Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad, Pin- 402103, Maharashtra

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Course Structure and Detailed Syllabus

For

M. Tech. Programme in Electronics & Telecommunication Engineering

In line with New Education Policy 2020 guidelines

(Effective from Academic Year 2023-24 for main campus)

Dr. Babasaheb Ambedkar Technological University
M. Tech Electronics & Telecommunication Engineering
In line with New Education Policy 2020 guidelines
(Effective from AY 2023-24 for main campus)

	Course Code	Course Title	L	T	P	Cr	Categorisation
SEM- I	12372PC101	Signal Theory	3	1	-	4	PCC
	12372PC103	Radiation and Microwave Techniques	3	1	-	4	PCC
	12372PE101	Program Elective-I	3	1	-	4	PEC
	12372PE103	Program Elective-II	3	1	-	4	PEC
	12372PC105L	PG Lab-I	-	-	4	2	PCC
	12372SE101	Seminar I	-	-	4	2	ELC
	12372AU101	YOGA for Stress Management	-	-	2	-	Audit Course
		Total	**12**	**4**	**10**	**20**	
SEM- II	12372PC102	Estimation and Detection Theory	3	1	-	4	PCC
	12372PC104	Information Theory and Coding	3	1	-	4	PCC
	12372PE102	Program Elective-III	3	1	-	4	PEC
	12372OE102	Open Elective I	3	-	-	3	OE
	12372PC106L	PG Lab-II	-	-	4	2	PCC
	12372MP102	Mini-Project	-	-	4	2	ELC
	12372AE102	IKS Bucket[#]	3	-	-	3	AEC/VEC/IKS
	12372AU102	Disaster Management	-	-	2	-	Audit Course
		Total	**15**	**3**	**10**	**22**	
SEM- III	12372OE201	Open Elective II	3	-	-	3	OE
	12372MD201	Multidisciplinary Minor	3	-	-	3	MD M
	12372SE201	Seminar II	-	-	4	2	ELC
	12372PR201	Project I	-	-	-	10	ELC
		Total	**6**	**2**	**4**	**18**	
SEM-IV	12372PR202	Project II	-	-	-	20	ELC
		Total				**20**	

Note:
1. Students can complete 40% of the courses from SWAYAM /NPTEL/Coursera/ from Institutes with MoU signed by university.
2. Existing passing rules will be applicable.

Credit Distribution				
SEM I	**SEM II**	**SEM III**	**SEM IV**	**Total**
20	**22**	**18**	**20**	**80**

Abbreviations: PCC (Programme Core Course), PEC (Programme Elective Course), ELC (Experiential Learning Courses), OE (Open Elective), AEC (Ability Enhancement Courses), VEC (Value Education Courses), IKS (Indian Knowledge System), MD M (Multidisciplinary Minor).

	Program Elective -I
A)	Artificial Neural Networks and Applications
B)	Electromagnetic Interference and Compatibility
C)	Mobile Communication
D)	Signal Processing Algorithms & Applications
E)	Analog and Mixed Signal Processing

	Program Elective -II
A)	RF and Millimeter Wave circuit Design
B)	System On-Chip
C)	Optical Fiber Communication
D)	Statistical Signal Processing
E)	Microelectronics

	Program Elective -III
A)	Multirate Digital Signal Processing
B)	Embedded System Design
C)	Wireless Sensor Network Design
D)	VLSI and Microsystems
E)	Numerical Methods in Electromagnetics

	Open Elective I
A)	New Labour Codes of India
B)	Urban Utilities Planning: Water Supply, Sanitation and Drainage
C)	Environment and Development
D)	Entrepreneurship
E)	Research Methodology

	Open Elective II
A)	Student Psychology
B)	Business To Business Marketing (B2B)
C)	Organizational Behaviour
D)	Principles Of Economics
E)	Intellectual Property & Rights
F)	Introduction to Public Administration

	Multidisciplinary Minor
A)	Design Of Mechatronic Systems
B)	Ethical Hacking
C)	Sustainable Power Generation Systems
D)	Components And Applications of Internet of Things
E)	Linear Algebra
F)	Artificial Intelligence and Machine Learning

IKS Bucket

	Indian Knowledge System (IKS)
A)	Indian Knowledge System (IKS): Concepts and Applications in Engineering
B)	Indian Knowledge System(IKS): Humanities and Social Sciences

SEMESTER I

12372PC101	Signal Theory	Credits 04

Course Objectives:

1. To provide in depth understanding of random nature of a signal using probability and random experiments.
2. To prepare mathematical background for communication signal analysis.
3. To provide in depth understanding of random processes.

Course Outcomes:

1. Learner will be able to apply knowledge of basic probability theory.
2. Learner will be able to understand concept of Random Variable.
3. Learner will be able to estimate different aspects of Random Variable like Mean,
4. Variance, Moments, distribution function, density function etc.
5. Learner will be able to distinguish multiple Random Variable and its properties.
6. Learner will be able to hypothesize nature of different Random Processes.
7. Learner will be able to adapt basic concepts of estimation on multiple and repeated data measurement.

UNIT I
Probability
The meaning of probability, the axioms of probability, repeated trials.

UNIT II
The Concept of a Random Variable
Introduction, Distribution and density functions, Specific random variables, Conditional distributions, Asymptotic approximations for Binomial random variables.

UNIT III
Functions of One Random Variable
The Random Variable g(X), The Distribution of g(X), Mean and variance, Moments, Characteristic functions.

UNIT IV
Two Random Variables
Bi-variable distribution, one function of two random variables, two function of two random variables, Joint moments, Joint characteristic functions, Conditional distributions, Conditional expected values.

UNIT V
Sequences of Random variables
General concepts conditional densities, Characteristic functions, and normality, mean square estimation stochastic convergence and limit theorem, Random Numbers: Meaning and Generation.

UNIT VI

Stochastic Processes

Introduction, Estimation, Parameter Estimation, Hypothesis Testing General concept, Random walks and other applications, Spectral representation, and estimation, Mean square estimation, Markov chains.

Textbooks / References:

1. Papoulis, S. Pillai, Probability, Random Variables and Stochastic Processes, 4th edition, Tata McGraw Hill, 2017.
2. T. Veerajan, Probability, Statistics and Random Processes, Tata McGraw-Hill Education (India) Pvt Limited, Third Edition, 2008.
3. R.P. Singh, S.D. Sapre, Communication Systems: Analog and Digital, Tata McGraw-Hill Education (India) Pvt Limited, Third Edition, 2017.
4. B.P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press, Third edition, 2010.

12372PC103 Radiation and Microwave Techniques Credits 04

Course Objectives:

1. To provide an insight into various aspects of the RF, microwave
2. To expose learners to the new emerging topics in the field of the RF involving the methodologies adopted for various applications
3. To provide brief theoretical foundation of Transmission line, RF, microwave techniques

Course Outcomes:

1. Learner will be able to analyse EM Transmission characteristics of waveguide.
2. Learner will be able to analyse Transmission line circuit at microwave frequency.
3. Learner will be able to demonstrate use of smith chart for solving transmission line problem.
4. Learner will be able to analyse various microstrip line integrated networks and their parameters
5. Learner will be able to formulate microwave communication system such as satellite and microwave antennas.
6. Learner will be able to demonstrate different applications of RF and Microwave.

UNIT I

Review of EM Theory

Introduction, Maxwell's equations, Wave equations, TEM/TE/TM/HE Wave definitions.

UNIT II

Microwaves

Introduction to microwaves, Microwave transmission lines, Smith chart and its applications at microwaves, Microwave measurements.

UNIT III

Microstrip lines and Antennas

Microstrip Lines: Types of microstrip lines, microwave components using strip lines, Methods of analysis, Design considerations, Microstrip arrays. Microstrip Antennas: Principle of operation, Methods of analysis, feeding techniques, Polarization, Design considerations.

UNIT IV

Microwave Elements

Microwave integrated circuits, Active and passive microwave elements.

UNIT V

Microwave Communication Systems

Introduction, Analog and digital microwave communication systems, Satellite communication, Microwave antennas

UNIT VI

Radar

Introduction, Classifications, Radar range equation, Modulators, Displays, Scanning and tracking, Doppler Effect, Blind speeds, FMCW radars, radar antennas.

Textbooks / References:

1. Guro, Hijiroglu, Electromagnetic Field Theory fundamentals; Thomson Publication, 2nd Edition, 2005.
2. Annapurna Das, Sisir Das; Microwave Engineering; TMH Publication, 2009.
3. M. Kulkarni, Microwave and Radar Engineering; Umesh Publications, 5th Edition, 2016.

12372PE101A Artificial Neural Networks and Applications Credits 04

Course Objectives:

1. To provide in-depth understanding of fundamental theory and concepts of computational intelligence methods.
2. To understand the fundamental theory and concepts of neural networks, neuro modelling, several neural network paradigms, and its applications.

Course Outcomes:

1. Learner will be able to articulate analogy of human neural network for understanding of artificial learning algorithms.
2. Learner will be able to analyse radial basis function network.
3. Learner will be able to analyse neural network architecture & basic learning algorithms.
4. Learner will be able to understand mathematical modelling of neurons, neural networks.
5. Learner will be able to analyse training, verification, and validation of neural models
6. Learner will be able to design engineering applications that can learn using neural networks.

UNIT I
Brain Style Computing: Origins and Issues, Biological neural networks, Neuron Abstraction, Neuron Signal.

UNIT II
Functions, Mathematical Preliminaries, Artificial Neurons, Neural Networks and Architectures Pattern analysis tasks: Classification, Clustering, mathematical models of neurons, Structures of neural networks, learning principles.

UNIT III
Feed forward neural networks: Pattern classification using perceptron, Multilayer feed forward neural networks (MLFFNNs), Pattern classification and regression using MLFFNNs, Error back-propagation learning, Fast learning methods: Conjugate gradient method.

UNIT IV
Auto-associative neural networks, Pattern storage and retrieval, Hopfield model, recurrent neural networks, Bayesian neural networks,

UNIT V
Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification.

UNIT VI
Self-organizing maps: Pattern clustering, Topological mapping, Kohonen's self-organizing map Introduction to cellular neural network, Fuzzy neural networks, and Pulsed neuron models recent trends in Neural Networks

Textbooks / References:

1. Satish Kumar, Neural Networks, A Classroom Approach, Tata McGraw-Hill, 2003
2. Jacek Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House, 1997.
3. S. Haykin, Neural Networks, A Comprehensive Foundation, Prentice Hall, 1998.
4. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. B. Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999.
6. L.O. Chua and T. Roska, Cellular Neural Networks and Visual Computing
7. Foundation and Applications, Cambridge Press, 2002.

12372PE101B Electromagnetic Interference and Compatibility Credits 04

Course Objectives:

1. To familiarize with the fundamentals those are essential for electronics industry in the field of EMI / EMC.
2. To understand EMI sources and its measurements.
3. To understand the various techniques for electromagnetic compatibility.

Course Outcomes:

1. Learner will acquire knowledge of EMI / EMC sources and their standards
2. Learner will be able to measure different parameters of interference in EM
3. Learner will be able to reduce the interference within EM devices

4. Learner will be able to illustrate the physical and statistical model of EM devices
5. Learner will be able to analyse the EM devices in terms of Computer Based Modelling and Simulation.
6. Learner will be able to design electronic systems that function without errors or problems related to electromagnetic compatibility.

UNIT I
Introduction to EMI / EMC
EMI / EMC Standards, Introduction to E, H, Near and far field radiators, Receptors and antennas, Different types of EMI sources and possible remedies.

UNIT II
Measurement techniques in EMI
Open area test sites, Radiated interference measurements, Conducted interference measurements, Interference immunity.

UNIT III
EMI reduction techniques:
Grounding, Shielding, Bonding, EMI filters.

UNIT IV
Probabilistic and Statistical Physical Model
Introduction, Probability considerations, Statistical Physical Models of EMI / EMC, EMC of terrestrial radio communication systems.

UNITV
Computer Based Modeling and Simulation
Computer Based Modeling and Simulation of EMI Models and Signal Integrity

Textbooks / References:
1. V. Prasad Kodali, Engineering Electromagnetic Compatibility, Principles and Measurement Technologies, IEEE Press.
2. Devid A. Weston, Marcol Dekker, Electromagnetic Compatibility, Principles and Applications, Inc New York.

12372PE101C Mobile Communication Credits 04

Course Objectives:
1. To provide in-depth understanding of the cellular radio concepts such as frequency reuse, handoff and how interference between mobiles and base stations affects the capacity of cellular systems.
2. To provide in-depth understanding of how to measure and model the impact that signal bandwidth and motion have on the instantaneous received signal through the multipath channel.
3. To provide in-depth understanding of theoretical aspects (such as the capacity) of wireless channels and basic spread spectrum techniques in mobile wireless systems.
4. To provide in-depth understanding of current and future cellular mobile communication systems.

Course Outcomes:

1. Learner will be able to analyze concept of basic cellular mobile system.
2. Learner will be able to analyze multipath fading channel.
3. Learner will be able to distinguish types of fading channels with the concept of coherence time.
4. Learner will be able to demonstrate the multiple access techniques.
5. Learner will be able to analyze diversity in multipath channels.
6. Learner will be able to understand the various standards involve in evolution of communication system.

UNIT I

Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards. Signal propagation: Propagation mechanism reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing.

UNIT II

Fading channels: multipath and small-scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread.

UNIT III

Coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate. Capacity of flat and frequency selective channels.

UNIT IV

Antennas: antennas for mobile terminal- monopole antennas, PIFA, base station antennas and array, Multiple access schemes: FDMA, TDMA, CDMA and SDMA. Modulation schemes: BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

UNIT V

Receiver structure: diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Alamouti scheme. MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing trade-off.

UNIT VI

Performance measures: outage, average SNR, average symbol/bit error rate. System examples: GSM, EDGE, GPRS, IS-95, CDMA2000 and WCDMA.

Textbooks / References:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2. T. S. Rappaport, Wireless digital communications: Principles and practice, 2nd Edition, Prentice Hall India, 2007.
3. W. C. Y. Lee, Wireless and cellular tele communications, 3rd Ed., MGH, 2006.
4. G. L. Stuber, Principles of mobile communications, 2nd Ed., Springer, 2007.
5. Simon Haykin and Michael Moher, Modern Wireless Communication, Pearson education.

12372PE101D Signal Processing Algorithms & Applications Credits 04

Course Objectives:

1. To instil research skills and bring in optimal solutions and novel products to signal processing and allied application areas using modern technology and tools that are technically sound, economically feasible, and socially acceptable.
2. To enable the graduates to engage in signal processing and its broad range of applications to understand the challenges of the rapidly changing environment and adapt their skills through reflective and continuous learning.
3. To provide graduates strong mathematical skills and in-depth knowledge in signal theory to analyze and solve complex problems in the domain of signal processing.

Course Outcomes:

1. Learner will be able to analyze the time and frequency response of discrete time system.
2. Learner will be able to design digital filters for various application.
3. Learner will be able to design FIR and IIR filters for various applications.
4. Learner will be able to understand the fundamentals of multi rate signal processing and
   its application.
5. Learner will be able to understand signal representation in terms of dimension, orthogonality etc.
6. Learner will be able to analyze least square method for power spectrum estimation.

UNIT I
Introduction
Review of discrete time signals and systems, Different transforms, Filtering, Use of DFT in linear filtering, Filtering of long data sequences, Spectrum, Algorithm for convolution and DFT.

UNIT II
LTI DT System in Transform Domain and Digital Filter Structures
Simple Digital Filters, All Pass, Linear Phase and Minimum & Maximum phase and Complementary transfer Functions. Basic FIR and IIR Digital Filter Structures, Linear Phase Structure IIR, FIR and All pass Lattice Structure.

UNIT III
Design of Digital Filters
General consideration, Design of FIR filters, Design of IIR filters from Analog filters, Frequency transformations, Design of Digital Filters Based on Least-square Method. Spectral Transformation of IIR Filters.

UNIT IV
Multi-rate Signal Processing
Filter banks, Interpolators, Decimators, Polyphase decomposition, Analysis and synthesis, Orthogonal and orthonormal filter banks.

UNIT V

Signal Representation

Representation of deterministic signals, orthogonal representation of signals, Dimensionality of signal spaces, Construction of orthogonal basis functions, Time bandwidth relationship, RMS duration and bandwidth, Uncertainty relations, Multiresolution Analysis and Wavelet Transform.

UNIT VI

Linear Prediction and Optimum Filter Design

Least square methods for system modelling, Adaptive filters, Power spectrum estimation.

Textbooks / References:

1. Sanjit Mitra, Digital Signal Processing A Computer-Based Approach, McGraw Hill Education; 4th edition (1 July 2013).
2. A. Oppenheim, R. Schafer, Discrete Time Signal Processing, Pearson; 3rd edition (18 August 2009).
3. John G. Proakis, Dimitris G. Manolakis, Advanced Digital Signal Processing, Pearson Education India; 4th edition (1 January 2007).
4. P. Vaidyanathanm, Multi-rate systems and Filter Banks, Prentice Hall; 1st edition (1 February 1993).
5. John D Proakis, Digital Signal Processing: Principles, Algorithms and Applications, Pearson Education; 4th edition (1 January 2014).
6. Simon O. Haykin, Adaptive Filter Theory, Pearson; 5th edition (June 2, 2013).

12372PE101E	Analog and Mixed Signal Processing	Credits 04

Course Objectives:

1. To provide in-depth understanding of the fundamental concepts of Analog signal processing.
2. To provide in-depth understanding of data conversion, PLL design, filter design.

Course Outcomes:

1. Learner will be able to distinguish between fundamental concepts of Analog and discrete time signal processing.
2. Learner will be able to design switched capacitor filters.
3. Learner will be able to demonstrate basics of Analog to digital data conversion.
4. Learner will be able to design Analog and digital PLLs.
5. Learner will be able to understand fundamentals of green data converters.

UNIT I

Switched Capacitor filters: Introduction to Analog and Discrete Time signal processing, sampling theory, Nyquist and over sampling rates, Analog filters, analog amplifiers, lock in amplifiers.

UNIT II

Analog integrated and discrete time switched capacitor filters, non-idealities in switched capacitor filters, architectures for switched capacitor filters and their applications and design. Switched capacitor amplifiers.

UNIT III
Data converters: Basics of data converters, Types of data converters, types of ADCs, Successive approximation, dual slope, Flash type, pipelined ADCs, hybrid ADCs, high resolution ADCs, parallel path ADCs like time-interleaved and multi-channel converters.

UNIT IV
Types of DACs and their architectures, binary weighted DACs. Performance metrics of data converters, SNR, SFDR, SNDR.

UNIT V
Background and foreground techniques to improve performance of data converters, Green data converters (low power design).

UNIT VI
Frequency synthesizers and synchronization: Analog PLLs, Digital PLLs design and architectures, Delay locked loops design and architectures. Direct Digital Synthesis.

Textbooks / References:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley-IEEE Press; 1st edition (May 1, 2002)
2. R. Jacob Baker, Switched-Current Signal Processing and A/D Conversion Circuits: Design and Implementation, Wiley India IEEE press 2008.
3. Andrzej Handkiewicz, Mixed Signal Systems: a guide to CMOS circuit design, Wiley-IEEE Press; 1st edition (23 August 2002)
4. Walt Kester, Mixed Signal and DSP Design techniques, Engineering Analog Devices Inc, Engineering Analog Devices Inc, Publisher Newnes.
5. Bar-Giora Goldberg, Digital Frequency Synthesis Demystified, Published by Elsevier.

12372PE103A RF and Millimeter Wave circuit Design Credits 04

Course Objectives:
1. To provide an insight into various aspects of the RF, mm-wave.
2. To provide brief theoretical foundation of RF, and mm-wave.
3. To provide an in-depth understanding of effects of the parasitic parameters.
4. To study layout of a block of CMOS circuit.

Course Outcomes:
1. Learner will be able to distinguish the type of network and application frequencies.
2. Learner will be able to interpret the behaviour of passive network components at RF and Millimeter wave frequencies.
3. Learner will be able to analyse distributed transmission media and prepare a smith chart of the same.
4. Learner will be able to categorize noise and to predict the effects of it on circuit performance.
5. Learner will be able to construct microwave amplifiers, oscillators, and Mixer circuit for given specifications at RF and Millimeter wave frequencies.
6. Learner will be able to perform frequency synthesis for the development of wireless communication systems and allied areas.

UNIT I
RF systems – basic architectures, Transmission media and reflections, Maximum power transfer. Passive RLC Networks: Parallel RLC tank, Q, Series RLC networks, Matching, Pi match, T match.

UNIT II
Passive IC Components: Interconnects and skin effect, Resistors, capacitors, Inductors. Review of MOS, Device Physics: MOS device review.

UNIT III
Distributed Systems:
Transmission lines, reflection coefficient, The wave equation, Examples Lossy transmission lines, Smith charts – plotting, gamma.

UNIT IV
Noise: Thermal noise, flicker noise review, Noise figure, LNA Design: Intrinsic MOS noise, Parameters Power match versus noise match, large signal performance, design examples & Multiplier based mixers, Mixer Design: Subsampling mixers.

UNIT V
RF Power Amplifiers: Class A, AB, B, C, Amplifiers Class D, E, F amplifiers RF Power amplifier design examples. Voltage controlled oscillators: Resonators, Negative resistance oscillators, Phase locked loops: Linearized PLL models, Phase detectors, charge pumps, Loop filters, PLL design examples.

UNIT VI
Frequency synthesis and oscillators: Frequency division, integer-N synthesis Fractional, frequency synthesis. Phase noise: General considerations, Circuit examples. Radio Architectures GSM radio architectures: CDMA, UMTS radio architecture.

Textbooks / References:
1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2004.
2. RF Microelectronics by Behzad Razavi. Pearson Prentice Hall; 2nd edition (22 September 2011)

12372PE103B System On-Chip Credits 04

Course Objectives:
1. To provide an in-depth understanding of what SoC is and what are the differences between SoC and Embedded System.
2. To provide an in-depth understanding of basics of System on Chip and Platform based design.
3. To provide an in-depth understanding of issues and tools related to SoC design and implementation.

Course Outcomes:
1. Learner will be able to interpret nature of hardware and software, its data flow modelling and implementation techniques.

2. Learner will be able to analyse the micro-programmed architecture of cores and processors.
3. Learner will be able to demonstrate system on chip design models.
4. Learner will be able to hypothesize and synthesize working of advanced embedded systems.
5. Learner will be able to develop design SOC controller.
6. Learner will be able to design, implement and test SOC model.

UNIT I

Basic Concepts: The nature of hardware and software, data flow modelling and implementation, the need for concurrent models, analyzing synchronous data flow graphs, control flow modelling and the limitations of data flow models, software, and hardware implementation of data flow, analysis of control flow and data flow, Finite State Machine with data-path, cycle-based bit parallel hardware, hardware model, FSMD data-path, simulation and RTL synthesis, language mapping for FSMD.

UNIT II

Micro-programmed Architectures: limitations of FSM, Micro-programmed: control, encoding, data-path, Micro-programmed machine implementation, handling Micro-program interrupt and pipelining, General purpose embedded cores, processors, The RISC pipeline, program organization, analyzing the quality of compiled code.

UNIT III

System on Chip, concept, design principles, portable multimedia system, SOC modelling, hardware/software interfaces, synchronization schemes, memory mapped Interfaces, coprocessor interfaces, coprocessor control shell design, data, and control design, Programmers model.

UNIT IV

RTL intent: Simulation race, simulation-synthesis mismatch, timing analysis, timing parameters for digital logic, factors affecting delay and slew, sequential arcs, clock domain crossing, bus synchronization, preventing data loss through FIFO, Importance of low power, causes and factors affecting power, switching activity, simulation limitation, implication on synthesis and on backend.

UNIT V

Research topics in SOC design: A SOC controller for digital still camera, multimedia IP development image and video CODECS

UNIT VI

SOC memory system design, embedded software, and energy management techniques for SOC design, SOC prototyping, verification, testing and physical design.

Textbooks / References:

1. Patrick R. Schaumont, “A Practical Introduction to Hardware/Software Co-design,” Springer; 1st Edition. (9 September 2010).
2. Sanjay Churiwala, Sapan Garg, “Principles of VLSI RTL Design a Practical Guide,” Springer; 2011th edition (1 October 2014)
3. Youn-Long Steve Lin, “Essential Issues in SOC Design, Designing Complex Systems-on-Chip,” Springer; 2006th edition (31 May 2007)

12372PE103C Optical Fiber Communication Credits 04

Course Objectives:

1. To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
2. To provide an in-depth understanding needed to perform fiber-optic communication system engineering calculations, identify system trade-offs, and apply this knowledge to modern fiber optic systems.

Course Outcomes:

1. Learner will be able to recognize and classify the structures of Optical fiber and types.
2. Learner will be able to demonstrate electromagnetic and mathematical analysis of light wave propagation.
3. Learner will be able to analyze fabrication techniques of different optical fibers.
4. Learner will be able to interpret behaviour of pulse signal and various loss mechanism.
5. Learner will be able to interpret Dispersion compensation mechanism, Scattering effects and modulation techniques.
6. Learner will be able to interpret working of Fiber based devices.

UNIT I

Introduction and importance of Fiber Optics Technology, Ray analysis of optical fiber: Propagation mechanism of rays in an optical fiber, Meridional rays, Skew rays, Fiber numerical aperture, dispersion.

UNIT II

Electromagnetic (modal) analysis of Step index multimode fibers: Wave equation and boundary conditions, Characteristics equation, TE, TH and Hybrid modes, Weakly guiding approximation, linearly polarized modes, Single mode fiber, V parameter, Power confinement and mode cutoff, Mode field diameter.

UNIT III

Graded-index fiber: Modal analysis of graded index fiber, WKB analysis, Optimum profile. Experimental techniques in fiber optics: Fiber fabrication (OVD, VAD, CVD, MCVD, PMCVD etc.) and characterization, Splices, Connectors, and fiber cable.

UNIT IV

Loss mechanism in optical fiber: Absorption loss, scattering loss, bending loss, splice loss. Pulse propagation, Dispersion and chirping in single mode fibers: Pulse propagation in nondispersive and dispersive medium, Pulse broadening and chirping, Group, and phase velocity, Intermodal and intramodal dispersion, Group velocity (material and waveguide) dispersion, Higher order dispersion, Fiber bandwidth.

UNIT V

Dispersion compensation mechanism: Dispersion tailored and dispersion compensating fibers, Fiber Birefringence and polarization mode dispersion, Fiber bandwidth, Nonlinear effects in optical fiber: Stimulated Raman Scattering, Stimulated Brillouin Scattering, Self Phase, Modulation, Cross Phase Modulation, Optical Solitons.

UNIT VI

Fiber based devices: Erbium-doped fiber amplifiers and lasers, Fiber Bragg gratings, Optical Fiber Sensors. Photonic Crystal fibers.

Textbooks / References:

1. A. K. Ghatak& K. Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (1998).
2. G. P. Agarwal, Fiber Optic Communication Systems, John Wiley Sons (1997).
3. John A. Buck, Fundamentals of Optical Fibers, Wiley Interscience, (2004).
4. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
5. G. Keiser, Optical Fiber Communications, McGraw Hill (2000).
6. K. Okamoto, Fundamentals of Optical Waveguides, Academic Press, (2000).
7. K. Iizuka, Elements of Photonics Vol I &II, Wiley-Interscience (2002).
8. D. W. Prather et.al, Photonic Crystal, Wiley (2009).

12372PE103D Statistical Signal Processing Credits 04

Course Objectives:

1. To provide in-depth understanding of more advanced probability theory, leading into random process theory and focus on discrete time methods.
2. To provide in-depth understanding of fundamental concepts of statistical signal processing,

Course Outcomes:

1. Learner will be able to generalize the properties of statistical models in the analysis of Signals using Stochastic processes.
2. Learner will be able to compare different Stochastic Processes and Models.
3. Learner will be able to demonstrate optimum linear filter algorithms and structures.
4. Learner will be able to differentiate the prominence of various spectral estimation techniques for achieving higher resolution in the estimation of power spectral density.
5. Learner will be able to visualize Least Square Filtering and Computation techniques.
6. Learner will be able to interpret adaptive filtering and its applications.

UNIT I

Introduction

Random Signals, Spectral Estimation, Adaptive Filtering, Random Variables, Distribution and Density Functions, Random Vectors: Definition, Transformation and Linear Combination of Random Vectors Linear System with Stationary Input, Innovations and Representation of Real Vectors, DT Stochastic Process: Stationarity, Ergodicity and Frequency Domain Representation of SP, Principles of Estimation.

UNIT II

Stochastic Processes and Models

Characterization of DT Stochastic Process, Correlation Matrix, Properties of Correlation Matrix, Stochastic Models: MA and AR Models, ARMA Models Hold Decomposition, Asymptotic Stationarity of AR Process, Yule Walker Equations, Power Spectral Density, Properties of Power Spectral Density Transmission of Stationary Process Through a Linear Filter, Other Statistical Characteristics of Stochastic Process Power Spectral Estimation, Spectral Correlation Density, Polyspectra.

UNIT III

Optimum Linear Filters Optimum Signal Estimation, Linear Mean Square Estimation, Solution of Normal Equations, Optimum FIR Filters, Linear Prediction: Linear Signal Estimation, Forward Linear Estimation, Backward Linear Estimation, Stationary Processes and Properties, Optimum IIR Filters, Inverse Filtering and Deconvolution.

UNIT IV

Algorithms and Structures for Optimum Filters.

Fundamentals of Order-Recursive Algorithms, Interpretation of Algorithmic Quantities, Order-Recursive Algorithms for Optimum FIR Filters, Algorithms of Levinson and Levinson-Durbin, Lattice Structure for Optimum Filters, Schur Algorithm, Triangularization and Inverse of Toeplitz Matrices, Kalman Filter Algorithm.

UNIT V

Least Square Filtering

Principle of LS, Linear Least Square Error Estimation, Least Square Filter, Linear Least Square Signal Estimation, LS Computation using Normal Equations, LS Computation using Orthogonalization Techniques, LS Computation using Singular Value Decomposition Techniques, Problems.

UNIT VI

Adaptive Filtering

Introduction, Typical Applications, Principles of Adaptive Filters, Method of Steepest Decent, LMS Algorithm, RLS Adaptive Filter, Fast RLS Algorithms for FIR Filtering, Frequency Domain and Sub-band Adaptive Filters.

Textbooks / References:

1. S. Haykin, Adaptive Filter Theory, 4th edition, Pearson Education India (1 January 2008)
2. D. G. Manolakis, V. K. Ingle, S. M. Kogon; Statistical and Adaptive Signal Processing; Artech House Publishers (31 May 2005)

12372PE103E Microelectronics Credits 04

Course Objectives:

1. To provide in-depth understanding and to be able to apply basic concepts of semiconductor physics relevant to devices.
2. To be able to analyse and design microelectronic circuits for linear amplifier and digital applications.

Course Outcomes:

1. Learner will be able to discuss MOS structure in terms of different parameters.
2. Learner will be able to express different CMOS technologies.
3. Learner will get knowledge of design rules for the CMOS design.
4. Learner will be able to understand how devices and integrated circuits are fabricated and describe discuss modern trends in the microelectronics industry.
5. Learner will be able to determine the frequency range of simple electronic circuits and understand the high frequency limitations of BJTs and MOSFETs.

6. Learner will be able to design simple devices and circuits to meet stated operating Specifications.

UNIT I

Ideal I-V Characteristics, C-V Characteristics: MOS Capacitance models, MOS Gate Capacitance Model, MOS Diffusion Capacitance Model. Non ideal I-V Effects: Velocity Saturation and Mobility Degradation, Channel Length Modulation, Body Effect, Sub-threshold Conduction, Junction Leakage, tunnelling, Temperature and Geometry dependence. DC Transfer characteristics: Complementary CMOS Inverter DC Characteristics, Beta Ratio Effects, Noise Margin, Ratio Inverter Transfer Function, Pass Transistor DC Characteristics, Tristate Inverter, Switch- Level RC Delay Models.

UNIT II

CMOS Technologies: Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology.

UNIT III

Layout Design Rules: Design Rules Background, Scribe Line and Other Structures, MOSIS Scalable CMOS Design Rules, Micron Design Rules. CMOS Process Enhancements: Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS. CMOS Fabrication and Layout: Inverter Cross-section, Fabrication Process, Layout Design rules, Gate Layout, Stick Diagrams.

UNIT IV

Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, choosing the Best Number of Stages. Power Dissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance, Delay, Cross talk. Design Margin: Supply Voltage, Temperature, Process Variation, Design Corners. Reliability, Scaling.

UNIT V

Static CMOS Logic: Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristate gates, Multiplexers, Latches and Flip-Flops, Circuit Families: Static CMOS, Ratioed Circuits

UNIT VI

Cascode Voltage Switch Logic, Dynamic Circuits, Differential Circuits, Sense Amplifier Circuits, BiCMOS Circuits, Low Power Logic Design, Comparison of Circuit Families, Analog Circuit Designs, MOS Small-signal Models, Common Source Amplifier, The CMOS Inverter as an Amplifier, Current Mirrors, Differential Pairs, CMOS Operational Amplifier topologies, Digital to Analog Converters, switched capacitors, Analog to Digital Converters, RF Circuits.

Textbooks / References:

1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson; 2nd edition (10 January 2003).
2. S-M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, Third Edition, McGraw-Hill.

3. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Education; Second edition (1 November 2017).
4. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, Second Edition, Oxford University Press
5. P. Gray, P. J. Hurst, S. H. Lewis and R. Meyer, Analysis and Design of Analog
6. Integrated Circuits, Fourth Edition, Wiley, 2001. (Low Price Edition).

12372SE101 Seminar I Credits 02

The seminar shall be on the state of the art in the area of the wireless communication and computing and of student's choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

12372AU101 YOGA for Stress Management Audit

Course Objectives:

1. Understand the physiological and psychological aspects of stress and its impact on overall well-being.
2. Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.
3. Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.
4. Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.
5. Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes:

1. Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.
2. Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress.
3. Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.
4. Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.
5. Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

UNIT I

Introduction to Yoga for Stress Management - 1
Introduction to Yoga for Stress Management - 2
Stress according to Western perspective
Stress Eastern Perspective
Developmental process: Western and Eastern Perspective
Stress Hazards and Yoga

UNIT II
Meeting the challenges of Stress - 1
Meeting the challenges of Stress - 2
Introduction to Stress Physiology
Stress, Appetite and Dietary management- Modern and Yogic perspective
Sleep and Stress: understanding the relationship for effective management of stress

UNIT III
Stress Assessment methods- a valuable tool toward stress management
Role of Yoga in prevention and management of stress related disorders – a summary of research evidence
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 1
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 2
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 3

UNIT IV
Concept of stress and its management - perspectives from Bhagavad Gita - Part 1
Concept of stress and its management - perspectives from Bhagavad Gita - Part 2
Concept of stress and its management - perspectives from Bhagavad Gita - Part 3

UNIT V
Bio-Psycho-Socio-Spiritual model of stress management
Yoga practices for Stress Management
Breathing practices – 1
Hands in and out breathing, Hands stretch breathing, Ankle stretch breathing
Breathing practices – 2
Dog Breathing, Rabbit breathing, Tiger breathing, Sashankasana breathing
Breathing practices – 3
Bhujangasana breathing, Ardha Shalabhasana breathing (alternate legs), Straight leg raising (alternate legs), Straight leg raising (both legs), Sethubandhasana lumbar stretch, Instant Relaxation Technique (IRT)
Loosening Practices – 1
Shoulder Rotation, Side bending, standing twist, Hip rotation, Thigh strengthening
Loosening practices – 2
Chakki chalan, Bhunamasana Chalana, Alternative toe touching
Loosening practices – 3
Side leg raising, Pavana muktasana kriya: Wind releasing pose movements, Quick Relaxation Technique (QRT)

UNIT VI
Asana practices – 1
Tadasana, Ardhakati Chakrasana, Ardha Chakrasana, Trikonasana, Vrikshasana
Asana practices – 2
Vakarasana, Janu Sirshasana, Ushtrasana, Sashankasana,
Asana practices – 3
Ardhamatseyndrasana, Paschimottanasana, Poorvottanasana, Gomukhasana
Asana practices – 4
Makarasana, Bhujangasana, Salambha Shalabahasana, Dhanurasana
Asana practices – 5
Setubandhasana, Sarvangasana, Mastyasana, Deep Relaxation Technique (DRT)

Soorya Namaskar
Pranayama – 1
Kapalbhati kriya and Sectional Breathing
Pranayama – 2
Nadishuddhi Pranayama
Pranayama – 3
Bhramari, Sheetali, Sitkari and Ujjayi
Om Meditation
Cyclic Meditation
Integrated Yoga Module I
Integrated Yoga Module II
Integrated Yoga Module III

Textbooks / References:

1. H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.
2. Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010
3. Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.
4. Van den Bergh, O. Principles, and practice of stress management. Guilford Publications. 2021.
5. Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998
6. Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975
7. Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Yoga for Stress Management	Dr H R Nagendra, Dr Mithila M V, Dr Rajesh Nair	Swami Vivekananda Yoga Anusandhana Samsthana	https://onlinecourses.swayam2.ac.in/aic23_ge10/preview#:~:text=In%20this%20course%20we%20intend,meeting%20the%20challenges%20of%20stress

SEMESTER II

12372PC102	Estimation and Detection Theory	Credits 04

Course Objectives:

1. To provide in-depth understanding basics of detection and estimation theory.
2. To be able to design and analyse optimum detection schemes
3. Learner will have basic knowledge of linear algebra.

Course Outcomes:

1. Acquire basics of statistical decision theory used for signal detection and estimation.
2. Examine the detection of deterministic and random signals using statistical models.
3. Examine the performance of signal parameters using optimal estimators.
4. Study different estimation schemes such as ML and MMSE estimators.

UNIT I

Linear Algebra

Vector space : linear dependence, Basis and dimension, vector subspace, inner product spaces, orthonormal basis and Gram- Schmidt Process of orthogonalisation, computation of linear dependence, linear transformation and matrices, change of basis, orthogonal and unitary transformation, Eigenvalue, Eigen vectors and characteristics equation. Systems theory, stochastic processes, Gauss Markov models, representation of stochastic processes, likelihood and sufficiency.

UNIT II

Binary Decision: Single Observation

Introduction to structure ofdecision and estimation problems.MaximumLikelihood decision criterian, Neyman-person criterian, Probability of error criterian, Bays risk criterian, MinMax criterian, problems.

UINT III

Binary Decision: Multiple Observations

Vector observation, The general Gaussian problem, Waveform observations and additive Gaussion noise, problems.

UNIT IV

Multiple Decisions: Multiple Decision

Bays risk, Probability of error: General case, Probability of error: Gaussian case, Ensure decision problems.

UNIT V

Composite and Nonparametric Decision Theory

Composite decisions Sign test, Wilason test, problems.

UNIT VI

Fumdamentals of Estimation

Maximum likelihood method, Bays cost method, Relationship of Estimation, Linear minimum, Variance and Least-square methods. Properties of Estimations: Unbiased estimators, efficient estimators, Asymphotic properties.

Textbooks / References:

1. James Melsa and David Cohn, Decision and Estimation Theory, Mc-Graw Hill
2. Harry L, Van Trees, Detection, Estimation, and Modulation Theory, John Wiley and Sons Inc.

12372PC104 Information Theory and Coding Credits 04

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.
2. To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
3. To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

1. Learner will be able to formulate equations for entropy mutual information and channel capacity for all types of channels.
2. Learner will be able to distinguish between different types error correcting codes based on probability of error.
3. Learner will be able to design a digital communication system by selecting an appropriate error correcting codes for a particular application.
4. Learner will be able to explain various methods of generating and detecting different types of error correcting codes.
5. Learner will be able to formulate the basic equations of linear block codes.
6. Learner will be able to compare the performance of digital communication system by evaluating the probability of error for different error correcting codes

UNIT I

Theory of Probability and Random Processes

Concept of probability, Random variables, Probability models, Statistical averages, Central limit theorem, Correlation, Linear mean square estimation.

UNIT II

Random Processes

Random variable and random process, Power spectral density of a random process, Multiple random processes, Transmission of random processes through linear systems, Band-pass random processes, Optimum filtering.

UNIT III

Noise in Communication Systems

Behaviour of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT IV
Information Theory
Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT V
Error Correcting Codes
Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ, Performance of codes, Comparison of coded and un-coded systems.

UNIT VI
Speech Coding
Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

Textbooks / References:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering (2nd Edition); TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory; Wiley Inter science.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2nd Edition); Pearson India.

12372PE102A Multirate Digital Signal Processing Credits 04

Course Objectives:
1. To master the fundamentals of multi-rate signal processing and demonstrate the ability to solve problems in sample rate conversion, filter banks, and transmultiplexers.

Course Outcomes:
1. Learner will be able to develop efficient realizations for up sampling and down sampling of signals using the polyphase decomposition.
2. Learner will be able to design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters to meet specifications.
3. Learner will be able to design digital filter banks based on the techniques presented.
4. Learner will be able to analyze fundamental concepts of wavelets.
5. Learner will be able to distinguish between wavelets and multirate filter banks, from the point of view of implementation.

UNIT I

Fundamentals of Multi-rate Systems

Introduction, Basic multi-rate operations, Interconnection of building blocks, Polyphase representation, Multistage implementation, Some application of multi-rate systems, Special filter, and filter banks.

UNIT II

Maximally Decimated Filter Banks

Introduction, Errors created in the QMF bank, a simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Transmultiplexer.

UNIT III

Paraunitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Transform coding and LOT.

UNIT IV

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT V

The Wavelet Transform and its Relation to Multi-rate Filter Banks

Introduction, Background and outline, Short time Fourier transform, The Wavelet transform, DT orthonormal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT VI

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multi-rate fundamentals. Review of discrete time multi-input multi-output LTI System, Paraunitary and lossless system.

Textbooks / References:

1. P.P.Vaidyanathan , Multirate System and Filter Banks, Pearson College Div; 1st edition (January 1, 1992)
2. N.J.Fliege, Multirate Digital Signal Processing, Wiley (January 13, 2000).
3. Raghuveer Rao, Ajit Bopardikar,Wavelet Transforms Introduction to Theory and Application, Longman Pub Group; Har/Dskt edition (January 1, 1998)
4. C. Sidney Burrus, R.A.Gopianath , Introduction to wavelet and wavelet Transform, Pearson; 1st edition (August 14, 1997).

12372PE102B Embedded System Design Credits 04

Course Objectives:

1. To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around a modern embedded processor.

Course Outcomes:

1. Learner will understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
2. Learner will be able to analyze a wide competence from different areas of technology, especially from computer engineering, study of processor for deep understanding analyze case study of Pentium processor.
3. Learner will be able to demonstrate architecture of 8051, Instruction set, addressing modes. Programming 8051 for various applications. Interfacing of LED/LCD, keyboard, stepper motor, ADC/DAC and sensors, RTC, serial communication with micro-controller.
4. Learner will be able to analyze deep state-of-the-art theoretical knowledge in the areas of real-time systems, artificial intelligence, learning systems, sensor and measuring systems, and their interdisciplinary nature needed for integrated hardware/software development of embedded systems.
5. Learner will have ability to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system, and understanding and experience of state-of-the-practice industrial embedded systems and intelligent embedded system development.

UNIT I

Fundamentals of Embedded System

Embedded System overview, Design challenges, Processor Technology, IC Technology, Design Technology.

UNIT II

Embedded System Hardware

Evaluation of Processors, Microprocessor architecture overview- CISC and RISC, Case study of Pentium processor architecture.

UNIT III

Microcontroller Architecture and Interfacing

Architecture of 8051, Instruction set, Addressing modes, Programming Examples. Interfacing of LED/LCD, keyboard, stepper motor, ADC/DAC and sensors, RTC, serial communication with micro-controller.

UNIT IV

Study of semiconductor memory

Memory device characteristics, SRAM, DRAM, SSRAM, SDRAM, RDRAM, FLASH, Smart card memory and interfacing of memory with micro-controller.

UNIT V

Introduction to DSP Processors

Architecture, features, instruction set, typical applications (TMS320XX or ADSP 21010).

UNIT VI

Embedded software and Applications

Introduction to software Engineering, C cross compiler, Computational models, FSM, Concurrent state model, Concurrent Processes, Communication among processes, synchronization among processes. Introduction to RTOS: Windows CE, VX works.

Applications: Network protocols- TCP/IP, Embedded Ethernet, CANBUS, I2C bus, Mod Bus, Digital Camera.

Textbooks / References:

1. Frank Vahid and Tony Givargis, "Embedded System Design A Unified Hardware/Software Introduction", Wiley; 1. Edition (24 Oct. 2001).
2. M.A. Mazidi and J.G. Mazidi, "The 8051 Micro-controller and Embedded System" Pearson Education Asia, 2000
3. K.J. Ayala, "The 8051 Micro-controllers", Cengage India; 3rd edition (8 Nov. 2007).
4. INTEL Microcontroller Manual
5. J. Zimmermann: "Fuzzy set theory and its applications, second edition, Allied Publishers limited, New Delhi, 1996.

12372PE102C Wireless Sensor Network Design Credits 04

Course Objectives:

1. To provide in-depth understanding of design and implementation of WSN.
2. To provide ability to formulate and solve problems creatively in the area of WSN.
3. To provide in-depth understanding of various applications of WSN.

Course Outcomes:

1. Student will understand the need of WSN and will analyze the challenges in creating WSN
2. Student will be able to design the architecture of WSN
3. Student will be able analyze the power and security constraints in WSN
4. Student will study different operating system to operate WSN
5. Student will be able to understand the basic functioning of WSN at physical layer
6. Student will understand different protocols at network layer to for multiple channel accessing.

UNIT I
Introduction: Motivation for a Network of Wireless Sensor Nodes, Sensing and Sensors, Wireless Networks, Challenges and Constraints. Applications: Health care, Agriculture, Traffic, and others.

UNIT II
Architectures: Node Architecture, the sensing subsystem, processor subsystem, communication, interface, LMote, XYZ, Hogthrob node architectures.

UNIT III
Power Management-Through local power, processor, communication subsystems and other means, time Synchronization need, challenges, and solutions overview for ranging techniques Security Fundamentals, challenges and attacks of Network Security, protocol mechanisms for security.

UNIT IV
Operating Systems-Functional and non-functional Aspects, short overview of prototypes – TinyOS, SOS, Contiki, Lite OS, sensor grid.

UNIT V
Physical Layer –Basic Components, Source Encoding, Channel Encoding, Modulation, Signal Propagation.

UNIT VI
Medium Access Control–types, protocols, standards and characteristics, challenges, Network Layer-Routing Metrics, different routing techniques.

Textbooks / References:

1. Dargie, W. and Poellabauer, C., "Fundamentals of wireless sensor networks: theory and practice", John Wiley & Sons (31 Jan. 2011).
2. Sohraby, K., Minoli, D., Znati, T. "Wireless sensor networks: technology, protocols, and applications, John Wiley and Sons", 2007.
3. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons; 1st edition (26 Sept. 2007).

12372PE102D	VLSI and Microsystems	Credits 04

Course Objectives:

1. To provide in depth understanding of the principals involved in the latest hardware required for designing and critically analysing electronic circuits relevant to industry need and society.
2. To provide in depth understanding of micro-fabrication process, packaging.

Course Outcomes:

1. The student will learn the different abstract levels in Verilog for modeling digital circuits.
2. The student will learn the designing of combinational and sequential circuits in CMOS.

3. The student will be able to understand CMOS analog circuits design.
4. The student will be able to understand the impact of the physical and chemical processes of integrated circuit fabrication technology on the design of integrated circuits.
5. The student will be able to understand physics of the Crystal growth, wafer fabrication and basic properties of silicon wafers.
6. The student will be able to understand implementation of finite element method for different semiconductor devices.

UNIT I

VHDL Modeling and PLD Architectures

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability, PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications.

UNIT II

SoC, Interconnect and Digital CMOS Circuits

Clock skew, Clock distribution techniques, clock jitter. Supply and ground bounce, power distribution techniques. Power optimization. Interconnect routing techniques; wire parasitic, Signal integrity issues. I/O architecture, pad design, Architectures for low power, MOS Capacitor, MOS Transistor theory, C-V characteristics, non-ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product. Transmission gate. CMOS combo logic design. Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

UNIT III

Analog CMOS Design and Testability

Current sink and source, Current mirror. Active load, Current source, and Push-pull inverters. Common source, Common drain, Common gate amplifiers, Cascode amplifier, Differential amplifier, Operational amplifier, Types of faults, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

UNIT IV

Microfabrication processes

Glimpses of Microsystems, scaling effects, Smart materials and systems: an overview, Microsensors: some examples, Micro actuators: some examples, Microsystems: some examples, Examples of smart systems: structural health monitoring and vibration control, Structure of silicon and other materials, Silicon wafer processing; Thin-film deposition, Lithography, wet etching and dry etching Bulk micromachining and Surface micromachining, Wafer-bonding; LIGA and other moulding techniques, Soft lithography and polymer processing, Thick-film processing; Low temperature co-fired ceramic Processing, Smart material processing.

UNIT V

Mechanics of Solids

Stresses and deformation: bars and beams, Micro device suspensions: lumped modeling, Residual stress and stress gradients, Poisson effect; Anticlastic curvature; examples of micromechanical structures, Thermal loading; bimorph effect, Dealing with large displacements; in-plane and 3D elasticity equations, Vibrations of bars and beams, Gyroscopic effect, Frequency response; damping; quality factor, Basic micro-flows for damping calculation.

UNIT VI

Finite element method and Electronics and packaging

Types of numerical methods for solving partial differential equations, what is finite element method? Variational principles, Weak form; shape functions, Isoperimetric formulation and numerical integration, Implementation of the finite element method, FEM for piezoelectric,
Semiconductor devices: basics of Op-Amps and Op-Amp circuits, Signal conditioning for microsystems devices, Control and microsystems, Vibration control of a beam, Integration of microsystems and microelectronics, Packaging of Microsystems: why and how, Flip-chip, ball grid, etc., reliability, Case-study 1 (Pressure sensor), Case-study 2 (Accelerometer)

Textbooks / References:

1. K. Eshraghian, Eshraghian. D, A. Pucknell, Essentials of VLSI Circuits and Systems, 1st edition, 2005, PHI.
2. Wayne Wolf, Modern VLSI Design, 3rd Ed., 1997, Pearson Education.
3. Ming-BO Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective –CRC Press, 2011.
4. N.H.E Weste, K. Eshraghian, Principals of CMOS VLSI Design –, 2nd Ed., Addison Wesley.

12372PE102E Numerical Methods in Electromagnetics Credits 04

Course Objectives:

1. To provide the mathematical foundation for the development of numerical methods in Electromagnetics
2. To formulate Finite Difference (FD) schemes for the solution of parabolic, elliptic, and hyperbolic PDEs with emphasis on the truncation boundaries, accuracy, and stability
3. To solve a variety of electromagnetic problems ranging from scattering and radiation to waveguide propagation and eigenvalue problems.

Course Outcomes:

1. To understand the main principles and laws that governs electromagnetic wave propagation.
2. To identify the most suitable numerical technique for the solution of a particular problem in Electromagnetics.
3. To understand the basic properties of transmission lines; analyze electromagnetic wave propagation in generic transmission line geometries.
4. To learn how to use numerical methods to solve for electric fields from charge distributions and conducting boundaries.

5. To understand the behaviour of magnetic and electric fields in the presence of dielectric and magnetic materials; appreciate how to simply modify expressions for capacitance and inductance from free space expressions.
6. To understand the behaviour of magnetic and electric fields in the presence of dielectric and magnetic materials.

UNIT I
Review of Analytical Methods, Separation of variables, conformal transformation – Green's function. Finite difference method – iterative solution, relaxation, and acceleration processes: different boundary conditions. Review and Introduction to Numerical Analysis: example boundary value problems; numerical tessellation, interpolation, and shape functions; splines, extrapolation method; numerical integration and differentiation; linear system solutions (direct and iterative); sparse system storage schemes.

UNIT II
Discretization of solution region: Shape functions, element matrices and global matrix, method of solution, Method of moments, Basis functions; weighted residuals, method of least squares, numerical integration.

UNIT III
Variational Method Derivation of variational expression, Euler-Lagrange equation, Rayleigh-Ritz method.

UNIT IV
Finite Element Method: Discretization of solution region: Shape functions, element matrices and global matrix, method of solution, Method of moments, Basis functions; weighted residuals, method of least squares, numerical integration. One- and two-dimensional finite element method: linear and quadratic shape functions, meshing; system construction and assembly; element matrix for the wave equation; boundary condition enforcement/condensation of boundary conditions; absorbing boundary conditions; perfectly matched layers(PML); boundary integral truncation; mesh generation issues; capacitance, inductance, propagation constant computations; shielded and open transmission lines; Inhomogeneous guides and cavities; magnetic circuits (permanent magnets, windings)

UNIT V
One- and two-dimensional finite differences: iterative solution; cavity field computations; field mapping, equipotential; capacitance computations for shielded transmission lines Microsoft Excel (spreadsheet); microstrip line analysis and material interface treatment; magnetic fields in motor windings; Finite difference time domain method and the Yee marching scheme (2D); gridding and stability conditions; absorbing boundary conditions

UNIT VI
Integral equation methods: boundary integral equations (2D and 3D); weighted residual method and system construction; capacitance computations using a supplied PC program; modeling various transmission lines; magnetic field and inductance computations (6)

Textbooks / References:
1. G.G. Skitek, S.V. Marshall, Electromagnetic concepts and applications, Prentice Hall (1 Jan. 1982).

2. Adder R.B., Electromagnetic energy transmission and radiation, MIT press, Cambridge, 1969.
3. SAAD T. and Hansen, Microwave Engineers handbook, Vol. I, Artech house, 1971. Space charge waves and slow EM waves, Beck, A.H.U., Pergamon press, 1950.

12372OE102A New Labour Codes of India Credits 03

Course Objectives:

1. Gain a clear understanding of the key Labour Codes, namely the Code on Wages, Code on Social Security, Code on Occupational Safety, Health, and Working Conditions, and the Industrial Relations Code.
2. Explore the legal structure and scope of each Labour Code, understanding their applicability to different categories of workers and industries.
3. Examine the provisions related to wages, including wage definitions, payment structures, deductions, and methods for calculating wages
4. Analyse the components of social security as outlined in the Code on Social Security, including provident funds, health insurance, maternity benefits, and pensions.
5. Explore the mechanisms for resolving disputes and conflicts between employers and employees, including the role of labour courts, tribunals, and the appellate process.

Course Outcomes:

1. Understand the historical context and reasons behind the overhaul of labour laws in India.
2. Analyze the economic, social, and administrative motivations driving the implementation of the new labour codes.
3. Evaluate the impact of the new Industrial Relations Code on trade unions, collective bargaining, and dispute resolution mechanisms.
4. Analyze the potential effects of these provisions on both workers and employers.
5. Speculate on the possible evolution of labour practices and employer-employee relations in response to these codes.

UNIT I

History of Labour Laws

Introduction**,** Government Policies, History of Labour Laws in the Country, History: Previous Social Legislations in India, National Labour Commission Reports

UNIT II

Trade Unions

Evolution of Trade Unions in India, Constitutional Freedom to Form Association and Unions, International Labour Organization on Trade Unions, Trade Union – Definition, Registration, Cancellation, Management of Funds, Trade Union – Recognition, Immunities.

UNIT III

Strikes & Layoffs

Industrial Dispute – Introduction, Definitions, Resolution of Industrial Disputes, Concept of Workmen, Contract of service, Contract for service, Strike, Lock-out, Retrenchment, Closure of Undertakings, Industrial Employment (Standing Orders), Disciplinary Action and Procedures**.**

UNIT IV

Payment of Wages

The Code on Wages 2019 – An Introduction, Minimum Wages, Floor Wages, Central and State Advisory Board, Payment of Wages, Deductions & Recovery, Fines, Equal Remuneration, Bonus, Minimum Wage Fixing Convention, 1970, Protection of Wages Convention, 1949, Equal Remuneration Convention, 1951: International Instruments on Equality of Pay, Protection of Workers' Claims (Employer's Insolvency) Convention, 1992, Discrimination (Employment and Occupation) Convention, 1992

UNIT V

Social security & Insurance

Employees State Insurance, Different Benefits under the ESI Scheme, Employee's Provident Fund, Gratuity, Maternity Benefit, Social Security in case of Building and other Construction Workers, Social Security for Unorganized sector and Platform workers, Bonded Labour System Abolition and Regulation, Child Labour Prohibition, Plantation Labour.

UNIT VI

Factories & various types of workers

The Meaning of Factory, Manufacturing Process, Approval and Licensing of Factories, Role of Inspector-cum-facilitator and Other Authorities, Social Security Fund, Offences and Penalties, Contract Labour and Proposed ILO Convention, Inter-State Migrant Workers**,** Mines Workers, Beedi and Cigar Workers (Kerala & West Bengal Legislations), Audio-Visual workers, Cine-workers and Dock workers, The Effective Abolition of Child Labour (ILO: C029, C105, C138 & C182), The Governance Convention of ILO Labour Standards.

Textbooks / References:

1. Labour Law (Taxman)
2. E-book of the Ministry of Labour and Employment - https://labour.gov.in/e-book-1
3. Reading material prepared by the Course Co-ordinator.
4. Avtar Singh and Harpreet Kaur, Introduction to Labour and Industrial Laws, 2nd ed., Lexis Nexis Butterworths Wadhwa.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
New Labour Codes of India	Prof. KD Raju	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_lw05/preview

12372OE102B Urban Utilities Planning: Water Supply, Sanitation and Drainage Credits 03

Course Objectives:

1. To develop a clear understanding of the significance of water supply, sanitation, and drainage systems in urban areas.
2. To explore different sources of water supply for urban areas, including surface water, groundwater, and treated wastewater.
3. To delve into various sanitation systems, such as sewerage networks, on-site sanitation solutions, and wastewater treatment plants.

4. To learn about hydraulic calculations, pipe sizing, pump station design, and related technical aspects.

Course Outcomes:

1. Students should be able to demonstrate a clear understanding of the fundamental concepts related to water supply, sanitation, and drainage systems in urban settings.
2. Students should be capable of applying design principles to develop efficient and sustainable water supply, sanitation, and drainage systems that meet the needs of urban populations while considering factors such as population growth, climate change, and land use.
3. Students should be able to outline strategies for the effective management, operation, and maintenance of water supply, sanitation, and drainage infrastructure to ensure long-term sustainability and functionality.

UNIT I
Urban Utilities
Urban utilities planning: Introduction, Urban Water Supply, Collection of water.

UNIT II
Water Storage & Distribution
Pumping and storage, Water supply Distribution system and Plans, Water Quality, testing, treatment, and cost.

UNIT III
Sanitation
Sanitation and Drainage Fundamentals, Water carriage system, Sewer design,

UNIT IV
Sewage treatment
Sewer appurtenances and master plans, Sewage treatment, drainage, and recharge

Textbooks / References:

1. Water Supply Engineering, S. K. Garg (18th ed.), Khanna Publishers.
2. Water Supply and Sanitary Engineering, G. S. Birdie & J. S. Birdie (8th ed.), Dhanpat Rai Publishing Company, New Delhi.
3. Stormwater drainage manual Planning, Design and Management, Drainage services department, Government of the Hong Kong Special Administrative Region.

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Urban Utilities Planning: Water Supply, Sanitation and Drainage	Prof. Debapratim Pandit	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_ar08/preview

12372OE102C Environment and Development Credits 03

Course Objectives:

1. To help students comprehend the complex interconnections between environmental factors and development processes, highlighting how they can either support or impede each other.
2. To identify and analyze key environmental challenges arising from development activities, such as pollution, resource depletion, deforestation, loss of biodiversity and climate change.
3. To study the effect of climate change on environment.
4. To analyze real-world case studies of both successful and unsuccessful attempts to integrate environmental considerations into development projects and policies

Course Outcomes:

1. Demonstrate a deep understanding of the complex interrelationships between environmental factors and socioeconomic development, including how they influence and shape each other.
2. Identify and critically analyze key environmental challenges resulting from development activities, and evaluate their impacts on ecosystems, natural resources, and human well-being.

UNIT I

Environmental movement

Introduction: Development, economic growth and sustainable development, Basic ecosystem ecology, Environmentalism, Environmental Movement, Environmentalism in the global south,

UNIT II

Social ecology

Approaches to environment: Ecofeminism, Feminist political ecology, Marxism and ecology, Debates on environmental ethics: Deep ecology, Gandhi and ecology, social ecology.

UNIT III

Impact of Religion on environment

Religion, environment, and conservation: Religion, environment and historical roots of ecological crisis, Biodiversity conservation ethics in Buddhism and Hinduism, Christian religion in the age of ecological crisis

UNIT IV

Natural Resources & development

Natural resource management, Common property vs. private property, Livelihoods, forests, and conservation, Displacement, dispossession, and development: Conservation-induced displacement, Environment impact assessment and national rehabilitation & resettlement policy, Dispossession, and land acquisition.

UNIT V

Gender & Development, Climate change

Development theory and gendered approach to development, Gender, environment & sustainable development.

Environment and climate change: Climate change interventions and policy framework, Eastern Himalayas, and climate change.

UNIT VI

Belief and local knowledge of environment

Belief and knowledge systems, biodiversity conservation and sustainability: Ecological knowledge, biodiversity conservation and sustainability, Traditional religion and conservation of nature in Northeast India: Case study

Local knowledge in the environment-development discourse: Indigenous knowledge, environment and development, Relevance of indigenous knowledge: case study

Textbooks / References:

1. Arnold, David, and Guha, Ramchandra, (eds.), 1997. Nature, Culture and Imperialism, New Delhi: Oxford University Press.
2. Baviskar, Amita. 1997. In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley, OUP, Delhi.
3. Barnhill, David Landis & Roger S. Gottlieb. (eds.) 2001. Deep Ecology and World Religions: New Essays on Sacred Grounds. State Univ. of New York Press, Albany.
4. Bicker, Alan, Paul Sillitoe and Johan Pottier. 2004. Development and Local Knowledge: New Approaches to Issues in Natural Resources Management, Conservation and Agriculture. Routledge, London & New York.
5. Esteva, G. 1997. 'Development' in W. Sachs, ed., The Development Dictionary, Orient Longman, pp. 8-34.
6. Gadgil, Madhav and Guha, Ramchandra. 1995. Ecology and Equity: The use and Abuse of Nature in Contemporary India, New Delhi: Oxford University.
7. Gottlieb, Roger S. 2004. This Sacred Earth: Religion, Nature, Environment. Routledge, New York, and London.
8. Merchant, Carolyn. 1994. Ecology: Key Concepts in Critical Theory, Humanities Press, New Jersey.
9. Ramakrishnan, P.S. 1992. Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India, Man and the Biosphere Series, Volume 10, UNESCO.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Environment and Development	Prof. Ngamjahao Kipgen	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc21_hs83/preview

12372OE102D Entrepreneurship Credits 03

Course Objectives:

1. To understand the role of entrepreneurs in driving innovation and economic growth.
2. Guide students through the process of developing a comprehensive business plan, including market research, financial projections, competitive analysis, and risk assessment.
3. Provide students with essential financial literacy skills, including budgeting, financial forecasting, and understanding different funding options such as bootstrapping, loans, venture capital, and angel investment.

4. Guide students through the process of developing, prototyping, and refining their products or services to meet customer needs and expectations.

Course Outcomes:

1. Students will be able to generate innovative business ideas by identifying market gaps, customer needs, and emerging trends.
2. Students will be capable of developing comprehensive business plans that encompass market research, financial projections, and strategic goals.
3. Students will gain skills in budgeting, financial forecasting, and managing financial resources for their entrepreneurial ventures.
4. Students will be able to identify and manage potential risks associated with entrepreneurship, including financial, operational, and market risks.

UNIT I

Entrepreneurial Journey, Entrepreneurial Discovery, Ideation and Prototyping,

UNIT II

Testing, Validation and Commercialisation, Disruption as a Success Driver

UNIT III

Technological Innovation and Entrepreneurship – 1, Technological Innovation and Entrepreneurship – 2, Raising Financial Resources.

UNIT IV

Education and Entrepreneurship, Beyond Founders and Founder-Families, India as a Start-up Nation

UNIT V

National Entrepreneurial Culture, Entrepreneurial Thermodynamics,

UNIT VI

Entrepreneurship and Employment, Start-up Case Studies

Textbooks / References:

1. Zero to One: Notes on Startups, or How the Build the Future by Peter Thiel.
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries.
3. India as Global Start-up Hub: Mission with Passion by C B Rao.
4. Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future by Ashlee Vance.
5. Steve Jobs by Walter Isaacson.
6. Innovation and Entrepreneurship: Practice and Principles by Peter F Drucker.
7. The Innovator's Solution: Creating and Sustaining Successful Growth by Clayton M Christensen.

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Entrepreneurship	Prof. C Bhaktavatsala Rao	IIT Madras	https://onlinecourses.nptel.ac.in/noc20_mg35/preview

12372OE102E Research Methodology Credits 03

Course Objectives:

1. To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods.
2. To develop understanding of the basic framework of research process.
3. To identify various sources of information for literature review and data collection.
4. To understand the components of scholarly writing and evaluate its quality.

Course Outcomes:

1. Learner will learn the meaning, objective, motivation, and type of research
2. Learner will be able to formulate their research work with the help of literature review
3. Learner will be able to develop an understanding of various research design and techniques
4. Learner will have overview knowledge of modelling and simulation of research work
5. Learner will be able to collect the statistical data with different methods related to research work
6. Learner will be able to write their own research work with ethics and non-plagiarized way.

UNIT I

Philosophy of Science (subjective versus objective, materialism versus idealism, causality, etc.) Logical Reasoning (inductive logic, deductive logix, syllogistic logic)

UNIT II

History of development of science and the influence of philosophy, What Scientists Actually Do

UNIT III

Forming a Hypothesis, Techniques of Scientific Measurement

UNIT IV

Testing of hypothesis, Methods of Theoretical Research

UNIT V

The Art of Scientific Communication, Presentation in Seminars and Conferences, Sponsored Research, Ethical Conduct in Science

Textbooks / References:

1. Soumitro Banerjee, Research Methodology for Natural Sciences, IISc Press, 2022.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Research Methodology	Prof. Soumitro Banerjee	IISER Kolkata	https://onlinecourses.nptel.ac.in/noc22_ge08/preview

12372MP102 Mini-Project Credits 02

The mini project shall be based on the recent trends in the industry, research and open problems from the industry and society. This may include mathematical analysis, modelling, simulation, and hardware implementation of the problem identified. The mini project shall be of the student's choice and approved by the guide. The student has to submit the report of the work carried out in the prescribed format signed by the guide and head of the department/institute.

12372AE102A
Indian Knowledge System (IKS): Concepts and Applications in Engineering
Credits 03

Course Objectives:

1. Introduce students to the foundational concepts, philosophies, and components of Indian knowledge systems, including ancient scriptures, philosophies, and traditional practices.
2. Introduce students to Vedic mathematical principles and computational techniques from ancient Indian texts, demonstrating their practical use in engineering calculations.
3. Explore the potential benefits of incorporating yogic and meditative practices into engineering to enhance focus, creativity, and overall well-being.
4. Study architectural concepts from Indian traditions and evaluate how they can inform modern urban planning and sustainable architecture.
5. Encourage students to draw inspiration from IKS to develop innovative engineering solutions that align with ancient wisdom while meeting contemporary needs.

Course Outcomes:

1. Gain a comprehensive understanding of the philosophical, scientific, and technological aspects of Indian Knowledge Systems and their historical development.
2. Understand the philosophical underpinnings of IKS, including concepts like dharma, karma, and holistic thinking, and explore their relevance to engineering.
3. Understand Vedic mathematical principles and computational methods, and their potential relevance in solving modern engineering problems.
4. Investigate the connections between yoga, meditation, and stress management, and their potential impact on mental well-being in engineering contexts.
5. Reflect on the ethical, cultural, and social dimensions of integrating IKS concepts into engineering practices and applications.

UNIT I
Indian Knowledge System – An Introduction & Vedic Corpus

What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS,

Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT II

Number system & Mathematics

Number systems in India - Historical evidence, Salient aspects of Indian Mathematics, Bhūta-Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight, Piṅgala and the Binary system.

Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contributions, Algebra, Geometry, Trigonometry, Binary mathematics, and combinatorial problems in Chandaḥ Śāstra, Magic squares in India

UNIT III

Engineering Technology: Metal & Other applications

Wootz Steel: The rise and fall of a great Indian technology, The Indian S & T heritage, Mining and ore extraction, Metals and metalworking technology, Iron and steel in India, lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components.

Irrigation systems and practices in South India, literary sources for science and technology, Physical structures in India, irrigation and water management, dyes and painting technology, the art of making perfumes, Surgical techniques, shipbuilding, sixty-four art forms (64 Kalās) status of Indigenous S & T.

UNIT IV

Town Planning and Architecture:

Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture eight limbs of Vāstu, town planning, temples in India: Marvelous stone architecture for eternity, temple architecture in India, Iconography.

UNIT V

Knowledge Framework and classifications:

Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action – the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya, Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge, Deductive or inductive logic framework, Potential fallacies in the reasoning process, Siddhānta: established tenets in a field of study.

UNIT VI

Linguistics

Introduction to Linguistics, Aṣṭādhyāyī, Phonetics, word generation, computational aspects, Mnemonics, Recursive operations, Rule based operations, Sentence formation verbs and prefixes, role of Sanskrit in natural language processing.

Textbooks / References:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Indian Knowledge	Prof. B. Mahadevan, Dr. Vinayak Rajat	(IIMB), Chanakya	https://onlinecourses.swayam2.ac.in/imb23_mg53/preview

System (IKS): Concepts and Applications in Engineering	Bhat, Dr. R Venkata Raghavan	University, Bangalore	

12372AE102B
Indian Knowledge System (IKS): Humanities and Social Sciences
Credits 03

Course Objectives:

1. Introduce students to the diverse range of Indian philosophical, cultural, and social knowledge systems that have evolved over millennia.
2. Encourage students to critically compare Indian knowledge systems with other global philosophies and social theories, fostering a nuanced understanding.
3. Study Vedic texts, ancient scriptures, and philosophical treatises to understand the core ideas and insights that inform Indian knowledge systems.
4. Investigate the intersections of spirituality, psychology, and well-being in Indian knowledge systems, exploring practices like meditation, yoga, and mindfulness.
5. Study the role of language, symbols, and communication in Indian knowledge systems, including Sanskrit as a language of knowledge transmission.

Course Outcomes:

1. Recognize the interdisciplinary nature of IKS, integrating traditional knowledge with contemporary concepts in humanities and social sciences.
2. Explore India's rich cultural heritage, including literature, art, music, dance, and rituals, and analyze their significance in shaping identity and social cohesion.
3. Explore Indian philosophical schools and their insights into consciousness, self-awareness, and psychological well-being.
4. Analyze India's cultural diversity, pluralism, and the coexistence of various belief systems, contributing to tolerance and social harmony.

UNIT I
Indian Knowledge System – An Introduction & Vedic Corpus
What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS,
Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT II
Philosophical Systems
An introduction to philosophical systems, development of philosophy unique features of philosophy, Sāṅkhya approach of philosophy, Introduction to Yoga, tenet of Nyāya philosophy principles of Vaiśeṣika, doctrine of Pūrva-Mīmāṃsā Darśana, thesis of Vedānta and synopsis of Advaita philosophy of Viśiṣṭādvaita.

UNIT III

Wisdom through ages

Gateways of ancestral wisdoms, introduction to Purāṇa, the Purāṇic repository, Issues of interest in Purāṇas, Introduction to Itihāsas, Key messages in Itihāsas, Wisdom through Nīti-śāstras, Wisdom through Subhāṣita.

UNIT IV

Health Wellness and Psychology:

Introduction to health, Āyurveda: approach to health, Sapta-dhātavaḥ: seven-tissues, role of agni in health, tri-doṣas, Āyurveda: definition of health, Psychological aspects of health, disease management elements, Dinacaryā: daily regimen for health & wellness, Importance of sleep, Food intake methods and drugs, Approach to lead a healthy life, Indian approach to psychology, the tri guṇa system & holistic picture of the individual, the Nature of Consciousness, consciousness studies and issues

UNIT V

Linguistics:

Introduction to Linguistics, Aṣṭādhyāyī, phonetics, word generation, computational aspects, mnemonics, recursive operations, rule-based operations, sentence formation, verbs and prefixes, role of Sanskrit in natural language processing.

UNIT VI

Governance and Public Administration:

Introduction to raja dharma, Arthaśāstra: a historical perspective, Elements of a kauṭilyan state, The king & the amātya, Janapada & durga, treasury and the state economy (Kośa), danda, Mitra, the administrative setup, relevance of Arthaśāstra, public administration in Epics.

Textbooks / References:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.
2. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
3. Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
4. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
5. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.
6. Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.
7. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Indian Knowledge System(IKS): Humanities and	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	Indian Institute of Management Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

Social Sciences		(IIMB), Chanakya University, Bangalore	

12372AU102 Disaster Management Audit

Course Objectives:

1. Mastering strategies to manage disasters and ensure public safety during emergencies.
2. Identifying hazards, vulnerabilities, and crafting plans to reduce disaster impact.
3. Collaborative Skills: Working across disciplines to address complex disaster challenges.
4. Developing, improving, and implementing disaster management policies. Community Empowerment: Educating and engaging communities for proactive disaster readiness.

Course Outcomes:

1. Learners will be able to understand the basic concept of disaster(s) and disaster management, their significance, and types.
2. Learners will develop the analytical skills to study relationship between vulnerability, disasters, disaster prevention and risk reduction
3. Learners will gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR)
4. Learners will be empowered with the awareness of institutional processes in the country for Disaster Management

UNIT I

Disaster Management: Disaster and Disaster Management – Concepts, Issues Concerned with Disaster Management.
Disaster Management: Phases of Disaster Management, Phases of Disaster Management
Types of Disasters: Bhopal Disaster: A Case Study, Types of Disasters-An Introduction, Natural Disaster, Man-made Disaster

UNIT II

Types of Disasters: Slow onset Disasters & Rapid onset Disasters, Simple and Complex, Tsunami: A Case Study Disasters, Tsunami: A Case Study, Cyclone Phallin 2013: A Case Study

UNIT III

Disaster Management in India -An Over View: Evolution of Disaster Management in India, Disaster and Disaster Management in India, National institute of Disaster Management, National Disaster Management Act 2005.

UNIT IV

Disaster Management in India -An Over View: The National Policy on Disaster Management, 2009.
Refugee Problem: National Plan on Disaster Management 2016, Refugee Problems, Impact of Disaster on the lives of Refugees.
Refugee Problem: Problems of Women and Children during disasters, Principles Of Psychosocial Care, Issues And Recovery During Emergency.

Refugee Problem: Relationship between Disasters, Development and Vulnerabilities, Relationship between Disasters, Development and Vulnerabilities.

UNIT V

Refugee Problem: Equity Issues in Disaster.
Refugee Problem: Issues of Rehabilitation and Resettlement among the Disaster Survivors, Stakeholders in Disaster Relief Management - An Introduction.
Stakeholders in Disaster Relief Management: Central Government.
Stakeholders in Disaster Relief Management: State Government, District Administration.
Armed Forces.

UNIT VI

Stakeholders in Disaster Relief Management: Para-Military Forces, Fire Services.
Disaster Risk Reduction: Disaster Risk Reduction Strategies, Risk Reduction Preparedness Plans.
Disaster Risk Reduction: Action Plans and Procedures, Early Warning Systems, Components of Disaster Relief, Factors contributing to Vulnerability.
Disaster Risk Reduction: Disaster Risk Reduction - Master Planning for the Future, Capacity Building Rehabilitation measures and long-term reconstruction, Understanding Kerala Disaster 2018.

Textbooks / References:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Encyclopaedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
6. Encyclopaedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008
7. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur.
8. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
9. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
10. Disaster Management Act 2005, Publisher by Govt. of India
11. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
12. NIDM Publications
13. High Power Committee Report, 2001, J.C. Pant
14. Disaster Mitigation in Asia & Pacific, Asian Development Bank
15. National Disaster Management Policy, 2009, GoI
16. Disaster Preparedness Kit, American Red Cross

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Disaster Management	Naveen Kumar Nanjundan	University Of Hyderabad	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

SEMESTER III

12372OE201A	Student Psychology	Credits 03

Course Objectives:

1. Gain an understanding of prominent learning theories and models, enabling you to grasp the foundational concepts that influence effective teaching and learning.
2. Acquire skills to assess and appreciate diverse student characteristics, including learning styles, cultural backgrounds, and individual differences that impact learning.
3. Gain proficiency in understanding, administering, and interpreting psychological tests and inventories to assess cognitive abilities, personality traits, and emotional development in learners.
4. Examine psychological theories of motivation and cultivate the skills needed to apply motivational strategies that enhance student engagement, commitment, and achievement.
5. Investigate the stages of physical, cognitive, emotional, and social development in individuals, equipping you to design instructional methods that support comprehensive growth.
6. Acquire an understanding of NLP concepts and techniques that can be used to improve communication, establish rapport, and optimize teaching and learning experiences.

Course Outcomes:

1. Understanding of Psychological Factors: Gain a comprehensive understanding of the psychological factors that influence students' learning, behaviour, and overall well-being in educational settings.
2. Recognition of Diverse Student Needs: Develop the ability to recognize and appreciate the diverse cognitive, emotional, and social needs of students, enabling tailored support and fostering inclusive learning environments.
3. Application of Psychological Strategies: Apply psychological theories and principles to address various challenges in student development, including motivation, learning difficulties, and behavioural issues.
4. Competence in Student Assessment: Acquire skills in utilizing psychological assessment tools to evaluate students' cognitive abilities, emotional states, and learning styles, informing instructional strategies and support plans.
5. Promotion of Positive Learning Experiences: Learn to create positive and conducive learning experiences by integrating insights from student psychology, fostering engagement, motivation, and holistic growth among learners.

UNIT I
Teaching Learning Process

UNIT II
Student Characteristics, Types and Problems

UNIT III
Psychological Tests and Inventories, Student Motivation

UNIT IV
Physical and Cognitive Development

UNIT V
Emotional and Social Development

UNIT VI
Neuro-Linguistic Programming, Counselling Skills, and Summary

Textbooks / References:

1. Sharma, R.A. (2007). Training Technology. Meerut: Surya Publications.
2. Sharma, R.A. (2007). Psychology of Teaching-Learning Process. Meerut: Surya Publications.
3. B.Mukhopadhyay(1997). Motivation in Educational Management. New Delhi: Sterling Publishers.
4. Barki & Mukhopadhyay. (1995). Guidance and Counselling. New Delhi: Sterling Publishers.
5. Agochya, D. (2010). Life competencies for adolescents. New Delhi: Sage Publications.
6. Davies, I.K. (1971). Management of Learning. Berkshire: McGraw Hill.
7. Dusay. (1980). Egograms. New York: harper & Row.
8. Goleman, D. (1996). Emotional Intelligence. New York: Bantom Books.
9. Anastasi. (2016). Psychological Testing. New Delhi: Pearson Education. Psychological Tests.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Student Psychology	Dr. S. Renukadevi	NITTTR, Chennai	https://onlinecourses.swayam2.ac.in/ntr19_ed23/preview

12372OE201B Business To Business Marketing (B2B) Credits 03

Course Objectives:

1. Develop a comprehensive understanding of the unique characteristics, dynamics, and complexities that define business-to-business (B2B) marketing, including the role of intermediaries, supply chains, and collaborative relationships.
2. Learn how to segment B2B markets based on factors such as industry, company size, and purchasing behaviour. Understand the significance of effective market segmentation in tailoring marketing strategies to specific B2B customer segments.
3. Explore the elements of the B2B marketing mix, including product/service offerings, pricing strategies, distribution channels, and promotional approaches. Develop the ability to design marketing strategies that align with the unique needs and preferences of B2B customers.
4. Gain insights into relationship-building strategies in B2B contexts. Learn how to nurture long-term, mutually beneficial partnerships with B2B clients through effective communication, trust-building, and value delivery.
5. Acquire skills in B2B sales processes, negotiations, and contract management. Understand the intricacies of negotiation dynamics, procurement processes, and key decision-making factors in B2B transactions.

Course Outcomes:

1. Foundational Knowledge: Gain a strong grasp of the core concepts and theories that form the basis of B2B marketing, enabling practical application.
2. Market Analysis Expertise: Develop skills to analyse B2B markets, segment customers effectively, and make informed marketing decisions.
3. Strategic Implementation: Acquire the ability to design and execute B2B marketing strategies tailored to the unique needs of business customers.
4. Relationship Management: Learn how to build and nurture enduring relationships with B2B clients through effective communication and collaboration.
5. Sales and Negotiation Proficiency: Master the art of B2B sales, negotiation strategies, and contract management for successful transactions.

UNIT I

Introduction to B2B Marketing: Business marketing, Classifying goods for the business market, Business market customers, Market structure, Environment and Characteristics of Business Marketing, Strategic role of marketing, Commercial enterprises, Commercial and institutional customers, B2B vs B2C Marketing.

Organizational Buying and Buyer Behaviour: Organizational buyers' decision process - A Stepwise Model and A Process Flow Model, Organizational and business markets - Government as a customer - Commercial enterprises - Commercial and institutional customers, Value analysis, Buygrid framework, Strategic procurement.

UNIT II

B2B Marketing Strategy: Strategy making and strategy management process, Industrial product strategy– Managing Products for Business Markets-Managing Services for Business Markets-Managing Business Market Channels the Growth-Share Matrix, Multifactor Portfolio Matrix, The Balanced Scorecard.

B2B Marketing STP: Market Segmentation, bases for segmenting business markets, basic framework of segmentation, choosing target segments and positioning.

UNIT III

Business Marketing Communications- B2B Advertising, Digital marketing, - Trade shows, exhibitions, business meets - Managing the sales force - Deployment analysis, Direct marketing

Demand forecasting: industrial market, Forecasting- meaning, importance and relevance, issues related to forecasting, forecasting measurement models, sales force forecasting, estimating segment demand, Collaborative approach to estimate demand, qualitative and quantitative forecasting methods.

UNIT IV

Product management: (existing and new) in industrial market, role of product in the industrial market, new product development, industrial product life cycle, product evaluation matrix, techniques for identifying new products QFD, perceptual mapping, reverse engineering, fish bone diagram, role of service and maintenance in industrial markets, customer experience life cycle, service quality.

Pricing: Pricing strategies; The pricing policy; Price on the Internet; Financial marketing, competitive bidding, commercial terms and conditions, role of leasing.

UNIT V

Buyer seller relationship, types of relationships, transactional and collaborative relationships, influencing industrial customers, role of service in industrial markets. CRM.

B2B marketing research, challenges in B2B research, developing a marketing information system, role of qualitative research techniques in B2B research.

UNIT VI

Business marketing channels and participants - Channel design and management decisions - B2B logistics management, types of industrial middlemen and intermediaries, marketing logistics and physical distribution.

Strategic decision making in industrial markets, strategic planning at corporate levels, allocation of resources, portfolio analysis, developing SBU'S objectives and goals, implementing and controlling marketing plan. Marketing through electronic commerce.

Textbooks / References:

1. Business Market Management Understanding, Creating and Delivering Value by James C. Anderson, Das Narayandas, James A. Narus and D.V.R. Seshadri Pearson, 2010 3rd edition
2. Business Marketing Management b2b By Hutt and Speh South-Western CENGAGE Learning www.cengagebrain.com 2013
3. B2B Brand Management by Kotler and Pfoertsch Springer www.springer.com 2006
4. Business Marketing: Text and Cases by Krishna K Havaldar, McGrawhill Publications, 2014 4th edition.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Business To Business Marketing (B2B)	Prof. J. K. Nayak	IIT Roorkee	Business To Business Marketing (B2B) – Course (nptel.ac.in)

12372OE201C Organizational Behaviour Credits 03

Course Objectives:

1. Explore how personality, motivation, perception, attitudes, and emotions impact employee performance and job satisfaction.
2. Study group formation, communication, decision-making, conflict resolution, and leadership's role in fostering teamwork.
3. Learn about the role of organizational culture in shaping behaviour, and develop skills to manage and align culture with goals.
4. Gain insights into leadership styles, communication, and team management for enhancing performance and satisfaction.
5. Navigate change, promote inclusivity, and address diversity-related challenges to cultivate adaptability and resilience in the workplace.

Course Outcomes:

1. Develop a grasp of how individual factors influence workplace behaviour, impacting job satisfaction and performance.

2. Acquire skills to foster productive group dynamics, facilitating better communication, decision-making, and conflict resolution.
3. Understand the role of organizational culture, and learn to manage and cultivate cultures aligned with organizational goals.
4. Gain insights into diverse leadership styles, enhancing the ability to manage teams and guide them towards success.
5. Develop the capacity to navigate change, promote diversity, and create an inclusive work environment, fostering resilience.

UNIT I

Introduction – a) defining organization, behavior and organizational behavior, b) assumptions of OB, c) principles of OB, d) levels of OB, e) scope of OB, f) OB and Human Resource Management, g) Applications of OB, h) Historical developments of OB, i) emerging concerns

Perception and Learning – a) understanding perception, b) Basic elements of perception, c) Principles of perceptual selection, d) Perceptual grouping, e) Social Perception, f) Self-perception and identity, g) attribution of causality, h) Perceptual biases in social perception, i) Implications for human resource management, j) defining learning, k) classical and operant conditioning l) learning in organizations.

UNIT II

Personality – a) Defining Personality, b) History of the concept, c) Key assumptions, d) biological and social determinants, e) Theories – Intrapsychic theory, social learning theory, self-theory, Trait, and type theories f) Related concepts (locus of control, dogmatism, authoritarianism, Machiavellianism), g) measuring personality.

Attitudes – a) Definition, b) Key elements of attitudes, c) Attitudes and related concepts (Values, opinion, belief, and ideology), e) Characteristics of attitudes, f) Attitude formation, g) Attitude measurement, h) Changing attitudes, i) Attitudes at workplace (job satisfaction, work attitude and organizational commitment), j) Prejudice and discrimination at workspace.

UNIT III

Emotions in workplace - a) Definition, b) Types of emotions, c) Related concepts (mood, temperament), d) Stress in workplace, e) General Adaptation Syndrome, f) Managing Stress, g) Psychosomatic disorders and stress h) emotional labor and emotional contagion.

Motivation – a) Definition, b) Process of motivation, c) Types of motives, d) Motivators at workplace, e) Motivation theories (Process and Content theories).

UNIT IV

Interpersonal Dynamics – a) Definition, b) Psychological Contract, c) Trust and trust building, d) Prosocial behaviour, e) Cooperation Vs Competition f) Conflict management, g) Levels and types of conflict at workplace, h) Conflict management Styles, i) Managing Negotiations

Power and Leadership - a) Defining Power, b) Sources of Power, c) Organizational politics, d) Leadership e) Managers Vs Leaders, f) Trait and Type approach to leadership g) Leadership style, h) Leadership Grid, i) Contingency Theories j) Contemporary issues

UNIT V

Team Dynamics – a) Groups and Teams, b) Types of Teams, c) Stages in group development, d) problems in team work (Free riding, social loafing, group think), e) Cross-cultural virtual teams.

Organizational culture – a) Defining culture, b) levels of culture, c) cultural dimensions, d) high and low context cultures, e) Strong and weak organizational cultures, f) Expressions of organizational culture, g) Impact of culture on individuals, h) Organizational cultural change

UNIT VI

Organization Change – a) Change in Organizations, b) Nature of the chance process, c) Types of chance, d) Impact of change, e) Managing resistance to change, f) Organizational Development interventions

Organizational Structure and Design – a) Basic dimensions of structure, b) Departmentalization, c) Organizational life cycle, d) Organizations as socio-technical systems, e) Organizational design and its impact on employees, f) Organizational boundary spanning.

Textbooks / References:

1. Behaviour in Organizations by Jerald Greenberg and Robert A. Baron, PHI learning private Ltd, New Delhi (Ninth Edition).
2. Understanding Organizational Behaviour by Udai Pareek, Oxford University Press (Third Edition).
3. ORGB by Nelson, Quick and Khandelwal, Cengage Learning New Delhi (second edition).

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Organizational Behaviour	Prof. M. P. Ganesh	IIT Hyderabad	Organizational Behaviour – Course (nptel.ac.in)

12372OE201D Principles of Economics Credits 03

Course Objectives:

1. Introduce essential economic terms and concepts for analysing real-world situations.
2. Understand market dynamics, supply and demand, and resource allocation.
3. Study national indicators, inflation, unemployment, and government policies' effects.
4. Learn to make informed choices using opportunity cost, utility, and cost analysis.
5. Explore global interdependencies, trade, exchange rates, and policy impacts.

Course Outcomes:

1. Grasp key economic principles, like supply and demand, opportunity cost, and marginal analysis, forming a foundation for economic understanding.
2. Gain insights into market structures, pricing mechanisms, and factors influencing consumer and producer behaviour.
3. Understand the role of government interventions, regulations, and fiscal/monetary policies in shaping economic outcomes.
4. Learn how societies allocate scarce resources efficiently, exploring topics like production, distribution, and factors of production.
5. Develop analytical thinking by applying economic principles to real-world scenarios, making informed personal and business decisions.

UNIT I
Principles of Economics, Thinking like an Economist; Interdependence and the gains from Trade.

UNIT II
Market forces of supply and Elasticity, Application of elasticity; supply, demand, and government policies

UNIT III
Consumer and producer surplus; cost of taxation and international trade, Externalities, and cost of production

UNIT IV
Competitive market and monopoly market, Game theory and oligopoly, measures national income, measuring cost of living

UNIT V
Production and growth; Saving, Investment and the financial system, the monetary system, Money growth and inflation

Textbooks / References:
1. N.Gregory Mankiw, Principles of Economics.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Principles Of Economics	Prof. Sabuj Kumar Mandal	IIT Madras	Principles Of Economics – Course (nptel.ac.in)

12372OE201E Intellectual Property & Rights Credits 03

Course Objectives:
1. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
2. To get registration in our country and foreign countries of their invention, designs and thesis or theory written by the students during their project work and for this they must have knowledge of patents, copy right, trademarks, designs and information Technology Act.
3. Further teacher will have to demonstrate with products and ask the student to identify the different types of IPR's.

Course Outcomes:
1. The students once they complete their academic projects, they get awareness of acquiring the patent.
2. They also learn to have copyright for their innovative works.
3. They also get the knowledge of plagiarism in their innovations which can be questioned legally.

UNIT I

Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant. Varieties and Traditional Knowledge.

UNIT II

Patent Rights and Copy Rights— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.

UNIT III

Copy Right—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.

UNIT IV

Trade Marks: Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.

UNIT V

Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.

UNIT VI

Basic Tenents Of Information Technology Act-2000, IT Act - Introduction, E-Commerce and legal provisions, E- Governance and legal provisions, Digital signature and Electronic Signature. Cybercrimes.

Textbooks / References:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3. IPR by P. Narayanan
4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Intellectual Property & Rights	Prof. Feroz Ali	IIT Madras	https://onlinecourses.nptel.ac.in/noc23_hs55/preview

12372OE201F Introduction to Public Administration Credits 03

Course Objectives:

1. Define public administration and explain its role in society.
2. Identify and analyze the different types of public organizations.
3. Apply public administration theories and principles to real-world problems.
4. Develop the skills and knowledge necessary to pursue a career in public administration.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define public administration and explain its role in society.
2. Identify and analyze the different types of public organizations.
3. Apply public administration theories and principles to real-world problems.
4. Develop the skills and knowledge necessary to pursue a career in public administration.

UNIT – I

Public Administration: Meaning Nature, Scope and Significance of Public, Administration. Difference between Public and Private Administration, Administration as an Art or Science, New Public Administration, New Public Management, E-Governance: Concept, Rationale and significance.

UNIT – II

Theories of Organization – Classical, Neo classical and Modern theory, Approaches to the study of Public Administration: Structural – functional, systems, approach, Behavioral approach, Public Choice approach, Bureaucracy: Meaning types and Weberian model of Bureaucracy.

UNIT – III

Organization: formal and informal organizations, Principles of organization – Hierarchy, Span of control, unity of command and Coordination.

UNIT IV

Concepts of Public Administration: Power, Authority, and responsibility, Decision Making: Meaning, Classification and Essentials of decision making, Process of decision making, techniques of decision making, approaches to decision making.

UNIT – V

Good Governance: Concept, characteristics, elements. Issues and Challenges, Leadership: Development of leadership, Qualities of leadership, Accountability and control –Executive, Legislative, Judicial. Citizen and Administration: Issues and problems, Methods to promote good relationship.

References/Textbooks:

1. Felix, A. Nigro and C. Nigro Modern Public Administration (New York: Lloyd Harper and Row, Latest edition)
2. John Pfiffiner and Frank Sherwood Administrative Organization (New Delhi: Prentice Hall, Latest ed.).

3. Peter F. Drucker Management: Tasks, Responsibilities, Practices (Bombay: Allied Publishers, latest ed.).
4. H. Koontz and Cyril O'Donnell Principles of Management, (Tokyo: McGraw Hill, latest ed).
5. Amitai Etzioni Modern Organizations (New Delhi: Prentice Hall, latest ed.).
6. Robert T. Golembiewsky Public Administration as a Developing Discipline (New York: Marcel, latest ed.).
7. Mohit Bhattacharya Public Administration (Calcutta: World Press, latest ed).
8. Mamta Mokta, S.S.Chauhan, S.K. Mahajan and Simmi Agnihotri Challenges in Governance(ed) Anamica Publishers,New Delhi 2011
9. C.P. Bhambri Public Administration (Theory and Practice (Meerut: Educational Publishers, latest ed.).
10. Bertram Gross The Managing of Organisations (London: Free Press, latest ed.).
11. W.M. Newman, C. Summer and E.Warren Management Concepts, behaviour & practice, edu. Publishers Meerut.
12. P. Herseay and K.H. Blanchard Management of Organisational Behaviour (New Delhi:latest ed.).
13. Nicholas Henry Public Administration and Public Affairs, (New Jersey: Prentice Hall, latest ed.).
14. Herbert G. Hicks and Ray C. Gutlet Organisations: Theory and Behaviour (New York: McGraw Hill, latest ed.).
15. Ramesh, K. Arora (ed.) Perspective in Administrative Theory (New Delhi: Associated, latest ed.).
16. S.L. Kaushik and Pardeep Sahni (eds.) Public Administration in India: Emerging Trends (Allahabad: Kitab Mehal, latest ed.).
17. J.S. Vickers and George K. YarrowPrivatization: An Economic Analysis (Cambridge: MIT Press, latest ed.).
18. David Osborne and T. Gaebler Re-inventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector (New York: Addison Wesley, latest ed.).

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Introduction to Public Administration	By Prof. Y. Pardhasaradhi	Osmania University Hyderabad.	https://onlinecourses.swayam2.ac.in/cec21_hs06/preview

12372MD201A Design of Mechatronic Systems Credits 03

Course Objectives:

1. Introduce students to the interdisciplinary nature of mechatronics, emphasizing the integration of mechanical engineering, electronics, control systems, and computer science.
2. Familiarize students with a variety of sensors and actuators commonly used in mechatronic systems, and explain their principles of operation and selection criteria.
3. Provide an understanding of control system theory, enabling students to design and implement closed-loop control strategies for mechatronic systems.
4. Introduce software development concepts, including programming languages, real-time operating systems, and software architecture for mechatronic applications.

5. Demonstrate techniques for integrating mechanical components, electronics, and software modules seamlessly, ensuring proper communication and synchronization.

Course Outcomes:

1. Apply knowledge to select appropriate sensors and actuators based on system requirements, considering factors such as accuracy, range, and compatibility.
2. Analyze and process sensor data using signal processing techniques, demonstrating the capability to extract meaningful information from noisy sensor measurements.
3. Proficiently program microcontrollers and embedded systems to interface with sensors, actuators, and other hardware components.
4. Integrate mechanical components and subsystems with electronics and software, ensuring seamless communication and optimal functionality.

UNIT I

Introduction: Elements of mechatronics system: Sensor, actuator, plant, and controller. Applications of mechatronics system. Systems like CDROM, scanner opened to see whats there inside and why? Integrated mechanical-electronics design philosophy. Examples of real-life systems. Smart sensor concept and utility of compliant mechanisms in mechatronics

UNIT II

Microprocessor building blocks, combinational and sequential logic elements, memory, timing, and instruction execution fundamentals with example of primitive microprocessor. Microcontrollers for mechatronics: Philosophy of programming interfaces, setting sampling time, and getting started with TIVA programming. programming different interfaces PWM, QEI etc. Mathematical modeling of mechatronic systems,

UNIT III

Modeling friction, DC motor, Lagrange formulation for system dynamics. Dynamics of 2R manipulator, Simulation using Matlab, Selection of sensors and actuators.

UNIT IV

Concept of feedback and closed loop control, mathematical representations of systems and control design in linear domain. Basics of Lyapunov theory for nonlinear control, notions of stability, Lyapunov theorems and their application

UNIT V

Trajectory tracking control development based on Lyapunov theory, Basics of sampling of a signal, and signal processing.

UNIT VI

Digital systems and filters for practical mechatronic system implementation. Research example/ case studies of development of novel mechatronics system: 3D micro-printer, Hele Shaw system for microfabrication.

Textbooks / References:

1. Devdas Shetty, Richard A. Kolk, “Mechatronics System Design,” PWS Publishing company.

2. Boukas K, Al-Sunni, Fouad M "Mechatronic,Systems Analysis, Design and Implementation," Springer,
3. Sabri Cetinkunt, "Mechatronics with Experiments," 2nd Edition, Wiley.
4. Janschek, Klaus, "Mechatronic Systems Design," Springer.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Design Of Mechatronic Systems	Prof. Prasanna Gandhi	IIT Bombay	Design Of Mechatronic Systems – Course (nptel.ac.in)

12372MD201B Ethical Hacking Credits 03

Course Objectives:

1. Introduce students to the concept of ethical hacking, its importance in cybersecurity, and the role of ethical hackers in identifying vulnerabilities.
2. Provide an overview of cybersecurity principles, threats, and attacks, highlighting the need for ethical hacking to strengthen defences.
3. Teach students a structured approach to hacking, including reconnaissance, scanning, gaining access, maintaining access, and covering tracks.
4. Cover essential network concepts to help students understand how networks function, including protocols, IP addressing, and network architecture.

Course Outcomes:

1. Gain a comprehensive understanding of ethical hacking concepts, methodologies, and its role in enhancing cybersecurity.
2. Acquire a solid grasp of cybersecurity principles, types of threats, and the importance of proactive defence strategies.
3. Develop proficiency in various hacking techniques, including reconnaissance, scanning, exploitation, and post-exploitation activities.
4. Perform effective vulnerability assessments on systems and networks, identifying potential security weaknesses and exposures.
5. Demonstrate the ability to conduct penetration tests, simulating real-world attacks to evaluate the strength of security measures.

UNIT I

Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.
IP addressing and routing. TCP and UDP. IP subnets. Routing protocols. IP version 6.

UNIT II

Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool**.**

UNIT III
Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

UNIT IV
Introduction to cryptography, private-key encryption, public-key encryption. Cryptographic hash functions, digital signature and certificate, applications. Steganography, biometric authentication, network-based attacks, DNS, and Email security.

UNIT V
Packet sniffing using Wireshark and Burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks. Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans.

UNIT VI
Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc. Attack on web servers: password attack, SQL injection, cross site scripting.

Textbooks / References:

1. Data and Computer Communications -- W. Stallings.
2. Data Communication and Networking -- B. A. Forouzan
3. TCP/IP Protocol Suite -- B. A. Forouzan
4. UNIX Network Programming -- W. R. Stallings
5. Introduction to Computer Networks and Cybersecurity -- C-H. Wu and J. D. Irwin
   Cryptography and Network Security: Principles and Practice -- W. Stalling

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Ethical Hacking	Prof. Indranil Sengupta	IIT Kharagpur	Ethical Hacking – Course (nptel.ac.in)

12372MD201C Sustainable Power Generation Systems Credits 03

Course Objectives:

1. The course content is designed to provide comprehensive knowledge of various renewable energy systems. Specifically, in this course, the design and analysis of renewable energy power plants will be discussed.
2. The concepts will be illustrated with practical examples, schematics and block diagrams wherever required. Enough numerical problems with solutions will be discussed in the course.
3. This course is specifically designed for undergraduate and postgraduate students of Energy Engineering and Technology.
4. Further, the course will be very much useful for students and researchers from varied academic backgrounds for the synthesis of novel energy conversion devices and processes.

Course Outcomes:

1. Explain the principles of sustainability in the context of power generation and understand its significance in the global energy transition.
2. Identify and describe various renewable energy sources, including solar, wind, hydro, geothermal, and biomass, and explain their potential for power generation.
3. Compare and contrast the advantages and limitations of different sustainable power generation technologies, considering factors such as efficiency, scalability, reliability, and intermittency.
4. Analyse the environmental, social, and economic impacts of both conventional and sustainable power generation methods, and evaluate their contributions to mitigating climate change and reducing pollution.

UNIT I

Introduction to power generation:

Global and Indian scenario, an overview of current technologies available for power generation, Concept of the renewable energy- based power plant

Solar Thermal Power Generation:

Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator), ORC, RC, and Stirling engine.

UNIT II

Solar Photovoltaic Power Generation:

Fundamentals of Solar photovoltaic energy conversion, Solar PV power plant design, Performance analysis of standalone and grid connected PV systems.

Wind Power Generation:

Introduction to wind turbine, classification and analysis of different components, Theory, design, and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.

UNIT III

Hydro Power Generation:

Introduction to hydro power plant, overview of micro, mini and small hydro power plants, hydraulic turbines, Selection and design criteria of pumps and turbines, Brief theory, design, and analysis of hydro power plants

Biomass Power Generation:

Fundamentals of bioenergy production technologies through different routes, design, and analysis of biochemical and thermochemical reactors for clean power generation and value-added products, IGCC.

UNIT IV

Hydrogen energy and fuel cells

Importance, various routes of hydrogen generation, basic principle, and design of different types of fuel cells and their applications, prospects, IGFC

Week 8: Module-8: Geothermal Energy

Fundamentals, classification, theory, design, and analysis of geothermal power plant

UNIT V

Ocean Thermal Energy

Fundamentals, classification, theory, design, and analysis of ocean thermal power plant

Week 10: Module-10: Wave and Tidal Energy

Fundamentals, classification, theory, design, and analysis of wave and tidal power plant

UNIT VI

Energy Storage

Different modes of energy storage; design and analysis of different technologies for thermal, mechanical, and electro-chemical energy storage systems

Week 12: Module-12: Energy Economics

Cost analysis, interest, accounting rate of return, Payback, Discounted cash flow, Net present value, Internal rate of return, Inflation, and life cycle analysis of energy systems.

Textbooks / References:

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, springer, 2nd Edition, 2019.
8. S.p Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Private Limited, 3rd Edition, 2010.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Sustainable Power Generation Systems	Dr. Pankaj Kalita	IIT Guwahati	Sustainable Power Generation Systems – Course (nptel.ac.in)

12372MD201D Components and Applications of Internet of Things Credits 03

Course Objectives:

1. The objective of this course is to learn about Basics of IoT, Components of IoT including Sensors and actuators, computing, and communication systems.
2. It will also cover IoT Protocols, Security of IoT, Cloud based design and AI/Deep learning-based analytics.

Course Outcomes:

1. Identify IoT Components: Recognize and classify key components of IoT systems, including sensors, actuators, communication protocols, and data processing units.
2. Explore IoT Communication: Understand various wireless and wired communication technologies used in IoT networks and their suitability for different application scenarios.

3. Design IoT Applications: Create IoT solutions by integrating hardware and software components, demonstrating proficiency in prototyping, programming, and data handling.
4. Analyse Data from IoT Devices: Collect, analyse, and interpret data generated by IoT devices to extract meaningful insights and support informed decision-making.

UNIT I
Basics of IoT
Introduction to Internet of things, Various sensors, and sensing techniques. Technological trends in IoT. impact of IoT on society. Review of various IoT application domain including agriculture, healthcare, manufacturing, device management, and vehicle to vehicle communication and wearable computing devices.

UNIT II
Microcontroller and Interfacing Techniques for IoT Devices
Introduction to IoT and architecture layers, IoT smart devices, Typical embedded computing systems, Introduction to ARM architecture and programming method, Embedded system development: a case study, Introduction to interfacing techniques.

UNIT III
IoT Protocols & Security
Networking and basic networking hardware. Networking protocols, Interaction between software and hardware in an IoT device. IoT components and technologies to secure systems and devices.
Various security issues related to the IoT and security architectures. Hardware security threats and security vulnerabilities; protecting physical hardware

UNIT IV
Location Tracking
Introduction to device localization and tracking; different types of localization techniques: time-of-arrival (TOA) based, time-difference-of-arrival (TDOA) based, angle-of-arrival (AOA) based, received signal strength (RSS) based, Radio-Frequency Identification (RFID) based and fingerprinting based; Monte-Carlo tracking; Kalman filter based tracking; Cramer-Rao lower bound (CRLB) for device location estimator; Device diversity/heterogeneity issue in IoT networks.

UNIT V
Deep learning for IoT
This topic will focus how to build good model from the past data to predict correctly when the system is provided with a data-point. In this course mostly, supervised learning will be considered. Basics of neural network, activation functions, back-propagation, etc. will be covered. At the end some of the challenges in the context of IoT will be mentioned.

UNIT VI
IoT Applications
Smart grid: Introduction to smart grid, Integration of IoT into smart grid, Standardization activities for IoT aided smart grid, Applications of IoT aided smart grid, Architectures for IoT sided smart grid, Prototypes, Applications of big data and cloud computing, Open Issues, and challenges.

IoT-based Smart Home and Nano-grid Monitoring System
Sensor-Controller Coordination of a DC Microgrid in IoT Platform, Cyber physical system, dc microgrid, dc–dc power converter, distributed energy generator, sensor control and controller design. Low-Cost DC Nano-grid with Smart Remote Monitoring Unit, DC-DC converter modelling, closed loop control, placement of IoT devices, sensors, micro grid, solar energy, low-cost communication system design.
Introduction, objective, components of home monitoring system, control, and management, Zigbee, Wireless Sensor Network (WSN), Internet of Things (IoT).

Internet of Robotic Things (IoRT):
Introduction to stationary and mobile robots; Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IoT in robotics; Architectures for IoRT; Examples and case studies; Open issues and challenges.

Textbooks / References:
It will be provided in each of the lecture sessions.
(Refer **NPTEL** platform)

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Components And Applications of Internet of Things	Dr. Sanjoy Kumar Parida	Indian Institute of Technology Patna	https://onlinecourses.swayam2.ac.in/arp20_ap03/preview

12372MD201E Linear Algebra Credits 03

Course Objectives:
1. Understand the fundamental principles of vector spaces and matrices.
2. Develop the ability to solve systems of linear equations using various methods.
3. Learn how to analyse and manipulate linear transformations and their properties.
4. Apply linear algebra concepts to solve real-world problems in fields such as physics, engineering, and computer science.

Course Outcomes:
1. Students will demonstrate proficiency in performing matrix operations and solving linear equations in diverse mathematical contexts.
2. Students will apply linear algebra concepts to model and solve practical problems across multiple disciplines.
3. Students will analyse and interpret geometric transformations through the lens of linear transformations.
4. Students will develop critical thinking and problem-solving skills by using linear algebra as a foundation for advanced mathematical and scientific studies.

UNIT I
Vectors, vector spaces, span, linear independence, bases
Dimension, linear transformations

UNIT II
Null spaces, range, coordinate bases
Matrix multiplication, Invertibility, Isomorphisms
UNIT III
Coordinate change, products and quotients of vector spaces, duality
Review of elementary row operations, rank, determinants
UNIT IV
Eigenvalues, Eigenvectors
Diagonalization
UNIT V
Characteristic polynomials, inner products and norms
Orthogonal bases, orthognalization, orthogonal complements
Adjoints, normal and self-adjoint operators
Spectral theorem for normal and self-adjoint operators

References/Textbooks:

1. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., First Course in Linear Algebra, Wiley Eastern Ltd., 1991.
2. Friedberg S.H, Insel A.J. and Spence L.E., Linear Algebra, 4th Edition, Prentice-Hall of India, New Delhi, 2004.
3. Hoffman K. and Kunze R., Linear Algebra, 2nd Edition, Prentice-Hall of India, New Delhi, 2000.
4. Kalman D., A singularly valuable decomposition; the SVD of a matrix, The College Math. Journal, Vol .27, No.1, (1996).
5. Kumaresan, S., Linear Algebra-A Geometric approach, Prentice-Hall of India, New Delhi, 2001.
6. Lay D.C., Linear Algebra and Its application, 3rd edition, Pearson Education(Singapore) Pvt. Ltd., Delhi, 2003.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Linear Algebra	Prof. Pranav Haridas	Kerala School of Mathematics	https://onlinecourses.nptel.ac.in/noc20_ma21/preview

12372MD201F Artificial Intelligence and Machine Learning Credits 03

Course Objectives:
1. Apply AI techniques to solve the given problems.
2. Implement trivial AI techniques on relatively large system
3. Explain uncertainty and Problem-solving techniques.
4. Compare various learning techniques.

Course Outcomes:
This course will enable students to
1. Identify the AI based problems.
2. Apply techniques to solve the AI problems.
3. Define learning and explain various logic inferences.
4. Discuss different learning techniques.

UNIT I
Introduction to AI and State space search, Introduction to unguided and guided search
UNIT II
Problems in search and solutions, Genetic algorithms, Neural Networks, BPNN, learning process in BPNN

UNIT III
Some other search methods and Admissibility, Planning, Game Playing

UNIT IV
Minimax and other game playing algorithms , using predicate logic for Knowledge Representation

UNIT V
Resolution and non-monotonic reasoning, Strong methods for Knowledge Representation; Fuzzy logic and CD, Scripts and Introduction to Expert systems, Developing expert systems and Machine learning

Text/Reference Books:
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. IIIEdition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGrawHill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education,2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems", Oxford UniversityPress-2015.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Artificial Intelligence and Machine Learning	By Prof. Bhushan Trivedi	GLS University	https://onlinecourses.swayam2.ac.in/cec21_cs08/preview

12372SE201 Seminar II Credits 02

The seminar shall be on the state of the art in the area of the advanced communication of student's choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

12372PR201 Project I Credits 10

Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed

system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic.
It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal.
The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

SEMESTER IV

12372PR202	Project II	Credits 20

In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal.

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.