocols

UNIT –II (9)

Routing Protocols for Ad Hoc Wireless Networks: Issues in designing, classifications of routing protocols, table-driven routing protocols, on-demand routing protocols, hybrid routing protocols, routing protocols with efficient flooding mechanisms, hierarchical routing protocols, power-aware routing protocols

Multicast Routing in Ad Hoc Wireless Networks: Issues in designing, operation of multicast routing protocols, an architecture reference model for multicast routing protocols, classifications of multicast routing protocols, tree-based multicast routing protocols, mesh-based multicast routing protocols

UNIT– III (9)

Transport Layer and Security Protocols for Ad Hoc Wireless Networks: Issues in designing,design goals of a transport layer protocol for Ad Hoc wireless networks, classification of transport layer solutions, TC power Ad Hoc wireless networks, and other transport layer protocols for Ad Hoc wireless networks, and security in Ad Hoc wireless networks

Quality of Service in Ad Hoc Wireless Networks: Issues and challenges in providing QoS in Ad Hoc wireless networks, classifications of QoS solutions, MAC Layer solutions, network layer solutions

UNIT - IV (9)

Energy Management in Ad Hoc Wireless Networks: Need for energy management in ad hoc wireless networks, classification of energy management schemes, battery management schemes, transmission power management schemes, system power management schemes

Text Book(s):

[1] C. Siva Ram Murthy, B. S. Manoj, *Ad Hoc Wireless Networks – Architectures and Protocols,* 6th ed.,New York:United States at Integrated Book Technology in Troy, 2008.

[2] Sarkar, Subir Kumar, TipturGangarajuBasavaraju, and C. Puttamadappa, *Ad hoc mobile wireless networks, principles, protocols and applications*, CRC Press, 2007.

Reference Book(s):

[1] Cory Beard,, William Stallings,*Wireless Communication Networks and Systems,* University of Missouri-Kansas City, 2015.

[2] Jyh-Cheng Chen, Tao Zhang, *IP-Based Next-Generation Wireless Networks Systems*, *Architectures, and Protocols*, 2nded., John Wiley & Sons, New Jersey, 2012.

Course Learning Outcomes (COs):

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

CO1: discuss wireless IEEE 802.11x standards, issues and elaborate different MAC protocols of Ad Hoc networks

CO2: classify and compare different routing protocols of Ad Hoc wireless networks

CO3: elaborate transport layer protocols & challenges of QoS in Ad Hoc wireless networks

CO4: examine energy management schemes of Ad Hoc wireless networks

Course Articulation Matrix (CAM): P20DC201: ADHOC NETWORKS AND ITS PROTOCOLS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC201.1	1	1	1	1	1
CO2	P20DC201.2	1	2	1	1	2
CO3	P20DC201.3	2	2	1	1	2
CO4	P20DC201.4	2	1	1	1	1
P20DC201		**1.5**	**1.5**	**1**	**1**	**1.5**

P20DC202: MACHINE LEARNING FOR COMMUNICATION SYSTEMS

Class: M.Tech. II – Semester **Specialization:** Digital Communications (DC)

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Exam	40

Course Learning Objectives (LOs):
This course will develop student's knowledge in/on
LO1: classification techniques used in machine learning
LO2: fundamentals and applications of neural networks
LO3: deep learning neural networks
LO4: machine learning algorithms for communication system applications

UNIT-I(9)

Introduction to learning and machine learning: Supervised, unsupervised and reinforcement learning, Regression Techniques. Introduction to mixture models and EM, K-means clustering, mixture of Gaussians - Maximum likelihood and EM for Gaussian mixtures, Support vector machines- SVM formulation with two variables - Lagrangian dual - L1 SVM with soft margin (linear Kernel) - L2 norm linear SVM - Non-linear SVM and Kernel trick - SVM formulation of non-linear Kernels with soft margin (L1 norm, and L2 norm) - Introduction to support vector regression - one class SVM

UNIT-II(9)

Neural networks: Feed-forward Network Functions, network training - local quadratic approximation - use of gradient information - gradient descent optimization; error back propagation - Bayesian neural networks Hessian matrix and diagonal approximation - Regularization in neural networks

UNIT-III(9)

Introduction to deep learning - Theoretical advantages of deep architectures - neural networks for deep architectures - deep generative architectures - convolution neural networks (CNN) - auto encoders - restricted boltzmann machines - variants of RBMs and auto encoders

UNIT-IV(9)

Applications in communication systems : Signal detection – channel encoding and decoding – channel estimation, prediction and compression – end – to – end communication – resource allocation

Text Book(s):

[1] Christopher Bishop, *Pattern Recognition and Machine Learning*, 1st ed., Springer, 2016.

[2] K. P. Soman, R. Loganathan, and V. Ajay, *Machine Learning with SVM and Kernel Methods*, 1st ed., PHI Learning Private Ltd., New Delhi: 2011.

[3] YoshuaBengio, *Learning Deep Architectures for AI,Foundations and Trends in Machine Learning*, 1st ed., Now Publishers Inc, 2009.

[4] https://www.comsoc.org/publications/best-readings/machine-learning-communications

ReferenceBook(s):

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

[2] AurélienGéron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed., Canada: O'Reilly Media, Inc.

Course Learning Outcomes:
After completion of this course, students will be able to….

CO1:elaborate various types of machine learning algorithms
CO2: classify different neural networks and develop applications
CO3: apply deep learning algorithms for communication systems
CO4: develop communication system modules using machine learning algorithms

Course Articulation Matrix (CAM): P20DC202: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC202.1	1	1	1	1	1
CO2	P20DC202.2	2	-	1	1	-
CO3	P20DC202.3	1	-	1	1	1
CO4	P20DC202.4	2	1	1	1	1
P20DC202		**1.5**	**1**	**1**	**1**	**1**

P20DC203A: FPGA BASED WIRELESS COMMUNICATION SYSTEMS

Class: M.Tech. II – Semester **Specialization**: Digital Communications (DC)

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's and their use in wireless communication engineering

LO2: nonlinear convolution implemented using FPGAs

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] 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,

Reference Book(s):

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

[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: elaborate the use of FPGA's in digital signal processing and in wireless communication

CO2: discuss implementation of non-linear convolution using FPGA

CO3: interpret advanced FPGA-based Fast Linear Convolution & applications in wireless communication

CO4: analyze FPGA based DSP system design verification at different stages

Course Articulation Matrix (CAM): P20DC203A: FPGA BASED WIRELESS COMMUNICATION SYSTEMS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC203A.1	2	2	2	1	1
CO2	P20DC203A.2	2	2	2	1	2
CO3	P20DC203A.3	2	2	2	2	1
CO4	P20DC203A.4	2	2	2	2	1
P20DC203A		**2**	**2**	**2**	**1.5**	**1.25**

P20DC203B: ADVANCED EMBEDDED SYSTEM

Class:M.Tech. II – Semester **Specialization**: Digital Communications (DC)

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: fundamentals of embedded systems, hardware &software co-design and firmware design approaches
LO2: architectural features of ARM CORTEX M3
LO3: instruction set of ARM CORTEX M3
LO4: ARM CORTEX M3 programming using the various instructions

UNIT – I (9)

Introduction: Embedded System: embedded vs general computing system, classification, application and purpose of ES. Core of an embedded system, memory, characteristics and quality attributes of embedded systems. Design and development environment-hardware software co-design, embedded firmware design approaches, computational models, embedded firmware development languages, integration and testing of embedded hardware and firmware, components in embedded system development environment (IDE), files generated during compilation, simulators, emulators and debugging

UNIT –II (9)

ARM-32-bit Microcontroller: Thumb-2 technology and applications of ARM, architecture of ARM Cortex M3, various units in the architecture, general purpose registers, special registers, exceptions, interrupts, stack operation, reset sequence

UNIT– III (9)

Instruction Sets: Assembly basics, instruction list and description, useful instructions, memory systems, memory maps, Cortex M3 implementation overview, pipeline and bus interface**.** Exceptions, nested vector interrupt controller design, cystic timer, cortex-m3 programming using assembly and C language, CMSIS. SMS based patient monitoring system, application of mobile embedded systems for home care applications

UNIT - IV (9)

Advanced Embedded devices: Introduction to Raspberry Pi, Interfaces: Programing Raspberry Pi with Python, interfacing with various sensors and other devices. Introduction to STM32 ARM Cortex M4, controlling LED, programing and debugging using Keil μ Vision

Text Book(s):

[1] K. V. Shibu, *Introduction to embedded systems*, TMH education Pvt. Ltd. 2009.
[2] JosephYiu, *The Definitive Guide to the ARM Cortex-M3*, 2nded.,Newness, (Elsevier),2010.

Reference Book(s):

[1] James K. Peckol, *Embedded systems- A contemporary design tool*, John Wiley, 2008.

Course Learning Outcomes (COs):

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

CO1: identify basic characteristics &attributes of embedded system and examine the hardware, software co-design & firmware design approaches

CO2: discuss architectural features of ARM CORTEX M3 including memory map, interrupts & exceptions

CO3: elaborate ARM CORTEX M3 instruction set and develop various applications

CO4: develop various real time applications with STM32 ARM Cortex M4 using Keil μ Vision

Course Articulation Matrix (CAM): P20DC203B: Advanced Embedded System

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC203B.1	1	1	-	1	-
CO2	P20DC203B.2	1	1	-	1	-
CO3	P20DC203B.3	1	1	-	1	-
CO4	P20DC203B.4	1	1	-	1	-
P20DC203B		**1**	**1**	**-**	**1**	-

P20DC203C: FIBER OPTIC COMMUNICATION AND NETWORKS

Class:M.Tech. II-Semester **Specialization**: Digital Communications (DC)

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 on /in…

LO1: optical fiber modes& transmission characteristics, optical sources and receivers
LO2: WDM concepts and components, digital & analog
LO3: various optical networks and their applications
LO4: optical fiber network measurements and monitoring coupling techniques

UNIT–I (9)

Optical Fibers: Structures, wave guiding and fabrication: nature of light, basic optical laws and definitions, single mode fibers, graded index fiber structure, attenuation, signal dispersion in fibers; optical sources- LEDs, laser diodes, line coding. photo detector noise, detector response time, avalanche multiplication noise. optical receiver operation-fundamental receiver operation, digital receiver performance, eye diagrams

UNIT–II (9)

WDM Concepts and Components: Passive optical couplers, isolators and circulators, digital links: point to point links, power penalties, error control, coherent detection, differential quadrature phase shift keying. analog links: carrier to noise ratio, multichannel transmission techniques, rf over fiber, radio over fiber links, microwave photonics

UNIT–III (9)

Optical Networks: Network concepts, network topologies, synchronous optical networking (SONET)/synchronous digital hierarchy(SDH), high speed light wave links, optical add/ drop multiplexing, optical switching, wavelength division multiplexing(WDM) network, passive optical networks, ip over dense wavelength division multiplexing (DWDM), optical ethernet, mitigation of transmission impairments

UNIT–IV (9)

Performance Measurement and Monitoring: Measurement standards, basic test equipment, optical power measurement, optical fiber characterization, eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements

Text Book(s):

[1] Gerd Keiser, "Optical Fiber Communications", 5th ed., McGraw Hill.

[2]Rajeev Ramaswamy and Kumar N Sivarajan, "*Optical Networks: A Practical Perspective*", 2nd ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

[3] John. M. Senior, "Optical Fiber Communications: Principles and Practice", 2nd ed., 2000, PE.

Reference Book(s):

[1] HaroldKolimbris, *Fiber Optic Communication*, 2nd ed., *2004, PEI.*

[2] UylessBlack, *Optical Networks: Third Generation Transport Systems*, 2nd ed., *2009, PEI.*

[3] Govind Agarwal, *Optical Fiber Communications*, 2nd ed., *2004, TMH.*

[4] S. C. Gupta, *Optical Fiber Communications and its Applications*, *2004, PHI.*

Course Learning Outcomes (COs):

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

CO1: *discuss optical fiber modes& transmission characteristics, optical sources and receivers*
CO2: *categorise digital and analog links*
CO3: *distinguish various optical networks such as SONET, SDH,WDM, DWDM*
CO4: *analyse performance of optical fiber networks and elaborate monitoring techniques*

Course Articulation Matrix (CAM): P20DC203C: FIBER OPTIC COMMUNICATION AND NETWORKS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC203C.1	-	-	1	1	1
CO2	P20DC203C.2	-	-	1	1	1
CO3	P20DC203C.3	2	2	2	1	1
CO4	P20DC203C.4	**1**	**1**	**2**	**1**	**1**
P20DC203C		**0.75**	**0.75**	**1.5**	**1**	**1**

P20DC204A: MULTI RATE DSP FOR COMMUNICATION

Class: M.Tech. II – Semester **Specialization:** Digital Communications (DC)

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 on /in…

LO1: fundamentals of multi-rate signal processing
LO2: filter-bank analysis in communications
LO3: filter-bank representation of OFDM
LO4: DMT systems

UNIT-I (9)

Fundamentals of Multirate signal processing: Multirate building blocks-transform domain formulas, multirate identities, blocking and upblocking; decimation filters, interpolation filters-time domain view of interpolation filter, nyquist(m) property, polyphase decomposition

UNIT-II(9)

Multirate formulation for communication system: Filter bank transceivers, analysis of filter bank transceivers, pseudo circular and circulant matrices, redundancyfor IBI elimination

UNIT-III (9)

DFT based transceivers: OFDM systems, zero padded OFDM, single carrier with cyclic prefix, single carrier with zero padding, filter bank representation of OFDM systems, DMT systems, channel estimation and carrier frequency synchronization

UNIT-IV (9)

DMT systems with improved frequency characteristics: Sidelobes, overall transfer matrix, transmitters with subfilters, design of transmit subfilters, design of receiver sub filter, zero padded transceivers

Text Books:

[1] Lin, Yuan-Pei, See-May Phoong, and P. P. Vaidyanathan, *Filter bank transceivers for OFDM and DMT systems*, Cambridge University Press, 2010.
[2] P. P. Vaidyanathan. *Multirate systems and filter banks*, Pearson Education India, 2006.

Reference Books:

[1] Chiueh, Tzi-Dar, and Pei-Yun Tsai. *OFDM baseband receiver design for wireless communications*, John Wiley & Sons, 2008.

[2] Crochiere, Ronald E, and Lawrence R. Rabiner, *Multirate digital signal processing*,New Jersey: Prentice-Hall, Inc. Englewood Cliffs, 1983.

[3] C. Sidney Burrus et al., *Computer-Based Exercises for Signal Processing using MATLAB*, New Delhi: Prentice-Hall, 1994.

Course Learning Outcomes (COs):

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

CO1: discuss the fundamentals of multirate signal processing

CO2: analyse the filter banks in communications

CO3: utilize the filter banks for representation of OFDM

CO4: design of sub filters in DMT systems

Course Articulation Matrix (CAM): P20DC204A: MULTI RATE DSP FOR COMMUNICATION						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC204A.1	1	1	-	2	2
CO2	P20DC204A.2	1	2	1	2	2
CO3	P20DC204A.3	2	2	2	2	2
CO4	P20DC204A.4	2	2	2	2	2
P20DC204A		**1.5**	**1.75**	**1.25**	**2**	**2**

P20DC204B: RF CIRCUITS

Class: M.Tech. II – Semester **Specialization:** Digital Communications (DC)

Teaching Scheme:

L	T	P	C
3	–	–	3

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

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

LO1: design consideration of RF components and impedance matching networks
LO2: measurement of noise temperature in microwave circuits
LO3: basics of RF passive components and circuits
LO4: design of RF active circuits for given specifications

UNIT – I (9)

Fundamentals: Introduction, radio frequency and microwave circuit applications, radio frequency waves, rf and microwave circuit design considerations, introduction to component basics, microstrip line, formulation and properties of s-parameters, signal flow graphs, smith chart concepts, types

Impedance Matching networks: Goal of impedance matching, components for matching, design of matching networks - matching network design using lumped elements- RC, RL, RLC circuits, design of matching networks using distributed elements- transmission lines, microstrip lines, stubs

UNIT – II (9)

Noise in Microwave Circuits: Noise in microwave circuits: dynamic range and sources of noise power and equivalent noise temperature, measurement of noise temperature, noise figure, noise figure of a cascaded system, noise figure of a passive two-port network, noise figure of a mismatched lossy line dynamic range and intermodulation distortion, gain compression intermodulation distortion third-order intercept point, intercept point of a cascaded system

UNIT – III (9)

RF Passive Circuits: Introduction, Couplers and power dividers - basic properties, types, power combining efficiency, wilkinson power divider- equal and unequal types, 90° hybrids, branch line couplers, n-way combiners, corporate structures, spatial combining, phase shifters – types, transmission line type, reflection types phase shifters. RF Resonators- basic resonator types, transmission line resonators, resonant waveguide cavities, excitation of resonators

RF Filters: Basic filter configurations, special filter realizations, filter implementation, coupled filter

UNIT – IV (9)

Active RF Components: Introduction, design of amplifiers, phase shifters, switches, mixers and oscillators. implementation in monolithic integrated circuit(MIC), monolithic microwave integrated circuit(MMIC) and RF integrated circuits(RFIC)

Text Book(s):

[1] Mathew M. Radmanesh, *Radio Frequency and Microwave Electronics*, Pearson Education Asia, 2001.
[2] David M. Pozar, *Microwave Engineering*, 2nd ed., John Wiley 1998, ISBN 0-471-17096-8.

Reference Book(s):

[1] Peter A. Rizzi, *Microwave Engineering – Passive Circuits*, PHI, ISBN 81-203-1461-1
[2] Chang K, Bahl I and Nair V, *RF and Microwave Circuit and Component Design for Wireless Systems*, Wiley Inter science. 2002.
[3]Inder J Bahl, *Fundamentals of RF and Microwave Transistor Amplifiers*, John Wiley & Sons Inc, 2009.

Course Learning Outcomes:
After completion of this course, students will be able to….

CO1: discuss the design considerations for RF active circuits
CO2: measure noise temperature in Microwave circuits
CO3: design of RF passive components and circuits
CO4: design different RF circuits and elaborate implementation of MIC, MMIC &RFIC

Course Articulation Matrix (CAM): P20DC204B: RF CIRCUITS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC204B.1	1	-	1	-	1
CO2	P20DC204B.2	1	-	1	1	2
CO3	P20DC204B.3	1	-	2	2	1
CO4	P20DC204B.4	1	1	2	1	2
P20DC204B		**1**	**1.5**	**1.5**	**1**	**1.5**

P20DC204C: IMAGE AND VIDEO PROCESSING

Class:M.Tech.II – Semester **Specialization:** Digital Communications(DC)

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 on /in…

LO1: image processing system and the concepts of image transforms for intended applications

LO2: image filtering techniques for enhancement, de-noising and restoration applications

LO3: representation of digital video in spatial domain& video segmentation and tracking

LO4: various video filtering & video compression standards

UNIT–I (9)

Fundamentals of Image processing and Image Transforms: Introduction, basic steps of image processing system, sampling and quantization of an image, basic relationship between pixels. 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 denoising- image and noise models, local adaptive filtering, image restoration-blur models

UNIT – III (9)

Video Processing: Introduction, human visual system and color, analog video, digital video, 3D video, digital-video applications

Video Segmentation and Tracking: Introduction**,** image segmentation- thresholding, clustering (K-means and FCM), content selected from reputed international journals, bayesian methods, graph-based methods, active-contour models; motion segmentation-region-based motion segmentation: fusion of color and motion, simultaneous motion estimation and segmentation; motion tracking-graph-based spatial-temporal segmentation and tracking, mean-shift tracking, active-contour tracking, content selected from research papers of international journals

UNIT – IV (9)

Video Filtering: Theory of spatial-temporal filtering, video-format conversion, multi-frame noise filtering, multi-frame restoration

Video Compression: Video-compression approaches, early video-compression standards, MPEG-4 AVC/ITU-T H.264 standard, high-efficiency video-coding (HEVC) Standard, Scalable-video compression

Text Book(s):

[1] R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 2nd ed., New Delhi: PHI, 2004.

[2] A Murat Tekalp, *Digital Video Processing*,2nd ed., New Delhi: PHI, 2015.

Reference Book(s):

[1] R. C. Gonzalez and R. E. Woods, *Digital Image Processing using MATLAB*, 2nd ed., New Delhi: McGraw Hill Education, 2010.

[2] Z. Li and M.S. Drew, *Fundamentals of Multimedia*, 1st ed., New Delhi: Pearson Education (Asia) Pvt. Ltd.,2004

[3] 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 apply image transform techniques for the intended application

CO2: apply image processing filtering techniques for enhancement, de-noising & restoration applications

CO3: classify video signals and analyze video segmentation & tracking algorithms

CO4: analyze video filtering operations and compare video compression standards

Course Articulation Matrix (CAM): P20DC204C: IMAGE AND VIDEO PROCESSING						
CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC204C.1	2	1	1	2	2
CO2	P20DC204C.2	2	1	1	2	2
CO3	P20DC204C.3	2	1	1	2	2
CO4	P20DC204C.4	2	1	1	2	2
P20DC204C		**2**	**1.75**	**1.75**	**2**	**2**

P20DC205: WIRELESS COMMUNICATION NETWORKS LAB

Class: M.Tech. II – Semester **Specialization**: Digital Communications(DC)

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

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

LO1: Ad Hoc on-demand routing protocols &Hybrid routing protocols
LO2: Optimized Link State Routing (OLSR)and ALOHA& CSMA/CA protocols
LO3: real time applications of wireless networks
LO4: real-time IoT data using statistical models, IoT data using Machine learning algorithms

List of experiments:

1. On demand routing protocols
   – Dynamic Source Routing Protocol (DSR)
   - Ad Hoc On-Demand Distance-vector Routing Protocol (AODV)
2. Hybrid routing protocols
   – Zone Routing Protocol (ZRP)
3. Routing protocols with efficient flooding mechanism
   – Optimized Link State Routing (OLSR)
4. WLAN protocols
   - Additive Links On-line Hawaii Area (ALOHA)
5. WLAN protocols
   – Carrier-Sense Multiple Access (CSMA), CSMA/Collision Avoidance(CA) (802.11DCF)
6. Study of real time applications of wireless networks
7. Study of real-time IoT data estimation using statistical models
8. Study of IoT data assessment using Machine learning algorithms

Text Book(s):

[1] Lab manual prepared by dept. of ECE
[2] C. Siva Ram Murthy, B. S. Manoj, *Ad Hoc Wireless Networks – Architectures and Protocols,* 6th ed.,New York:United States at Integrated Book Technology in Troy, 2008.

Reference Book(s):

[1] Cory Beard, *Wireless Communication Networks and Systems,* William Stallings, University of Missouri-Kansas City, 2015.

[2] Jyh-Cheng Chen, Tao Zhang - *IP-Based Next-Generation Wireless Networks Systems*, *Architectures, and Protocols*, 2nded., New Jersey:John Wiley & Sons, 2012.

Course Learning Outcomes (COs):

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

CO1: discuss on-demand routing & hybrid routing protocols

CO2: analyze Optimized Link State Routing (OLSR), ALOHA& CSMA/CA protocols

CO3: develop real time applications of wireless networks

CO4: estimate real-time IoT data using statistical models &Machine learning algorithms

Course Articulation Matrix (CAM): P20DC205: WIRELESS COMMUNICATION NETWORKS LAB

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC205.1	2	1	1	2	2
CO2	P20DC205.2	2	1	1	2	2
CO3	P20DC205.3	2	1	1	2	2
CO4	P20DC205.4	2	1	1	2	2
P20DC205		**2**	**1.75**	**1.75**	**2**	**2**

P20DC206: MACHINE LEARNING LAB

Class: M. Tech II-Semester **Specialization**: Digital Communications (DC)

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on

LO1: linear & circular convolution, first order & second order systems, DFT, IDFT, FFT, FIR & IIR Filters implementation using python

LO2: channel encoder & decoder, channel estimation, channel estimation & signal detection in OFDM Systems with deep learning

LO3: real-time wireless communication applications implementation using Deep Learning

LO4: real-time communication applications implementation using Machine learning

List of programs

1. Generation of Basic signals with Python
2. Computation of Linear and Circular convolution with Python.
3. Frequency Response of a First order and Second Order System with Python
4. Computation of DFT, IDFT add FFT with Python
5. Design FIR and IIR filter to reject unwanted frequencies with python
6. Study of Analog Modulation techniques with python
7. Study of PCM, DPCM, DM with python
8. Implement channel encoder and decoder with Deep learning
9. Study of channel estimation using Deep Learning techniques
10. Implement channel estimation & signal detection in OFDM systems using Deep Learning algorithms
11. Study of real-time wireless communication applications using Deep Learning
12. Study of real-time communication applications using Machine learning

Books:

[1] Manual prepared by dept. of ECE.

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

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

[4] AurélienGéron, *Hands-On Machine Learning with Scikit-Learn*, *Keras, and TensorFlow*, 2nd ed., Canada: O'Reilly Media, Inc, 2019.

https://www.gaussianwaves.com/2020/02/how-to-design-a-simple-fir-filter-to-reject-unwanted-frequencies/
https://towardsdatascience.com/fast-fourier-transform-937926e591cb
http://cs230.stanford.edu/files_winter_2018/projects/6863790.pdf
https://reality.ai/ffts-and-stupid-deep-learning-tricks/
http://ataspinar.com/2018/04/04/machine-learning-with-signal-processing-techniques/
https://towardsdatascience.com/speech-recognition-in-python-the-complete-beginners-guide-de1dd7f00726.
https://scipy-lectures.org/intro/scipy/auto_examples/plot_spectrogram.html
https://medium.com/@nabanita.sarkar/simulating-amplitude-modulation-using-python-6ed03eb4e712
https://github.com/IIT-Lab/Paper-with-Code-of-Wireless-communication-Based-on-DL/blob/master/English%20version.md

Course Learning Outcomes:

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

CO1:apply python fundamentals and design linear & circular convolution, first order & second order systems, DFT, IDFT, FFT, FIR & IIR filters

CO2: test the performance of channel encoder & decoder, channel estimation, channel estimation & signal detection in OFDM Systems with deep learning

CO3: design wireless communication applications using Deep Learning

CO4: develop real-time communication applications using Machine learning

Course Articulation Matrix (CAM): P20DC206: MACHINE LEARNING LAB						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC206.1	2	-	1	-	-
CO2	P20DC206.2	2	-	1	-	-
CO3	P20DC206.3	2	-	1	-	1
CO4	P20DC206.4	2	1	1	-	1
P20DC206		**1.5**	**1**	**1**	-	**1**

P20DC207: MINI PROJECT WITH SEMINAR

Class:M.Tech.II - Semester **Specialization**: Digital Communications (DC)

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	100 marks
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) forseminar
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 thedepartment

(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): P20DC207: MINI PROJECT WITH SEMINAR

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20DC207.1**	2	-	2	2	2
CO2	**P20DC207.2**	2	-	2	2	2
CO3	**P20DC207.3**	-	2	-	1	1
CO4	**P20DC207.4**	-	2	-	1	1
P20DC207		**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&CSP

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 student's 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 YogabhyasiMandal.

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

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 &CSP

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 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,:2nded., 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 & CSP

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 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.

[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 & CSP

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: 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.

[2] N. G. Dhawan, A. S. Khan, *Disaster Management and Preparedness*, 1st ed., New Delhi: CBS Publication, 2014.

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. (DIGITAL COMMUNICATIONS)

SEMESTER-III

S. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PE	P20DC301	Professional Elective-5/ MOOC-5	3	-	-	3	8	8	8	6	10	20	60	40	100
2	OE	P20OE302	Open Elective/ MOOC-6	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PROJ	P20DC303	Dissertation Phase – I/Industrial Project (*to be continued in IV – Semester also as Dissertation Phase – II*)	-	-	18	9	-	-	-	-	-	-	100	-	100
4	PROJ	P20DC304	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- 5	Open Elective/ MOOC-6
P20DC301A: IoT and Communication Protocols	P20OE302A: Business Analytics
P20DC301B: Optimization techniques for Wireless Communications	P20OE302B: Industrial Safety
P20DC301C: VLSI Signal Processing	P20OE302C: Operations Research
P20DC301D: 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 in the DAC. The credits will be provided in the grade sheet.

P20DC301A: IOTAND COMMUNICATION PROTOCOLS

Class: M.Tech. III – Semester **Specialization**: Digital Communications (DC)

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: IoT reference architecture and IoT solutions & Security
LO2: various protocols of IoT & cloud platforms
LO3: ZigBee based IoT protocol and communication range
LO4: LoRa enabled IoT technology and coverage distance

UNIT – I (9)

Fundamentals of IoT: Introduction to Internet of Things (IoT), architecture, overview of IoT components, IoT platform and design methodology. IoT reference architecture-functional view, information view, deployment and operational view, other relevant architectural views, sensors, transducers, classification, roles of sensors in IoT, various types of sensors. Parameters of radio transmission- received signal strength indicator (RSSI), link quality, line of sight (LOS), non-line of sight (NLOS), transmission rate, response time, and received packet ratio

UNIT –II (9)

Network Protocols and Cloud Computing: Wi-Fi, Wi-Fi direct, ZigBee, Z wave, Bacnet, BLE, LoRa LPWAN, Modbus, SPI, I2C. 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)

Wireless Standard: ZigBee Protocol: Architecture, types ZigBee chips. Introduction to ZigBee-Pro Series 2 module, block diagram, pinout, and specification. ZigBee X-CTU software tool- introduction, configuration of ZigBee-pro series 2 modules in AT and API mode. Case study- perform coverage range test with ZigBee-Pro Series 2 devices in indoor (NLOS) and outdoor (LOS) environments

UNIT - IV (9)

Wireless Standard: LoRa protocol: Architecture, protocol stack. Introduction to Semtech SX1272 LoRa Chip, Block diagram, Pin configuration, and Specifications. visual studio code software tool-installation, Python programming, configuration of LoRa devices. Case study-

conduct coverage range test using SX1272 LoRa modules in indoor (NLOS) and outdoor (LOS) environments

Text Book(s):

[1] A. Bahga and V. Madisetti, *Internet of Things, A Hands-on Approach*, 1st ed., Atlanta: Universities Press, 2015.

[2] T. Erl, Z. Mahmood, and R. Puttini, *Cloud Computing Concepts, Technology &Architecture*, 1st ed., New Jersey: Prentice Hall, 2013.

Reference Book(s):

[1] C. Hakima, *The Internet of Things Connecting Objects to the Web*, USA: Willy Publications, 2010.

[2] O. Hersent, D. Boswarthick, O. Elloumi, *The Internet of Things: Key Applications and Protocols*, 2nd ed., UK: Willy Publications, 2012.

[3] A. Cama-Pinto, G. Pineres-Espitia, J. Caicedo-Ortiz, E. Ramírez-Cerpa, L. Betancur-Agudelo, and F. Gómez-Mula,*Received strength signal intensity performance analysis in wireless sensor network using Arduino platform and XBee wireless modules*. International Journal of Distributed Sensor Networks, 13(7), 1550147717722691, 2014.

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

[5] E. Sisinni, P. Ferrari, D.F. Carvalho, S. Rinaldi, P. Marco, A. Flammini, and A. Depari,*LoRaWAN range extender for Industrial IoT*. IEEE Transactions on Industrial Informatics, 16(8), 5607-5616, 2020.

Course Learning Outcomes (COs):

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

CO1: explain IOT architecture & design methodologies

CO2: analyze various IoT protocols and develop API on cloud platform

CO3: evaluate ZigBee protocol range to develop efficient IoT prototype

CO4: design and build LoRa testbed to test communication range in different environments

Course Articulation Matrix (CAM): P20DC301A: IoT and Communication Protocols						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC301A.1	1	1	-	-	-
CO2	P20DC301A.2	1	1	-	1	1
CO3	P20DC301A.3	2	1	-	1	1
CO4	P20DC301A.4	2	1	-	1	1
P20DC301A		**1.5**	**1**	**-**	**1**	**1**

P20DC301B: OPTIMIZATION TECHNIQUES FOR WIRELESS COMMUNICATIONS

Class: M.Tech. – III Semester

Specialization: Digital Communications (DC)

TeachingScheme:

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 on /in…

LO1: *convex sets, affine sets, norm ball, norm cone, norm balls and its applications*

LO2: *convex & concave functions and its properties*

LO3: *practical applications like beam forming, maximum ratio combining & least squares*

LO4: *duality, KKT conditions & its application and optimal MIMO power allocation*

UNIT–I (9)

Convex sets and applications: Introduction to convex sets and properties. Affine sets examples and application. Norm ball and its practical applications, Ellipsoid and its practical applications. Norm cone, polyhedron and its applications – cooperative cellular transmission. Introduction to affine functions. Norm balls, properties of norms

UNIT–II (9)

Convex functions and applications: Introduction to convex and concave functions. Properties of convex functions. Test for convexity – positive semi definite Hessian matrix, application – MIMO receiver design as a least squares problem. Jensens inequality, properties of convex functions, conjugate function, operations preserving convexity

UNIT–III (9)

Practical applications: Beam forming in multi antenna wireless communication, Maximal ratio combiner for wireless systems, multi-antenna beam forming with interfering user, zero-forcing beam forming with interfering user, robust beam forming with channel uncertainty for wireless systems. Linear modeling and approximation problems: least squares. Geometric intuition for least squares, application – multi antenna channel estimation

UNIT–IV (9)

Duality and KKT conditions: concept of duality, relation between optimal value of primal and dual problems. Concepts of duality gap and strong duality. Karush-Kuhn-Tucker (KKT) conditions, application – optimal MIMO power allocation

Text Book(s):

[1] Boyd, Stephen, Stephen P. Boyd, and Lieven Vandenberghe. *Convex optimization*. Cambridge university press, 2004.
[2] Tse, David, and Pramod Viswanath. *Fundamentals of wireless communication*. Cambridge university press, 2005.

Reference Book(s):

[1]Goldsmith, Andrea. *Wireless communications*. Cambridge university press, 2005.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…
CO1: *discuss convex, norm ball, ellipsoid and & practical applications*
CO2: *elaborate convex functions & test for convexity*
CO3: *analyze practical applications like beam forming & maximum ratio combining in MIMO systems*
CO4: *apply KKT conditions for optimal MIMO power allocation problem*

Course Articulation Matrix (CAM): P20DC301B: OPTIMIZATION TECHNIQUES FOR WIRELESS COMMUNICATIONS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DC301B.1	1	1	1	1	1
CO2	P20DC301B.2	1	1	1	1	1
CO3	P20DC301B.3	2	2	2	2	2
CO4	P20DC301B.4	2	2	2	2	2
P20DC301B		**1.5**	**1.5**	**1.5**	**1.5**	**1.5**

P20DC301C: VLSI SIGNAL PROCESSING

Class: M.Tech. III – Semester **Specialization**: Digital Communications (DC)

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: fundamentals of DSP systems, VLSI signal processing and it's applications
LO2: unfolding and folding in multirate systems
LO3: systolic architecture design and space representations containing delays
LO4: algorithms for fast convolution and 3D discrete wavelet transform

UNIT – I (9)

Introduction to DSP Systems: Introduction; representation of dsp algorithms: block diagram, signal flow graph, data flow graph, dependence graph. **Iteration Bound**: Data flow graph representations, loop bound and iteration bound, longest path matrix algorithm, iteration bound of multirate data flow graphs; **Pipelining and Parallel Processing:** Introduction, pipelining of fir digital filters, parallel processing. pipelining and parallel processing for low power

UNIT –II (9)

Retiming: Introduction, definition and properties, solving system of inequalities, retiming techniques.**Unfolding:** Introduction an algorithms for unfolding, properties of unfolding, critical path, unfolding and retiming application of unfolding. **Folding:** Introduction to folding transformation, register minimization techniques, register minimization in folded architectures, folding in multirate systems

UNIT– III (9)

Systolic Architecture Design: Introduction, systolic array design methodology, FIR systolic arrays, selection of scheduling vector, matrix multiplication and 2D systolic array design, systolic design for space representations containing delays

UNIT - IV (9)

Fast Convolution: Introduction, Cook -toom Algorithm, modified Cook-toom algorithm, Winograd Algorithm, iterated convolution, cyclic convolution, design of fast convolution algorithm by inspection. Efficient VLSI architectures of lifting based 3D discrete wavelet transform; overview of recent advances in VLSI signal processing

Text Book(s):

[1] Keshab K. Parhi, *VLSI Digital Signal Processing Systems:Design and Implementation*, 1st ed., United States: Wiley-Inter Sciences, 1999.

[2] Mohammed Ismail, Terri, Fiez, *Analog VLSI Signal and Information Processing,* 1st ed.,Singapore: McGraw Hill, 1994.

Reference Book(s):

[1] Kung. S.Y., H.J. While house, T.Kailath, *VLSI and Modern signal processing*,1st ed.,Englewood Cliffs, N. J.: Prentice-Hall, cop. 1985.

[2] Jose E. France, Yannis Tsividls, *Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing*, 2nd ed., United States: Pearson Education, 1994.

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

CO1: solve systems inequalities using the fundamentals of VLSI signal processing
CO2: analyze unfolding & folding algorithms in multirate systems
CO3: design systolic architecture & space representations with delays
CO4: inspect fast convolution algorithms and discuss recent advances in VLSI Signal Processing

Course Articulation Matrix (CAM): P20DC301C: VLSI SIGNAL PROCESSING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DC301C.1	1	1	1	2	2
CO2	P20DC301C.2	1	1	1	2	2
CO3	P20DC301C.3	1	1	1	2	2
CO4	P20DC301C.4	1	1	1	2	2
P20DC301C		**1**	**1**	**1**	**2**	**2**

P20OE302A: BUSINESS ANALYTICS

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

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.

[2] Bhimasankam Pochiraju, Sridhar S, *Essentials of Business Analytics: A Textbook*,1st ed., Springer Nature Switzerland, 2019.

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 & CSP

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: 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.

[2] Amit Gupta., "Industrial Safety and environment" Laxmi Publications (P) LTD., New Delhi., 2006.

Reference Book(s):

[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 &CSP

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: 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-tuckermethod

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 ed., 2013.

[2] S.S. Rao,*Optimization Techniques,* New Age International, New Delhi, 3rd ed., 2013.

Reference Book(s):

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

[2] N.D Vohra, *Quantitative Techniques in Management*, 3rd ed., 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 &CSP

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 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.

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

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 &CSP

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: 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.

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 &CSP

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 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.

[2] Sunil Pandey, *Industrial and Urban Waste Management in India*, New Delhi : TERI Press, 2015.

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 &CSP

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

Textbook(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**		

P20DC303: DISSERTATION PHASE-I /INDUSTRIAL PROJECT

Class: M.Tech.III - Semester

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

Teaching Scheme:

L	T	P	C
-	-	18	9

Examination Scheme:

Continuous Internal Evaluation	100 marks
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 techinical knowledge

LO4: 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 voceto 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): P20DC303: DISSERTATION PHASE-I /INDUSTRIAL PROJECT

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20DC303.1**	2	-	2	2	2
CO2	**P20DC303.2**	2	-	2	2	2
CO3	**P20DC303.3**	-	2	-	1	1
CO4	**P20DC303.4**	-	2	-	1	1
P20DC303		**2**	**2**	**2**	**1.5**	**1.5**

P20DC304: INTERNSHIP EVALUATION

Class: M.Tech. III - Semester

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

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

(i) 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

(ii) 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

(iii) (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): P20DC304: INTERNSHIP EVALUATION

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20DC304.1**	2	-	2	2	2
CO2	**P20DC304.2**	2	-	2	2	2
CO3	**P20DC304.3**	-	2	-	1	1
CO4	**P20DC304.4**	-	2	-	1	1
P20DC304		**2**	**2**	**2**	**1.5**	**1.5**

SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME

M.TECH. (DIGITAL COMMUNICATIONS)

SEMESTER-IV

S. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
				L	T	P		I²RE				Minor	MSE	Total		
								ATLP	CRP	CP	PPT					
1	PROJ	P20DC401	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**

P20DC401: DISSERTATION PHASE-II

Class:M.Tech.IV - Semester

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

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 /6thweek 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 andviva-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): P20DC401DISSERTATION PHASE-II

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20DC401.1**	2	-	2	2	2
CO2	**P20DC401.2**	2	-	2	2	2
CO3	**P20DC401.3**	-	2	-	1	1
CO4	**P20DC401.4**	-	2	-	1	1
P20DC401		**2**	**2**	**2**	**1.5**	**1.5**