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

Telephone and Fax: 02140 - 275142

www.dbatu.ac.in

Course Structure and Detailed Syllabus

For

M. Tech. Programme in VLSI and Embedded System

In line with New Education Policy 2020 guidelines

(Effective from Academic Year 2024-25 for Affiliated colleges only)

Dr. Babasaheb Ambedkar Technological University
M.Tech. (VLSI and Embedded System)
In line with New Education Policy 2020 guidelines
(Effective from AY 2024-25 for Affiliated colleges only)

	Course Code	Course Title	L	T	P	Cr	Categorisation
SEM- I	MTVEC101	VLSI Technology and Design	3	1	-	4	PCC
	MTVEC103	Advanced Embedded Logic	3	1	-	4	PEC
	MTVEE114	Elective-I	3	1	-	4	PEC
	MTVEE125	Elective-II	3	1	-	4	PCC
	MTVEL107L	PG Lab-I	-	-	4	2	PCC
	MTVES 101	Seminar-I	-	-	4	2	ELC
	MTVEAU 101	YOGA for Stress Management	-	-	2	-	Audit Course
		Total	**12**	**2**	**10**	**20**	
SEM- II	MTVEC201	Embedded Real Time Operating Systems	3	1	-	4	PCC
	MTVEC202	CMOS Mixed Signal Circuit Design	3	1	-	4	PCC
	MTVEE244	Elective- III	3	1	-	4	OE
	MTVEE255	Open Elective I	3	-	-	3	PCC
	MTVEL 207L	PG Lab-II	-	-	4	2	PCC
	MTVEP207	Mini-Project	-	-	4	2	ELC
	MTVES206	IKS Bucket	3	-	-	3	AEC/VEC/IKS
	MTVEAU201	Disaster Management	-	-	2	-	Audit Course
		Total	**15**	**2**	**10**	**22**	
SEM- III	MTVEOE201	Open Elective II	3	-	-	3	OE
	MTVEMD201	Multidisciplinary Minor	3	-	-	3	MD M
	MTVESE201	Seminar II	-	-	4	2	ELC
	MTVEPR201	Project I	-	-	-	10	ELC
		Total	**6**	**2**	**4**	**18**	
SEM-IV	MTVEPR202	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)	Hardware Software Co-Design
B)	Digital System Design
C)	Soft Computing Techniques
D)	CPLD and FPGA Architectures and Applications
E)	Advanced Computer Architecture

	Program Elective -II
A)	Advanced Operating Systems
B)	Network Security and Cryptography
C)	CMOS Digital Integrated Circuit Design
D)	Embedded C
E)	Optical Communication Design & Test

	Program Elective -III
A)	Sensors and Actuators
B)	Low Power VLSI Design
C)	Semiconductor Memory Design and Testing
D)	Analog and Mixed Signal Processing
E)	Analysis and Design of Digital Systems using VHDL

	Open Elective I
A)	Internet of Things
B)	Linear Algebra
C)	Neural Networks in Embedded Applications
D)	Research Methodology
E)	Wavelet Transforms and its Applications

	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

MTVEC101 VLSI TCHNOLOGY AND DESIGN Credits 04

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To introduce MOS technology and its layout design rules
B	To provide basic knowledge sequential and combinational logic design

Course Outcomes:

CO1	Learner will be able to express technologies such as MOS, BiCMOS
CO2	Learner will get knowledge of design tools for CMOS
CO3	Learner will be able to design basic gates and their alternative circuits
CO4	Learner will be able to design and simulate combinational logic designs
CO5	Learner will be able to validate and test the design

UNIT I

Review of Microelectronics and Introduction to MOS Technologies:

MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT II

Layout Design and Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.

UNIT III

Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT IV

Combinational Logic Networks:

Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing

UNIT V

Sequential Systems:

Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design

UNIT VI

Floor Planning: Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Textbooks / References:

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

MTVEC103 ADVANCED EMBEDDED LOGIC Credits 04

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To introduce ARM architecture
B	Use of VHDL for modeling and simulation
C	Basic concept of android OS

Course Outcomes:

CO1	Learner will be able to list ARM instruction set
CO2	Learner will be able to interface I/O devices with ARM
CO3	Learner will be able to design, debug and simulate practical examples
CO4	Learner will be able to identify fault in the system
CO5	Learner will be have knowledge of different operating systems

UNIT I

The ARM architecture, ARM organization and implementation, The ARM instruction set, The thumb instruction set, Basic ARM Assembly language program, ARM CPU cores.

UNIT II

Interfacing Memory and I/O devices, synchronous and asynchronous transfer, DMA, Serial data transfer, GPIB, RS-232C, I2C, CAN bus protocols. RFID, Smartcards, PDA‟s, Zip drives.

UNIT III

Host and target machines, Linkers / Locators for Embedded Software, Debugging techniques Instruction set simulators, Practical example– Source code.

UNIT IV

Hardware description languages - VHDL and Verilog, programming and subsystem design concepts, Fault Modeling and Simulation, Functional testing, Design for testability, Scan based designs, Boundary scan standards (JTAG), BIST, BILBO

UNIT V

Tasks and Task states, Semaphores, Shared data, Message queues, Interrupt routines – Encapsulating semaphore and queues, Hard Real-time scheduling, Power saving.

UNIT VI

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Textbooks / References:

1. David. E.Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
3. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004
4. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011
5. Steave Furber, “ARM system – on – chip architecture”, Addison Wesley, 2000
6. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
7. VHDL: D. Perry,MaGraw Hill Int. Edition.
8. Advanced UNIX Programming, Richard Stevens.
9. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh

ELECTIVE-I

MTVEE114A HARDWARE- SOFTWARE CO-DESIGN Credits 04

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	Show benefits of the codesign approach over current design process
B	Illustrate how codesign concepts are being introduced into design methodologies
C	Introduce the fundamentals of HW/SW codesign and partitioning concepts in designing embedded systems

Course Outcomes:

CO1	Learner will be able to express co-design issues
CO2	Learner will have knowledge of Prototyping and emulation techniques
CO3	Learner will have knowledge of Architecture Specialization techniques
CO4	Learner will have knowledge of Tools for Embedded Processor Architectures
CO5	Learner will be able to design and verify computational models

UNIT I

Co- Design Issues:

Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

Co- Synthesis Algorithms:

Hardware software synthesis algorithms: hardware – software partitioning distributed system cosynthesis.

UNIT II

Prototyping and Emulation: Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure.

UNIT III

Target Architectures: Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT IV

Compilation Techniques and Tools for Embedded Processor Architectures: Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

UNIT V

Design Specification and Verification:

Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification.

UNIT VI

Languages for System – Level Specification and Design-I:

System – level specification, design representation for system level synthesis, system level specification languages.

Languages for System – Level Specification and Design-II:

Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

Textbooks / References:

1. Jorgen Staunstrup, Wayne Wolf Hardware / Software Co- Design Principles and Practice — 2009, Springer.
2. Giovanni De Micheli, Mariagiovanna Sami, Hardware / Software Co- Design - 2002, Kluwer Academic Publishers
3. Patrick R. Schaumont, A Practical Introduction to Hardware/Software Co-design - 2010 – Springer

MTVEE114B DIGITAL SYSTEM DESIGN Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objective:

A	To get an idea about designing complex, high speed digital systems and how to implement such design

Course Outcomes:

CO1	Learner will be able to identify mapping algorithms into architectures.
CO2	Learner will be able to understand various delays in combinational circuit and its optimization methods.

CO3	Learner will be able to understand circuit design of latches and flip-flops
CO4	Learner will be able to demonstrate combinational and sequential circuits of medium complexity that is based on VLSIs, and programmable logic devices.
CO5	Learner will be able to understand the advanced topics such as reconfigurable computing, partially reconfigurable, Pipeline reconfigurable architectures and block configurable.

UNIT I

Mapping algorithms into Architectures: Data path synthesis, control structures, critical path and worst case timing analysis. FSM and Hazards.

UNIT II

Combinational network delay. Power and energy optimization in combinational logic circuit.

Sequential machine design styles. Rules for clocking. Performance analysis.

UNIT III

Sequencing static circuits. Circuit design of latches and flip-flops. Static sequencing element methodology. Sequencing dynamic circuits. Synchronizers.

UNIT IV

Data path and array subsystems: Addition / Subtraction, Comparators, counters, coding, multiplication and division.

UNIT V

SRAM, DRAM, ROM, serial access memory, context addressable memory.

UNIT VI

Reconfigurable Computing- Fine grain and Coarse grain architectures, Configuration architectures-Single context, Multi context, partially reconfigurable, Pipeline reconfigurable, Block Configurable, Parallel processing.

Textbooks / References:

1. N. H.E.Weste, D. Harris, CMOS VLSI Design (3/e), Pearson, 2005.
2. W.Wolf, FPGA- based System Design, Pearson, 2004.
3. S.Hauck, A.DeHon, Reconfigurable computing: the theory and practice of FPGA-basedcomputation, Elsevier, 2008.
4. F.P. Prosser, D. E. Winkel, Art of Digital Design, 1987.
5. R.F.Tinde, Engineering Digital Design, (2/e), Academic Press, 2000.

A. Bobda, Introduction to reconfigurable computing, Springer, 2007.
6. M.Gokhale, P.S.Graham, Reconfigurable computing: accelerating computation with field-programmable gate arrays, Springer, 2005.
7. C.Roth, Fundamentals of Digital Logic Design, Jaico Publishers, V ed., 2009.
8. Recent literature in Digital System Design.

MTVEE114C SOFT COMPUTING TECHNIQUES Credits 04

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests: 20	IA: 20	Total: 100

Course Objectives:

A	To expose the concepts of feed forward neural networks.
B	To provide adequate knowledge about feedback neural networks.
C	To teach about the concept of fuzziness involved in various systems.
D	To expose the ideas about genetic algorithm
E	To provide adequate knowledge about of FLC and NN toolbox

Course Outcomes:

CO1	Learner will be familiar with the concept of artificial neural network
CO2	Learner will be able to model fuzzy logic operations
CO3	Learner will be able to solve typical control problems using genetic algorithm
CO4	Learner will be able to identify and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox
CO5	Learner will be able to Implement of fuzzy logic controller using MATLAB fuzzy-logic toolbox

UNIT I

Introduction:

Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning system, Rulebased systems, the AI approach, Knowledge representation - Expert systems.

UNIT II

Artificial Neural Networks:

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Learning and Training the neural network, Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller.

UNIT III

Fuzzy Logic System:

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning, Introduction to fuzzy logic modeling and control, Fuzzification, inferencing and defuzzification, Fuzzy knowledge and rule bases, Fuzzy modeling and control schemes for nonlinear systems, Self organizing fuzzy logic control, Fuzzy logic control for nonlinear time delay system.

UNIT IV

Genetic Algorithm:

Basic concept of Genetic algorithm and detail algorithmic steps, Adjustment of free parameters, Solution of typical control problems using genetic algorithm, Concept on some other search techniques like Tabu search and anD-colony search techniques for solving optimization problems.

UNIT V

Applications I:

GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox,

UNIT VI

Applications II:

Stability analysis of Neural Network interconnection systems, Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox, Stability analysis of fuzzy control systems.

Textbooks / References:

1. Introduction to Artificial Neural Systems - Jacek.M.Zurada, Jaico Publishing House, 1999.

2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.
3. Fuzzy Sets, Uncertainty and Information - Klir G.J. & Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.
4. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994.
5. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
6. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
7. Elements of Artificial Neural Networks - Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka, Penram International.
8. Artificial Neural Network –Simon Haykin, 2nd Ed., Pearson Education.
9. Introduction Neural Networks Using MATLAB 6.0 - S.N. Shivanandam, S. Sumati, S. N. Deepa,1/e, TMH, New Delhi.

MTVEE114D CPLD & FPGA ARCHITECTURES & APPLICATIONS Credits 04

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To introduce field programmable lo ic devi es and their design applications

Course Outcomes:

CO1	Learner will acquire Knowledge about various architectures and device technologies of PLD‟s
CO2	Learner will be able to Comprehend FPGA Architectures.
CO3	Learner will be able to analyze System level Design and their application for Combinational and Sequential Circuits.
CO4	Learner will be familiar with Anti-Fuse Programmed FPGAs
CO5	Learner will able to apply knowledge of this subject for various design applicaitons

UNIT I

Introduction to Programmable Logic Devices: Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

UNIT II

Field Programmable Gate Arrays: Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

UNIT III

SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT IV

Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT V

Design Applications: General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator,

UNIT VI

A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

Textbooks / References:

1. Stephen M. Trimberger, Field Programmable Gate Array Technology - Springer International Edition.
2. Charles H. Roth Jr, Lizy Kurian John, Digital Systems Design - Cengage Learning.
3. John V. Oldfield, Richard C. Dorf, Field Programmable Gate Arrays - Wiley India.
4. Pak K. Chan/Samiha Mourad, Digital Design Using Field Programmable Gate Arrays - Pearson Low Price Edition.
5. Ian Grout, Digital Systems Design with FPGAs and CPLDs - Elsevier, Newnes.
6. Wayne Wolf, FPGA based System Design - Prentice Hall Modern Semiconductor Design Series.

MTVEE114D ADVANCED COMPUTERS ARCHITECTURES

Credits 04

Weekly Teaching Hours	TH: 03	Tut: --		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	The objective of this course is to learn the fundamental aspects of computer architecture design and analysis.

Course Outcomes:

CO1	Learner will be able to understand different processor architectures and system-level design processes.
CO2	Learner will be able to understand the components and operation of a memory hierarchy and the range of performance issues influencing its design
CO3	Learner will be able to understand the principles of I/O in computer systems, including viable mechanisms for I/O and secondary storage organization.
CO4	Learner will be able to understand basic concept of pipelining
CO5	Learner will be able to understand Multiprocessor architecture
CO6	Learner will be able to understand Non von Neumann Architectures

UNIT I

Overview of von Neumann architecture: Instruction set architecture; The Arithmetic and Logic Unit, The Control Unit, Memory and I/O devices and their interfacing to the CPU; Measuring and reporting performance; CISC and RISC processors.

UNIT II

Pipelining: Basic concepts of pipelining, data hazards, control hazards, and structural hazards; Techniques for overcoming or reducing the effects of various hazards.

UNIT III

Hierarchical Memory Technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies..

UNIT IV

Instruction-level parallelism: Concepts of instruction-level parallelism (ILP), Techniques for increasing ILP; Superscalar, superpipelined and VLIW processor architectures; Vector and symbolic processors; Case studies of contemporary microprocessors.

UNIT V

Multiprocessor Architecture: Taxonomy of parallel architectures; Centralized shared-memory architecture, synchronization, memory consistency, interconnection networks; Distributed shared-memory architecture, Cluster computers.

UNIT VI

Non von Neumann Architectures: Data flow Computers, Reduction computer architectures, Systolic Architectures.

Textbooks / References:

1. W. Stallings, Computer Organization and Architecture: Designing for performance, 4th Ed. PHI, 1996.
2. J. H. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 2nd Ed., Morgan Kaufmann, 1996.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability and Programmability McGraw-Hill Inc, 1993.
4. D. E. Culler, J. Pal Singh, and A. Gupta, Parallel Computer Architecture: A Hardware/Software Approach, Harcourt Asia Pte Ltd., 1999.

MTVEE125A ADVANCE OPERATING SYSTEMS Credits 04

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests: 20	IA: 20	Total: 100

Course Objectives:

A	To learn the basic and advanced concepts of operating systems.

Course Outcomes:

CO1	students will understand how the operating system defines an abstraction of hardware behavior with which programmers can control the hardware.
CO2	students will understand how operating system manages resource sharing among the computer‟s users
CO3	Learner will know basic commands and command arguments for UNiX and LINUX
CO4	Learner will have knowledge of distributed systems
CO5	Learner will be able to detect and prevent deadlock in distributed system

UNIT I

Introduction to Operating Systems: Overview of computer system hardware, Instruction execution, I/O function, Interrupts, Memory hierarchy, I/O Communication techniques, Operating system objectives and functions, Evaluation of operating System

UNIT II

Introduction to UNIX and LINUX: Basic Commands & Command Arguments, Standard Input, Output, Input / Output Redirection, Filters and Editors, Shells and Operations

UNIT III

System Calls: System calls and related file structures, Input / Output, Process creation & termination. Inter Process **Communication:** Introduction, File and record locking, Client – Server example, Pipes, FIFOs, Streams & Messages, Name Spaces, Systems V IPC, Message queues, Semaphores, Shared Memory, Sockets & TLI.

UNIT IV

Introduction to Distributed Systems: Goals of distributed system, Hardware and software concepts, Design issues.

Communication in Distributed Systems: Layered protocols, ATM networks, Client - Server model, Remote procedure call and Group communication**.**

UNIT V

Synchronization in Distributed Systems: Clock synchronization, Mutual exclusion, E-tech algorithms, Bully algorithm, Ring algorithm, Atomic transactions

UNIT VI

Deadlocks: Dead lock in distributed systems, Distributed dead lock prevention and distributed dead lock detection.

Textbooks / References:

1. Maurice J. Bach, The Design of the UNIX Operating Systems –1986, PHI.
2. Andrew. S. Tanenbaum, Distributed Operating System 1994, PHI.
3. Richard Peterson, The Complete Reference LINUX – 4th Ed., McGraw – Hill.
4. Stallings, Operating Systems: Internal and Design Principles - 6th Ed., PE.
5. Andrew S Tanenbaum,Modern Operating Systems - 3rd Ed., PE.
6. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Principles - 7th Ed., John Wiley 4. UNIX User Guide – Ritchie & Yates.
7. W.Richard Stevens,UNIX Network Programming - 1998, PHI.

MTVEE125B NETWORK SECURITY AND CRYPTOGRAPHY

Credits 04

Weekly Teaching Hours	TH: 03	Tut: 01		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To understand OSI security architecture and classical encryption techniques
B	Describe the principles of public key cryptosystems, hash function and digital signature

Course Outcomes:

CO1	Learner will get knowledge of various classical techniques for encription
CO2	Learner will be able to compare various cryptographic techniques
CO3	Learner will be able to design secure application
CO4	Learner will be able to inject secure coding in developed application

UNIT I

Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security. Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.

UNIT II

Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations.

Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers.

Conventional Encryption: Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

UNIT III

Number Theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat‟s and Euler‟s theorems, Testing for primality, Euclid‟s Algorithm, the Chinese remainder theorem, Discrete logarithms.

Message authentication and Hash Functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.

UNIT IV

Hash and Mac Algorithms: MD File, Message digests Algorithm, Secure Hash Algorithm, RIPEMD-160, HMAC.

Digital signatures and Authentication Protocols: Digital signatures, Authentication Protocols, Digital signature standards.

Authentication Applications: Kerberos, X.509 directory Authentication service.

Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT V

IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management**.**

Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.

UNIT VI

Intruders, Viruses and Worms: Intruders, Viruses and Related threats.

Fire Walls: Fire wall Design Principles, Trusted systems.

Textbooks / References:

1. William Stallings, Cryptography and Network Security: Principles and Practice - 2000, PE.
2. Mark Burgess,John Wiel, Principles of Network and Systems Administration

MTVEE125C CMOS DIGITAL INTEGRATED CIRCUIT DESIGN

Credits 04

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To create model of moderately sized CMOS circuits that realize specified digital functions
B	Have an understanding of the characteristics of CMOS circuit construction

Course Outcomes:

CO1	Learner will be familiar with basic MOS characteristics
CO2	Learner will be able to design CMOS logic gates
CO3	Learner will be able to model complex combinational logic circuits
CO4	Learner will be able to realize sequential MOS logic circuits
CO5	Learner will have knowledge of various types of semiconductor memories

UNIT I

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT II

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate,

UNIT III

Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT IV

Sequential MOS Logic Circuits: Behavior of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flipflop.

UNIT V

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT VI

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

Textbooks / References:

1. Ken Martin, Digital Integrated Circuit Design –Oxford University Press, 2011.
2. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design –TMH, 3rd Ed., 2011.

3. Ming-BO Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective –CRC Press, 2011
4. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits – A Design Perspective, 2nd Ed., PHI.

MTVEE125D	**EMBEDDED C**	**Credits 04**

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To understand role of programming language in embedded systems

Course Outcomes:

CO1	Learner will be able to define embedded system
CO2	Learner will be able to classify between processors, programming languages, operating systems etc.
CO3	Learner will be able to describe architecture of 8051 microcontroller
CO4	Learner will be able to write a program basic techniques for reading from port pins
CO5	Learner will learn concept of Object oriented programming
CO6	Learner will be able to create hardware delays using timers
CO7	Learner will be able to solve a real word problem using knowledge of embedded C

UNIT I

Programming Embedded Systems in C

Introduction ,What is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, How do you develop embedded software, Conclusions

UNIT II

Introducing the 8051 Microcontroller Family

Introduction, What‟s in a name, The external interface of the Standard 8051, Reset requirements ,Clock frequency and performance, Memory issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption ,Conclusions

UNIT III

Reading Switches Introduction, Basic techniques for reading from port pins, Example:

Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions

UNIT IV

Adding Structure to the Code

Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the „Hello Embedded World" example, Example: Restructuring the goat-counting example, Further examples, Conclusions

UNIT V

Meeting Real-Time Constraints

Introduction, Creating „hardware delays" using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, Example: Creating a portable hardware delay, Why not use Timer 2?, The need for „timeout" mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions

UNIT VI

Case Study: Intruder Alarm System Introduction, The software architecture, Key software components used in this example, running the program, the software, Conclusions

Textbooks / References:

1. Michael J. Pont , Embedded C, A Pearson Education
2. Nigel Gardner, PIC micro MCU C-An introduction to programming, The Microchip PIC in CCS C.

MTVEE125E OPTICAL COMMUNICATION DESIGN & TEST

Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To understand optics phenomenon.
B	To know basics of lenses and their types.

Course Outcomes:

CO1	Learner will be able to understand concept of aberrations.
CO2	Learner will be able to perform image evaluation.
CO3	Learner will be able to classify types of lenses.
CO4	Learner will be able to understand basic of optics.
CO5	Learner will be able to understand optimization techniques in lens design.
CO6	Learner will be able to get familiar with telescope.

UNIT I

Aberrations: Transverse ray and wave aberrations, chromatic aberration; Ray tracing: paraxial, finite and oblique rays

UNIT II

Image evaluation: transfer functions, point spread function, encircled energy and its computation and measurement, optimization techniques in lens design, merit function, damped least square methods, orthonormalization, and global search method, Tolerance analysis.

UNIT III

Achromatic doublets, achromats and aplanats; Cooke triplet and its derivatives.

UNIT IV

Double Gauss lens, Zoom lenses and aspherics, GRIN optics, focal shift, high and low N number focusing systems, focusing of light in stratified media, high numerical aperture focusing, basics of non-paraxial propagation of light.

UNIT V

Classification of lens systems. Refractive systems- cookes triplet, Gatelecentric system, telephoto system, f-theta lens (fish eye lens).

UNIT VI

Relective systems–single mirror telescope, two mirror telescope–Greogrian, dall-kirkham, marsenne, cassegrain, R-C telescope, three mirror aspheric system: unobscured system, obscured system.

Textbooks / References:

1. A. C. Kak and Malcolm Slaney, Principles of Computerized Tomographic Imaging. -.

IEEE Press
2. Lihong V. Wang and Hsin-i Wu, Biomedical Optics: Principles and Imaging. - Wiley-Interscience.
3. P. Gibson, J. C. Hebden, and S. R. Arridge, Recent advances in diffuse optical imaging, Physics in Medicine and Biology, 50, R1-R43. (2005).
4. S.R.Arridge Optical tomography in medical imaging, Inverse Problems, 15, R41–R93. (1999)
5. J. W. Goodman, Introduction to Fourier Optics
6. L. Nikolova & P.S. Ramanujam, Polarization holography
7. P. Hariharan, Optical holography principles techniques and applications

MTVEL107L	**PG LAB-I**	**Credits 04**

Weekly Teaching Hours	TH: --		Practical: 04	
Scheme of Marking	TH: --	IA: 25	PR/OR: 25	Total: 50

Practical‟s of the Lab - I shall be based on the courses of first semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

MTVES 101	**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.

MTVEAU 101	**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

MTVEC 201 EMBEDDED REAL TIME OPERATING SYSTEMS Credits 04

EMBEDDED REAL TIME OPERATING SYSTEMS

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide understanding of the techniques essential to the design and implementation of device drivers and kernel internals of embedded operating systems.
B	To provide the students with an understanding of the aspects of the Real-time systems and Real-time Operating Systems.
C	To provide an understanding of the techniques essential to the design and implementation of real-time embedded systems.

Course Outcomes:

CO1	Learner will understand the Embedded Real Time software that is needed to run embedded systems
CO2	Learner will understand the open source RTOS and their usage.
CO3	Learner will understand the VxWorks RTOS and realtime application programming with it
CO4	Learner will be able to build device driver and kernel internal for Embedded OS & RTOS

UNIT I

Introduction:

Introduction to UNIX/LINUX, Overview of Commands, File I/O,(open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec.)

UNIT II

Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization,

UNIT III

Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT IV

Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT V

Exceptions, Interrupts and Timers Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT VI

Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Textbooks / References:

1. Qing Li, Elsevier, Real Time Concepts for Embedded Systems , 2011
2. Rajkamal, Embedded Systems- Architecture, Programming and Design, 2007, TMH.
3. Richard Stevens, Advanced UNIX Programming,
4. Dr. Craig Hollabaugh, Embedded Linux: Hardware, Software and Interfacing.

MTVEC 202 CMOS MIXED SIGNAL CIRCUIT DESIGN Credits 04

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To know mixed signal circuits like DAC, ADC, PLL etc.
B	To gain knowledge on filter design in mixed signal mode.
C	To acquire knowledge on design different architectures in mixed signal mode.

Course Outcomes:

CO1	Learner will have knowledge of operation of switched capacitor cicuits
CO2	Learner will be able to design a filter network
CO3	Learner will be able to learn topology of PLL network
CO4	Learner will learn Data Converter Fundamentals

UNIT I

Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits,

UNIT II

Switched capacitor integrators first order filters, Switch sharing, biquad filters.

UNIT III

Phased Lock Loop (PLL):

Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications

UNIT IV

Data Converter Fundamentals:

DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT V

Nyquist Rate A/D Converters: Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.

Oversampling Converters:

Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A

Textbooks / References:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits- TMH Edition, 2002
2. Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design - Oxford University Press, International Second Edition/Indian Edition, 2010.

3. David A. Johns, Ken Martin, Analog Integrated Circuit Design- Wiley Student Edition, 2013
4. Rudy Van De Plassche, CMOS Integrated Analog-to- Digital and Digital-to-Analog converters- Kluwer Academic Publishers, 2003
5. Richard Schreier, Understanding Delta-Sigma Data converters, Wiley Interscience, 2005.
6. R. Jacob Baker, CMOS Mixed-Signal Circuit Design - Wiley Interscience, 2009.

ELECTIVE III

MTVEE244A	**SENSORS AND ACTUATORS**	**Credits 04**

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	understanding basic laws and phenomena on which operation of sensors and actuators-transformation of energy is based,
B	Conducting experiments in laboratory and industrial environment.

Course Outcomes:

CO1	Learner will be able to characterize types sensors
CO2	Learner will be able to interpret working of different types of sensors
CO3	Learner will be able to describe application of sensor
CO4	Learner will be familiar with Actuation Systems

UNIT I

Sensors / Transducers: Principles – Classification – Parameters – Characteristics - Environmental Parameters (EP) – Characterization

Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors

UNIT II

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermosensors – Helium Low Temperature Thermometer – Nuclear Thermometer –

Magnetic Thermometer – Resistance Change Type Thermometric Sensors –Thermoemf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors

Magnetic sensors: Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magnetoresistive Sensing – Semiconductor Magnetoresistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros – Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

UNIT III

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors

Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential - Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media .

UNIT IV

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

UNIT V

Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing – Sensors for environmental Monitoring

UNIT VI

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Presure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

Textbooks / References:

1. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
2. W. Bolton – "Mechatronics" –Pearson Education Limited.
3. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.

MTVEE244B	**LOW POWER VLSI DESIGN**	**Credits 04**

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To match with todays need for low power circuit design for energy efficient systems

Course Outcomes:

CO1	Learner will be able to classify causes for various power dissipation
CO2	Learner will acquire knowledge of Low-Power Design Approaches
CO3	Lerner will be able to use Switched Capacitance Minimization Approaches
CO4	Learner will be able to design low power adder networks
CO5	Learner will be able to design low power multiplier networks
CO6	Learner will have knowledge of low power memory technologies

UNIT I

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT II

Low-Power Design Approaches:

Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches.

UNIT III

Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT IV

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder‟s Architectures – Ripple Carry Adders, Carry LookAhead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT V

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, BaughWooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT VI

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbooks / References:

1. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits – Analysis and Design –TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, Low-Voltage, Low-Power VLSI Subsystems –TMH Professional Engineering.
3. Ming-BO Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective –CRC Press, 2011
4. Anantha Chandrakasan, Low Power CMOS Design –IEEE Press/Wiley International, 1998.
5. – Kaushik Roy, Sharat C. Prasad, Low Power CMOS VLSI Circuit Design John Wiley & Sons, 2000.
6. Gary K. Yeap, Practical Low Power Digital VLSI Design –Kluwer Academic Press, 2002.
7. A. Bellamour, M. I. Elamasri, Low Power CMOS VLSI Circuit Design –Kluwer Academic Press, 1995.
8. Siva G. Narendran, Anatha Chandrakasan, Leakage in Nanometer CMOS Technologies –Springer, 2005.

MTVEE244C SEMICONDUCTOR MEMORY DESIGN AND TESTING

Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	In this course the students will learn overview of memory chip design, DRAM circuits performance analysis and design issues Memory Packing Technologies

Course Outcomes:

CO1	Learner will have knowledge of Random Access Memory Technologies

CO2	Learner will have knowledge of Non-volatile Memories
CO3	Learner will have knowledge of Memory Fault Modeling Testing and Memory Design for Testability
CO4	Learner will have knowledge of Semiconductor Memory Reliability
CO5	Learner will have knowledge of Radiation Effects
CO6	Learner will have knowledge of Advanced Memory Technologies

UNIT I

Random Access Memory Technologies: SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, Advanced DRAM design and architecture, Application specific DRAM

UNIT II

Non-volatile Memories: Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture

UNIT III

Memory Fault Modeling Testing and Memory Design for Testability and Fault Tolerance: RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modeling and testing, IDDQ fault modeling and testing, Application specific memory testing, RAM fault modeling, BIST techniques for memory

UNIT IV

Semiconductor Memory Reliability: General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modeling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification,

UNIT V

Radiation Effects:

Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures

UNIT VI

Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging Future Directions

Textbooks / References:

1. Ashok K. Sharma, Semiconductor Memories Technology 2002, Wiley.
2. Ashok K. Sharma, Advanced Semiconductor Memories – Architecture, Design and Applications - 2002, Wiley.
3. Chenming C Hu, Modern Semiconductor Devices for Integrated Circuits –1st Ed., Prentice Hall.

MTVEE244D ANALOG AND MIXED SIGNAL PROCESSIBG Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To understand the signal processing concepts of mixed-signal systems.
B	The ability to use this knowledge to design mixed-signal processing systems on system level.

Course Outcomes:

CO1	Learner will have knowledge of operation of switched capacitor circuits.
CO2	Learner will be able to design a filter network.
CO3	Learner will learn Data Converter Fundamentals.
CO4	Learner will be able to learn topology of PLL network.

UNIT I

Switched Capacitor filters: Introduction to Analog and Discrete Time signal processing, sampling theory, Nyqist 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 India, IEEE press, reprint 2008
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, IEEE computer Society Press.
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.

MTVEE244E ANALYSIS AND DESIGN OF DIGITAL SYSTEMS USING VHDL
Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objective:

A	To prepare the student to understand the VHDL language feature to realize the complex digital systems.
B	To design and simulate sequential and concurrent techniques in VHDL
C	To explain modeling of digital systems using VHDL and design methodology
D	To explain predefined attributes and configurations of VHDL.
E	To Understand behavioral, non-synthesizable VHDL and its role in modern design

Course Outcomes:

CO1:	Learner will be able to model, simulate, verify, and synthesize with hardware description languages.
CO2:	Learner will be able to understand and use major syntactic elements of VHDL - entities, architectures, processes, functions, common concurrent statements, and common sequential statements
CO3:	Learner will be able to design digital logic circuits in different types of modeling
CO4:	Learner will be able to demonstrate timing and resource usage associated with modeling approach.
CO5:	Learner will be able to use computer-aided design tools for design of complex digital logic circuits.

UNIT I

An overview of design procedures for system design using CAD tools. Design verification tools.

UNIT II

Examples using commercial PC based VLSI CAD tools. Design methodology based on VHDL. Basic concepts and structural descriptions in VHDL.

UNIT III

Characterizing hardware languages, objects and classes, signal assignments, concurrent and sequential assignments. Structural specification of hardware.

UNIT IV

Design organization, parameterization and high level utilities, definition and usage of subprograms, packaging parts and utilities, design parameterization, design configuration,

design libraries. Utilities for high-level descriptions.

UNIT V

Data flow and behavioral description in VHDL- multiplexing and data selection, state machine description, open collector gates, three state bussing, general dataflow circuit, updating basic utilities. Behavioral description of hardware.

UNIT VI

CPU modeling for discrete design- Parwan CPU, behavioral description, bussing structure, data flow, test bench, a more realistic Parwan. Interface design and modeling. VHDL as a modeling language.

Textbooks / References:

1. Z.Navabi, VHDL Analysis and Modeling of Digital Systems, (2/e), McGraw Hill, 1998. 2. Perry, "VHDL (3/e)", McGraw Hill.2002
2. A. Dewey, Analysis and Design of Digital Systems with VHDL, CL-Engineering, 1996.
3. Z.Navabi, VHDL: modular design and synthesis of cores and systems, McGraw, 2007.
4. C. H. Roth, Jr., L.K.John, Digital Systems Design Using VHDL - Thomson Learning EMEA, Limited, 2008.
5. Recent literature in Analysis and Design of Digital Systems using VHDL.

OPEN ELECTIVE I

MTVEE255A	**INTENET OF THINGS**	**Credits 04**

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	Students will be explored to the interconnection and integration of the physical world and the cyber space.
B	To provide ability to design and develop IOT devices.

Course Outcomes:

CO1	Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
CO2	Learner will be able to interpret IOT working at transport layer with the help of various protocols
CO3	Learner will be able to understand IOT concept at data link layer
CO4	Learner will be able to apply the concept of mobile networking to the internet connected devices
CO5	Learner will be able to measure and schedule the performance of networked devices in IOT
CO6	Learner will be able to analyze the challenges involve in developing IOT architecture

UNIT I

Introduction: What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT II

Fundamental IoT Mechanisms & Key Technologies : Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT III

Radio Frequency Identification Technology: Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication.

UNIT IV

Wireless Technologies For IoT : Layer ½ Connectivity : WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT V

Governance of The Internet of Things: Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

UNIT VI

Internet of Things Application Examples: Smart Metering, advanced metering infrastructure, e-Health/Body area network, City automation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control application examples.

Textbooks / References:

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978- 3842-19156-5, Springer.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

MTVEE255B LINEAR ALGEBRA Credits 04

Weekly Teaching Hours TH : 03 Tut: 01

Scheme of Marking TH :60 Tests : 20 IA: 20 Total : 100

Course Objectives:

A	To provide in-depth understanding of fundamental concepts of linear algebra
B	To understand the importance of linear algebra and learn its applicability to practical problems

Course Outcomes:

CO1	Learner will learn to solve and analyze linear system of equation
CO2	Learner will analyze the direct notations, duality, adjointness, bases, dual bases in linear algebra
CO3	Learner will understand the concept of Linear transformations and matrices, equivalence, similarity.
CO4	Learner will be able to find eigen values and eigen vectors using characteristics polynomials
CO5	Learner will learn to find the singular value decomposition of the matrix
CO6	Learner will be to find the inverse of matrix

UNIT I

Fields Fq, R, C. Vector Spaces over a field, Fn, F[ɵ]=Polynomials in one Variable.

UNIT II

Direct Notations, Ket, bra vector, duality, adjointness, linear transformations, bases, dual bases.

UNIT III

Linear transformations and matrices, equivalence, similarity.

UNIT IV

Eigenvalues, eigenvectors, diagonalization, Jordon canonical form

UNIT V

Bilinear and sesquiplane forms, inner product, orthonormal, bases, orthogonal decomposition, projections

UNIT VI

System of equations, generalized inverses.

Textbooks / References:

1. Ronald Shaw, Linear Algebra and Group Representations, AcademicPress, Volume I-1982.

2. Ronald Shaw, Linear Algebra and Group Representations, AcademicPress, Volume II-1983.

3. A. R. Rao, Bhima Sankaran, Linear Algebra, TRIM, 2nd Edition, Hindustan

MTVEE255C NEURAL NETWORKS INEMBEDDED APPLICATIONS
Credits 04

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To be able to use analogy of human neural network for understanding of artificial learning algorithms.
B	To give in-depth understanding of fundamental concepts of neural network
C	To exhibit the knowledge of radial basis function network

Course Outcomes:

CO1	Learner will be able to understand concept of fuzzy logic.
CO2	Learner will be able to understand embedded digital signal processor, Embedded system design and development cycle, applications in digital camera
CO3	Learner will be able to understand embedded systems, characteristics, features and applications of an embedded system
CO4	Learner will be able to design and utilization of fuzzy logic controller for various industrial applications
CO5	Learner will be able to implement of radial basis function, neural network on embedded system: real time face tracking and identity verification, Overview of design of ANN based sensing logic and implementation for fully automatic washing machine

UNIT I

Introduction to artificial neural networks, Fundamental models of artificial neural network, Perceptron networks, Feed forward networks, Feedback networks, Radial basis function networks, Associative memory networks

UNIT II

Self organizing feature map, Learning Vector Quantization, Adaptive resonance theory, Probabilistic neural networks, neocgnitron, Boltzmann Machine.

UNIT III

Optical neural networks, Simulated annealing, Support vector machines, Applications of neural network in Image processing,

UNIT IV

Introduction to Embedded systems, Characteristics, Features and Applications of an embedded system

UNIT V

Introduction to embedded digital signal processor, Embedded system design and development cycle, ANN application in digital camera,

UNIT VI

Implementation of Radial Basis Function, Neural Network on embedded system: real time face tracking and identity verification, Overview of design of ANN based sensing logic and implementation for fully automatic washing machine

Textbooks / References:

1. S N Sivanandam, S Sumathi, S N Deepa, "Introduction to Neural Networks Using Matlab 6.0", Tata McGraw Hill Publication
2. Simon Haykin, "Neural Networks: Comprehensive foundation", Prentice Hall Publication
3. Frank Vahid, TonyGivargis, "Embedded System Design A unified Hardware/ Software Introduction", Wiley India Pvt. Ltd.
4. Rajkamal, "Embedded Systems Architecture, Programming and Design," Tata McGraw-Hill

MTVEE255D	**RESEARCH METHODOLOGY**	**Credits 04**

Weekly Teaching Hours	TH: 03	Tut: --		
Scheme of Marking	TH: 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

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

Course Outcomes::

CO1	Learner will learn the meaning, objective , motivation and type of research
CO2	Learner will be able to formulate their research work with the help of literature review
CO3	Learner will be able to develop an understanding of various research design and techniques
CO4	Learner will have an overview knowledge of modeling and simulation of research work
CO5	Learner will be able to collect the statistical data with different methods related to research work

CO6	Learner will be able to write their own research work with ethics and non-plagiarized way

UNIT I

Introduction: Defining research, Motivation and Course Objectives:, Types of research

Meaning of Research, Course Objectives: of Research, Motivation in Research, Types of Research

UNIT II

Research Formulation: Formulating The research Problem, Literature Review, Development of Working Hypothesis

UNIT III

Research Design: Important Concept in Research Design, Research Life Cycle, Developing Research Plan

UNIT IV

Overview of Modeling and Simulation: Classification of models, Development of Models, Experimentation, Simulation.

UNIT V

Statistical Aspects: Methods of Data Collection, Sampling Methods, Statistical analysis, Hypothesis testing.

UNIT VI

Research Report: Research Ethics, Plagiarism, Research Proposal, Report Writing and Writing Research Papers.

Textbooks / References:

1. J.P. Holman., Experimental Methods for Engineers
2. C.R. Kothari, Research Methodology, Methods & Techniques

MTVEE255E WAVELET TRANSFORM AND ITS APPLICATIONS **Credits 04**

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of fundamental concepts of Wavelets.
B	To study wavelet related constructions, its applications in signal processing, communication and sensing.

Course Outcomes:

CO1	Learner will be able to understand the meaning of wavelet transform
CO2	Learner will understand the terminologies used in Wavelet transform with its properties
CO3	Learner will be able to model various filter bank using wavelet transformation
CO4	Learner will understand bases , orthogonal bases in wavelet transform
CO5	Learner will learn different types of wavelet transform
CO6	Learner will be able to design practical system using wavelet transform

UNIT I

Continuous Wavelet Transform Introduction, Continuous-time wavelets, Definition of the CWT, the VWT as a Correlation, Constant-Factor Filtering Interpretation and Time-Frequency Resolution, the VWT as an Operator, Inverse CWT, Problems.

UNIT II

Introduction to Discrete Wavelet Transform And Orthogonal Wavelet Decomposition: Introduction, Approximation of Vectors in Nested Linear Vector Subspaces, Examples of an MRA, Problems.

UNIT III

MRA, Orthonormal Wavelets, And Their Relationship To Filter Banks: Introduction, Formal Definition of an MRA, Construction of General Orthonormal MRA, a wavelet Basic for the MRA,

UNIT IV

Digital Filtering Interpretation, Examples of Orthogonal Basic Generating Wavelets, Interpreting Orthonormal MRAs for Discrete-Time signals, Miscellaneous Issues Related to

PRQME Filter Banks, generating Scaling Functions and wavelets from Filter Coefficient, Problems.

UNIT V

Wavelet Transform And Data Compression: Introduction, Transform Coding, DTWT for Image Compression, Audio Compression, And Video Coding Using Multiresolution Techniques: a Brief Introduction.

UNIT VI

Other Application 0f Wavelet Transforms: Introduction, Wavelet denoising speckles Removal, Edge Detection and Object Isolation, Image Fusion, Object Detection by Wavelet Transform of Projections, Communication application.

Textbooks / References:

1. C. Sidney Burrus, R. A. Gopianath, Pretice Hall, Introduction to Wavelet and Wavelet Transform
2. P.P.Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, Multirate System and Filter Banks
3. N.J.Fliege , John Wiley & Sons, Multirate Digital Signal Processing
4. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application
5. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999).
6. Rao, "Wavelet Transforms", Pearson Education, Asia.

MTVEP207 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.

MTVES206A
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	

MTVES206B
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 Social Sciences	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

MTVEAU201 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

OPEN ELECTIVE II

MTVEOE201A	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

MTVEOE201B 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)

MTVEOE201C 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.

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)

MTVEOE201D 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)

MTVEOE201E 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

MTVEOE201F 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

Multidisciplinary Minor

MTVEMD201A **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

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)

MTVEMD201B 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)

Multidisciplinary Minor

MTVEMD201C 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)

MTVEMD201D 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

Multidisciplinary Minor

MTVEMD201E **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

MTVEMD201F 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

MTVESE201 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.

MTVEPR201	**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

MTVEPR201	**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.