Manipal School of Information Sciences (MSOIS)
MAHE, Manipal

Master of Engineering - ME (Vehicular Embedded Systems)

Program Structure (July 2019 Onwards)

I Semester									
Sub Code	Subject Name	No of Hrs./week				Duration of Exam in Hrs.	Maximum Marks		
		Lecture	Tutorial	Practical	Credit		Internal Assessment	Final Exam	Total
CSE 602	Real Time Operating Systems	3	-	-	3	3	50	50	100
ESD 605	Embedded Systems	3	-	-	3	3	50	50	100
AES 601	Sensors and Transducers	3	-	-	3	3	50	50	100
AES 602	Vehicular Adhoc Networks	3	-	-	3	3	50	50	100
	Elective – 1	3	-	-	3	3	50	50	100
CSE 602L	Real Time Operating Systems Lab	-	-	3	1	3	50	50	100
ESD 605L	Embedded Systems Lab	-	-	3	1	3	50	50	100
AES 601L	Sensors and Transducers Lab	-	-	3	1	3	50	50	100
AES 602L	Vehicular Adhoc Networks Lab	-	-	3	1	3	50	50	100
	Elective – 1 Lab	-	-	3	1	3	50	50	100
VES 695	Mini Project – 1	-	-	-	4	-	100	-	100
VES 697	Seminar – 1	-	-	-	1	-	100	-	100
TOTAL		**15**	**-**	**15**	**25**				

II Semester									
Sub Code	Subject Name	No of Hrs./week				Duration of Exam in Hrs.	Maximum Marks		
		Lecture	Tutorial	Practical	Credit		Internal Assessment	Final Exam	Total
CSE 601	Data Structure and Algorithms	3	-	-	3	3	50	50	100
CDC 601	Cloud Computing	3	-	-	3	3	50	50	100
VES 601	Automotive Bus Architecture	3	-	-	3	3	50	50	100
VES 602	Data Analytics for Automobiles	3	-	-	3	3	50	50	100
	Elective – 2	3	-	-	3	3	50	50	100
CSE 601L	Data Structure and Algorithms Lab	-	-	3	1	3	50	50	100
CDC 601L	Cloud Computing Lab	-	-	3	1	3	50	50	100
VES 601L	Automotive Bus Architecture Lab	-	-	3	1	3	50	50	100
VES 602L	Data Analytics for Automobiles Lab	-	-	3	1	3	50	50	100
	Elective - 2 lab	-	-	3	1	3	50	50	100
VES 696	Mini Project - 2	-	-	-	4	-	100	-	100
VES 698	Seminar - 2	-	-	-	1	-	100	-	100
Total		**15**	**-**	**15**	**25**				

III & IV Semesters									
VES 799	Project Work	-	-	-	25				
Total Number of Credits to award Degree		**75**							

List of Electives (Theory)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
AES-603	Process Dynamics and Control	BDA-613	Machine Learning
CSE-620	Linux and Scripting Languages	CSE-609	Cryptography and Network Security
CSE-624	Linux Internals and Programming	ENP-601	Entrepreneurship
ESD-602	Microcontrollers and its applications	ESD-604	Device Drivers
IOT-607	Internet of Things	VES-604	Autonomous Vehicles
VES-603	Automotive Control System	VES-605	Advanced Control Systems
		CSE-631	IT Project Management

List of Electives (Lab)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
AES-603L	Process Dynamics and Control Lab	BDA-613L	Machine Learning Lab
CSE-620L	Linux and Scripting Languages Lab	CSE-609L	Cryptography and Network Security Lab
CSE-624L	Linux Internals and Programming Lab	ENP-601L	Entrepreneurship Lab
ESD-602L	Microcontrollers and its applications Lab	ESD-604L	Device Drivers Lab
IOT-607L	Internet of Things Lab	VES-604L	Autonomous Vehicles Lab
VES-603L	Automotive Control System Lab	VES-605L	Advanced Control Systems Lab
		CSE-631L	IT Project Management Lab

Note:

- Eligibility for Gold Medal
  - Graduates who have earned all the credits required for the award of the degree from MAHE only will be considered.
  - Gold Medal will be awarded to a graduate who has scored highest CGPA

SEMESTER I

CSE 602: Real Time Operating Systems

[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to OS and RTOS:
Essential features of an OS, Single Processor Systems and Multiprocessor Systems, Essential Features of Batch Processing, Time sharing, Multiprogramming, Interactive systems, User mode and Kernel Mode operations, Distinction between function call and system call, Real time operating system and real time embedded systems. **(3 Hrs.)**

Process Management:
A process in memory, process state, PCB, Process scheduling, scheduling Queues, Types of schedulers, Process system calls - IPC using Shared Memory, IPC using Sockets. **(5 Hrs.)**

Multithreaded Programming:
Introduction, benefits, multithreading models, Pthreads, Win32 threads, Threading Issues, Thread pools Linux threads. **(4 Hrs.)**

Process Scheduling:
Introduction, scheduling criteria, scheduling Algorithms – FCFS, SJF, PS, RR, Multilevel Queues, Multilevel feedback Queue Scheduling, Scheduling evaluations. **(5 Hrs.)**

Synchronization:
Introduction, Critical Section Problem, Petersons Solutions, synchronization hardware, Semaphores, usage, implementations; Deadlocks and starvation, Classical problem of synchronization – Bounded Buffer problem, Reader's Writer's problem, Dining Philosophers problem, sleeping barbers problem; Monitors. **(6 Hrs.)**

Deadlocks:
Introduction, deadlock, characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, recovery from deadlock. **(3 Hrs.)**

Memory Management:
Memory Management Strategies, Virtual Memory Management. **(5 Hrs.)**

Real Time Systems:
Overview of Real Time Systems, Real Time clocks and Real Time Scheduling Algorithms (**5 Hrs.**)

Associated Lab Work:
Hands on experience on the theory

References:

1. *"**Operating System principles**", Seventh Edition, Abraham Silberschatz, Peter Galvvin, Grag Gagne. John Wiley Publications*
2. *"**Real – Time Systems and Programming Languages**", Allan Burns, Andy Wellings.*
3. *"**Operating Stems Concepts and Design**", Milan Milenkovic*
4. *"**Design of Unix Operating System**", Maurice Bach (IPC)*
5. *"**The C Programming Language**", Kerninghan & Ritchie*

ESD 605: Embedded Systems
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Embedded Systems – Design Challenges– Processors Technology – Design Technology. **(2 Hrs.)**

Introduction to ARM Cortex processor – Variants of Cortex and ARM versions – Comparison of M-series processor – Architecture – Programmers Model – APSR register – Memory Model – Exception – Interrupts – Reset **(4 Hrs.)**

Instruction Set Architecture – More on Memory System – Exceptions and Interrupts – NVIC – Memory .Protection Unit - Assembly Programming – Embedded C programming – CMSIS – Startup Code. **(3 Hrs.)**

Introduction to LPC13/17xx Microcontroller – Memory Mapping – Registers involved and programming with GPIO – PWM **(3 Hrs.)**

Data Acquitstion System: ADC – Types of ADC – Choosing the ADC – DAC **(4 Hrs.)**

Serial Communication: UART – I2C – SPI – Interfacing **(4 Hrs.)**

USB BUS – Speed Identification on the bus –States – Packets – Data flow types – Enumeration – Descriptors - USB Interface – C Programs **(6 Hrs.)**

CAN Bus – Introduction - Frames – Bit stuffing – Types of errors -Nominal Bit Timing - A simple application with CAN **(4 Hrs.)**

Introduction to Multitasking in Microcontrollers – Variants of RTOS – FreeRTOS, UCOS, uCLinux – FreeRTOS on Cortex based Microcontrollers – TASK CREATION – QUEQUES – SEMAPHORE – MUTEX – Application development. **(4 Hrs.)**

Designing a Digital Camera: Introduction – Requirement Specifications – Implementation - Testing **(2 Hrs.)**

References:

1. *Joseph Yiu, "The definitive guide to the ARM Cortex-M3", 2nd Edition, Elsevier 2010.*
2. *Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India, 2007,ISBN:81-265-0837-X*
3. *LPC13xx/17xx User Manual*
4. *LPCzone Examples*
5. *FreeRTOS Reference Manual*
6. *FreeRTOS port for Cortex M3*

AES 601: Sensors and Transducers
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction **(2 Hrs.)**
Sensors/ Transducers – Principles – Classification – Parameters – Environmental Parameters – Characterization

Mechanical and Electromechanical Sensors: **(6 Hrs.)**
Resistive Potentiometer – Strain Gauge – Inductive Sensors – Capacitive Sensors – Force/ Stress Sensors using Quartz Resonators – Ultrasonic Sensors

Thermal Sensors **(6 Hrs.)**
Gas Thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Thermometric Sensors – Dielectric Constant and Refractive Index Thermo sensors - Helium Low Temperature 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: **(6 Hrs.)**
Sensors and the Principles Behind – Magnetoresistive Sensors – Hall Effect and Sensors – Inductive and Eddy Current Sensors – Angular/ Rotary Movement Sensors – Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors – SQUID Sensors

Electroanalytical Sensors: **(5 Hrs.)**
Electrochemical Cell – Cell Potential – Standard Hydrogen Electrode – Liquid Junction and other potentials – Polarization – Reference Electrodes – Sensor Electrodes – Electroceramics in Gas Media - ChemFET

Smart Sensors: **(5 Hrs.)**
Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation – Information Coding/ Processing – Data Communication – Automation

Recent Trends in Sensor Technology: **(3 Hrs.)**
Film Sensors – Semiconductor IC Technology – Microelectromechanical Systems (MEMS) - Nano Sensors

Applications of Sensors **(3 Hrs.)**
On-board Automobile Sensors – Flow-rate Sensors – Pressure Sensors – Temperature Sensors – Oxygen Sensors – Torque and Position Sensors.

References:

1. ***D Patranabis "Sensors and Transducers", Second Edition, PHI, 2004***
2. ***John G. Webster. Editor-in-chief. "Measurement, Instrumentation, and Sensors Handbook", CRC Press. 1999. 0-8493-2145-X.***
3. ***Pawlak Andrzej M, "Sensors and actuators in Mechatronics", 2007***
4. ***PDF files online available at www.engnetbase.com***
5. ***"Automotive Hand Book", Robert Bosch, Bently Publishers, 2007.***
6. ***John G. Webster*, "Modern instrumentation applications and design", 2004**

AES 602: Vehicular Adhoc Networks
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction:
Vehicular AdHoc Networks, Basic Concept of VANET, Taxonomy of Vehicular Communication Systems, Challenges and Perspectives, Application for VANETs Basic Principles and Challenges, Past and Ongoing VANET Activities **(2 Hrs.)**

Cooperative Vehicular Safety Applications:
Motivation, Enabling Technologies, Cooperative System Architecture, Mapping for Safety Applications, VANET-enabled Active Safety Applications **(3 Hrs.)**

Information Dissemination in VANETs:
Obtaining Local Measurements, Information Transport, Protocols for information transport, Improving network connectivity, Geographical Data Aggregation **(4 Hrs.)**

Vehicular Mobility Modeling for VANET:
Random Models, Flow Models, Traffic Models, Behavioural Models, Integration with Network Simulators, A Design Framework for Realistic Vehicular Mobility Models **(4 Hrs.)**

Physical Layer Considerations for Vehicular Communications:
Standards Overview, Wireless Propagation Theory, Channel Metrics, Highway environments, Urban environments, Rural LOS environments **(4 Hrs.)**

MAC Layer and Scalability Aspects of Vehicular Communication Networks:
Introduction: Challenges and Requirements, A Survey on Proposed MAC Approaches for VANETs, Communication Based on IEEE 802.11p, The IEEE 802.11 standard, IEEE 802.11p: towards wireless access in vehicular environments, Performance Evaluation and Modeling, Aspects of Congestion Control. **(6 Hrs.)**

Efficient Application Level Message Coding and Composition:
Introduction to the Application Environment, Message Dispatcher, Example Applications, DataSets, Architecture Analysis **(3 Hrs.)**

Data Security in Vehicular Communication Networks:
Introduction and Outline, Challenges of Data Security in Vehicular Networks, Network, Applications, and Adversarial Model, Security Infrastructure, Privacy Protection Mechanisms. **(5 Hrs.)**

Standards and Regulations:
Layered Architecture for VANETs, DSRC Regulations, DSRC Physical Layer Standard, DSRC Data Link Layer Standard (MAC and LLC), DSRC Middle Layers, DSRC Message Sublayer. **(5 Hrs.)**

References:

1. ***Hannes Hartenstein, Kenneth P Laberteaux, "VANET: Vehicular Applications and Inter-Networking Technologies", John Wiley & Sons Ltd, 2010***
2. ***Hassnaa Moustafa, Yan Zhang, "Vehicular Networks Techniques, Standards and Applications", Auerbach Publications, 2009***
3. ***IEEE and other Transaction papers***

ELECTIVE - 1

ESD-602: Microcontrollers and Its Applications

[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Microprocessor & Microcontrollers:
Comparison – Variants – Types – General – ASIC – PLD – Introduction to Motherboard(Desktop) - Introduction to Embedded Board – Compare and Contrast - Application Types – Single Tasking – Multitasking – Multi-Application. **(2 Hrs.)**

Introduction to ARM Microcontrollers:
Programming Model – Processor Modes – ARM vs Thumb – Introduction to LPCxxxx Microcontrollers – Features – Detailing of Pins - Memory Map Concepts – RAM & ROM - Interrupts Concepts (Internal & External). **(6 Hrs.)**

Reset Circuitry:
Crystals - Introduction to GPIO – Registers – Input /Output Configuration – Pull Up and Pull Down Resistor Concept – Interfacing with LED – Interfacing Push Buttons – LCD – Stepper Motor – DC Motor. **(2 Hrs.)**

Relays:
Types of Relays – Interfacing **(8 Hrs.)**

Timer, Counter Introduction:
Configuration – Programming **(3 Hrs.)**

Serial vs Parallel Bus:
Compare and Contrast – Terminology: Baud Rate – Bit Rate – RS232 – DB9 handshaking concepts - Configuring Registers – Programming for UART modules . **(3 Hrs.)**

Introduction to SPI and I2C Protocol:
Detailed Discussion – Bit Banging – Interfacing with SPI and I2C Devices – RTC / ADC /DAC.
(6 Hrs.)

Introduction to ADC and DAC:
Types – Chips - Register Configuration – Interfacing **(6 Hrs.)**

References:

1. ***William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854***
2. ***Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN-13: 978-1558608740, ISBN-10: 1558608745***
3. ***David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional.***
4. ***Steve Furber,"ARM System-on-Chip Architecture",2nd Edition,Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196***
5. ***Douglas V. Hall,"Microprocessors and Interfacing",Mcgraw Hill Education ,ISBN-10 1259006158,ISBN-13 9781259006159,2012.***
6. ***Websites & Transaction Papers***

IOT-607: Internet of Things
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Internet of Things: IoT Protocols – Logical Design - Enabling Technologies - Levels – IoT vs M2M – Design Methodology – Domain Specific Applications **(4 Hrs.)**

Introduction to Python – Datatypes - Constructs – Packages **(6 Hrs.)**

Wireless Sensor Networks – Protocol Standards – Issues – Routing – Applications **(3 Hrs.)**

Protocols:

Bluetooth - Introduction – Protocol Stack - RF Classes – Radio Technologies – Service Discovery – Device Discovery – Profiles – Security (Discovering Bluetooth) - Hardware
(3 Hrs.)

Zigbee - Frequency - Channels – Topology - Zigbee Protocol Stack - PHY - MAC Layer - Working – Frame Structure – Beacon – Non-Beacon Communication - Zigbee PDU – Zigbee Hardware – API Mode and AT mode communication. **(3 Hrs.)**

Internet Protocol - Introduction to IPv4 and IPv6 – IPv4 Headers – Ipv6 Headers **(3 Hrs.)**

6LoWPAN - 6LoWPAN architecture: simple, extended and ad-hoc networks. Issues in determining IPv6 links in LLNs and illustration of the undetermined link addressing model. IPv6 addressing in 6LoWPAN.
(4 Hrs.)

Sockets: Introduction to Sockets – Client Server Architecture –Unix Sockets – PORTS – Python APIs of Sockets – TCP socket programming using Python – UDP – RAW packets python programming. **(4 Hrs.)**

Databases & Web Programming: Introduction to Databases – File System vs RDBMS – ER Diagram – Python Database connectivity (CRUD) - Web Server Concepts - Python Web Programming – IoT Framework. **(6 Hrs.)**

References:

- *Arshdeep Bhaga, Vijay Madishetti, "Internet of things:A hands on Approach", Universities Press, ISBN:978172719547*
- *Robert Faludi,"Building Wireless Sensor Networks",Orielly, 2012*
- *Jean-Philippe Vasseur,Adam Dunkels,"Interconnecting Smart Objects with IP: The Next Internet",Morgan Kaufmann Publishers,2010,ISBN:0123751659 9780123751652*
- *Marco Schwartz,"Internet of Things with the Arduino Yun",Packt Publishing,2014*
- *Charalampos Doukas,"Building Internet of Things With the Arduino: Volume 1",CreateSpace Independent Publishing Platform,2012*
- *Todor Cooklev ,"Wireless communication standards", IEEE Press*
- *Houda Labiod, Hossam Afifi, Costantino De Santis, "Wi-Fi, Bluetooth, Zigbee and WiMAX", Springer Publications*
- *Madhushree Ganguli , "Getting started with Bluetooth", Premier Press, 2002, ISBN 1931841837, 9781931841832.*

CSE-620: Linux and Scripting languages
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Section 1:

Essentials:
Structure of a Linux Based Operating System, Hardware, Kernel, Logging into a Linux System, The Password File, The Shell Command Interpreter, Different Shell Command Interpreters, The Command History within the shell, configuring your shell environment. **(5 Hrs.)**

Section 2:

Getting started with Shell Programming: Writing shell scripts, Variables in shell, User defined variables (UDV), Rules for Naming variable name (Both UDV and System Variable), Printing or accessing values of UDV (User defined variables), echo Command, Shell Arithmetic, More about Quotes, Exit Status, The read Statement, Wild cards (Filename Shorthand or meta Characters), More commands on one command line, Command Line Processing, Requirements for Command Line arguments, Redirection of Standard output/input i.e. Input - Output redirection, Pipes, Filter, What is Processes, Why Process required, Linux Command(s) Related with Process **(5 Hrs.)**

Shells (bash) structured Language Constructs:
Decision making in shell script, test command or [expr], if...else...fi, Nested ifs, Multilevel if-then-else, Loops in Shell Scripts, for loop, Nested for loop, while loop, The case Statement, Debugging the shell script **(2 Hrs.)**

Advanced Shell Scripting Commands:
/dev/null - to send unwanted output of program, Local and Global Shell variable (export command) Conditional execution i.e. && and ||, I/O Redirection and file descriptors, Functions, User Interface and dialog utility-Part I, User Interface and dialog utility-Part II, Message Box (msgbox) using dialog utility, Confirmation Box (yesno box) using dialog utility, Input (inputbox) using dialog utility, User Interface using dialog Utility - Putting it all together, trap command, The shift Command, getopts command. **(5 Hrs.)**

Essential Utilities for Power User:
Preparing for Quick Tour of essential utilities, Selecting portion of a file using cut utility, Putting lines together using paste utility, The join utility, Translating range of characters using tr utility, Data manipulation using awk utility, sed utility - Editing file without using editor, Removing duplicate lines from text database file using uniq utility, Finding matching pattern using grep utility. **(4 Hrs.)**

awk Revisited:
Getting Starting with awk, Predefined variables of awk, Doing arithmetic with awk, User Defined, variables in awk, Use of printf statement, Use of Format Specification Code, if condition in awk, Loops in awk, Real life examples in awk, awk miscellaneous, sed - Quick Introduction, Redirecting the output of sed command, Writing sed scripts. **(5 Hrs.)**

Section 3:
Introduction to perl:
What is PERL?, The structure of a Perl CGI script, Informing the Server software where Perl, CGI scripts are stored, Concept of granting permissions for everyone, to be able to use the Perl scripts. **(2 Hrs.)**

The perl programming environment:
Creating a Perl CGI script, Invoking a Perl CGI script, Executing a Perl CGI script, Placing comments in a Perl script. **(1 Hr.)**

Scalar Variables:
What is Scalar? , Defining Scalar Variables, Literal Representation, Scalar Operators **(1 Hr.)**

Arrays:
What is a List or Array? , Defining Array variables, Literal Representation, Array Operators **(1 Hr.)**

Hash Arrays:
What is a Hash Array?, Hash Key and its value, Defining Array variables, Literal Representation, Accessing Hash Array values, Hash Array Operators, How a Scalar Operator determines, Strings, Numbers. **(1 Hr.)**

Perl functions and procedures:
Scalar Functions, Scalar Procedures, Array Functions, Array Procedures, Hash Array Functions, Hash Array Procedures. **(1 Hr.)**

Stdin/Stdout:
Input from STDIN (Server Default Port 80), Output to STDOUT (Server Default Port 80) **(1 Hr.)**

Section 4:
Makefile – create a makefiles, shortcuts **(2 Hrs.)**

References:

*"**The Art of Unix Programming**", Eric Steven Rajword Thyrsus Enterprises*
1. *"**Learning Perl the Hard Way**",Allen B Downey*
2. *"**A Practical Guide to Linux Commands, Editors, and Shell Programming**", Mark G Sobell*
3. *"**Sed & awk** ", Second edition by O'reilly*
4. *"**Programming Perl**", 4th Edition By Tom Christiansen,brian d foy,Larry Wall,Jon Orwant*

VES-603: Automotive Control Systems
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Control Systems and Mathematical Modelling Systems: Introduction to Control Systems and History of Automatic Control-Examples of Automotive Control Systems-Steering Control, Cruise Control, Adaptive Suspension System, Future Evolution of Control System. - Differential Equation of Physical Systems and Transfer Function of Linear Systems - Transfer Function of a D.C Motor, Throttle Position Sensor, Velocity Sensor, Accelerometer, Gear Train and Rack-Pinion System - Block Diagram Transformation and Block Diagram Reduction for Finding Closed Loop Transfer Functions.- Signal Flow Graphs Models and Mason's Gain for mula and Transfer Function of Multiple-Loop System - Introduction to CACSD to ols and Simulation of Mathematical Models **(6 Hrs.)**

Feedback Control System Characteristics and Performance - Introduction to Time Response Analysis-Error Signal Analysis - Sensitivity of Control System, Disturbances Test Input Signals, Steady State and Transient Response, Time Response Analysis of First Order System. - Time Response Analysis of Second Order System - S-Plane Root Location and Transient Response, Steady State Error of Feedback Control System - Time Domain Specifications and Performance Using Control Design Software. - Time Response Analysis of Cruise Control System and Mobile Robot Steering Control **(6 Hrs.)**

Stability Analysis of Linear Feedback System - Introduction to Concept of Stability. - Routh – Hurwitz Stability Criterion.- Stability Analysis of Tracked Vehicle Turning Control. - Introduction to Root Locus Concept. - The Root locus Procedure and Rootlocus Analysis. - Three Term (PID) Controller - Case Study On Automobile Velocity Control In An IVHS,Root Locus Using Control Design Software. **(6 Hrs.)**

Frequency Response Analysis - Frequency Response Plots, Performance Specification, Log Magnitude and Phase Diagrams - Frequency Response Methods Using Control Design Software - Nyquist Stability Criterion, Relative Stability, Nyquist Plot, Pid Controller In Frequency Domain, Lead, Lag and Lead-Lag Compensators. **(6 Hrs.)**

State Variable Models and Analysis - Introduction to State Space and State Variable Models - State Variable of a Dynamic System, State Differential Equation, Transfer Function From State Equation, Time Response and State Transition Matrix - Introduction to Controllability, Observability and Full State Feedback - Analysis of A State Variable Model Using Control Design Software for A Segway Using Inverted Pendulum Model **(6 Hrs.)**

References

1. **Richard.C.Dorf and Robert.H.Bishop , "Modern Control System" 12th edition Pearson Prentice Hall,2013.**
2. **Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.**
3. **J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.**

CSE-624: Linux Internals and Programming
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Linux Introduction- General OS Architecture - Boot Process – Kernel – Monolithic vs Microkernel Architecture - Linux Directory structure – Boot Loader – Grub **(4 Hrs.)**

Linux Shell and Files:
Shell Programming – Pipes – Shell Syntax – Commands -Working with Files – File Structure – Low level File Access – Standard I/O Library – File and Directory Maintenance – Linux Environment **(8 Hrs.)**

Python Scripting – Python Constructs – Introduction to Sockets – UDP – TCP – Socket Programming using Python - Object Oriented Python (**10 Hrs**.)

Device Drivers:
Types of Device Driver – Kernel C vs Pure C – Writing the first Device Driver –Dynamic Loading – Character Driver – Character Device Files – Decoding Character Device File Operations – Generic Hardware access in Linux - Accessing x86-Specific I/O-Mapped Hardware – IO control in Linux – Kernel Space Debuggers in Linux – Generic USB drivers in Linux – Hard disk Partitions – Block Drivers – Peeping through proc – Module Interactions – Network Drivers – File System. **(14 Hrs.)**

References:

1. ***"Beginning Linux Programming" , Wrox, 3rd edition***
2. ***"Unix Shell Scripting" , Yaswant Kannetkar, BPB Publications***
3. ***"Foundations of Python Network Programming", Brandon Rhodes and John Goerzen, 2nd Edition, Apress.***
4. ***Socket Programming Article Series***
5. ***Device Drivers Article Series***

AES-603: Process Dynamics and Control
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Review of Process and Control Systems:
Control Systems, Process control principles, servomechanism, Process control block diagram, identification of elements, Dynamics of liquid process, gas process, flow process, thermal process, mixing process - Batch process and continuous process - Self regulation. (**6 Hrs.)**

Design aspects of Process Control System:
Classification of variables, Design elements of a control system, control aspects of a process. The input – output model, degrees of freedom and process controllers. Modes of operation of P, PI and PID controllers - Effect of variation of controller variables- Typical control schemes for flow, pressure, temperature and level processes. **(8 Hrs.)**

Control System Components:
I/P and P/I converters - Pneumatic and electric actuators - valve positioner - control valve Characteristics of control valve - valve body - globe, butterfly, diaphragm ball valves - control valve sizing - Cavitation, flashing in control valves - Response of pneumatic transmission lines and valves. Actuators – Pneumatic, Hydraulic, Electrical/ Electronic. (**8 Hrs)**

Dynamic Behavior of Feedback Controlled Process:
Stability considerations. Simple performance criteria, Time integral performance criteria: ISE, IAE, ITAE, Selection of type of feedback controller. Logic of feed forward control, problems in designing feed forward controllers, feedback control, Ratio Control, Cascade Control, Override control, auctioneering control, split range control - Processes with large dead time - Dead time compensation. Control of systems with inverse response. (**10 Hrs.)**

Computer Control:
Zero order hold, First order hold, pulse transfer function, Sampled data control system, Dahlin's algorithm, Dead-beat algorithm, Kalman's algorithm, Digital feed-forward control. (**4 Hrs.)**

References:

1. ***Curtis Johnson,Process Control Instrumentation Technology , Prentice Hall of India. 1996***
2. ***George Stephanopoulos, Chemical Process Control, Prentice Hall of India. 2005***
3. ***Caughanour and Koppel, Process systems analysis and control, Tata McGraw Hill. 1991***
4. ***Dale E. Seborg, Process Dynamics and Control, John Wiley. 2009***
5. ***Eckman D.P,Automatic process control, Wiley Eastern, 1986***
6. ***Peter Harriot, Process control, Tata McGraw Hill. 1964.***
7. ***Patranabis D, Principles of process control, Tata McGraw Hill. 2000.***
8. ***F.G. Shinkskey, Process controls Systems, McGraw Hill. 1986.***
9. ***P.B. Deshpande, and R.H.Ash, 'Computer Process Control', ISA Publication, USA, 1995.***

CSE 602L: Real Time Operating Systems Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in CSE 602: Real Time Operating Systems

ESD 605L: Embedded Systems Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in ESD 605: Embedded Systems

AES 601L: Sensors and Transducers Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in AES 601: Sensors and Transducers

AES 602L: Vehicular Adhoc Networks Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in AES 602: Vehicular Adhoc Networks

Elective – 1 Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in elective - 1

VES 695: Mini Project – 1
[L-T-P-C: 0-0-0-4]
Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester.

VES 697: Seminar – 1
[L-T-P-C: 0-0-3-1]
Students have to make a literature survey and select a latest topic in the area of their interest and the area of their specialization and make a presentation in the semester.

SEMESTER II

CSE 601: Data Structures and Algorithms
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction: **(2 Hrs.)**
Algorithm Specification, Performance Analysis

Algorithm Analysis Techniques: **(3 Hrs.)**
Analysis of Recursive Programs, Solving Recurrence Equations, General Solution for a large class of Recurrences

Elementary data structures: **(5 Hrs.)**
Implementation of Lists, Stacks, Queues

Sorting & Searching Techniques: **(5 Hrs.)**
Quick sort, Heap sort, Merge sort, Binary search, linear search, Fibonacci search;

Operations on Sets: **(4 Hrs.)**
Introduction to Sets, A Linked- List implementation of Set, The Dictionary, The Hash Table Data Structure;

Trees: **(4 Hrs.)**
Basic Terminology, Implementation of Trees, Binary Trees, Binary Search Trees

Graphs: **(5 Hrs.)**
Basic definitions, Representation of Graphs, Minimum Cost Spanning Tree, Single Source Shortest Paths, All-Pairs Shortest Path;

Algorithm Design Techniques: **(8 Hrs.)**
Divide-and-Conquer Algorithms, Dynamic Programming, Greedy Algorithms, Backtracking;

Associated Lab Work:
Hands on experience on the theory

References:

- *"Introduction to Algorithms" Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest.*
- *"Data Structures& Algorithms" Aho, Hopcroft and Ulmann*
- *"Data structures and algorithm analysis in C" Mark Allen Weiss*
- *"Computer Algorithms" : Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran*

CDC 601: Cloud Computing
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction: **(4 Hrs.)**
Evolution of Cloud Computing, Enabling technologies, Cloud computing infrastructure models, Public, private, and hybrid clouds, Architectural layers of cloud computing, Cloud application programming interfaces, Inside Grid, HPC, Clouds

Cloud Architecture: **(8 Hrs.)**
models for cloud computing, Types of Clouds and Services, Security, Privacy, and Trust management issues, Cloud Economics and Business Models, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Virtual Machines Provisioning and migration services, Support for Market-Aware Cloud Services, Pricing Schemes and Risk Management, SLA (Service Level Agreements) negotiation and management Accounting, Billing and Verification Infrastructure

Infrastructure models: **(4 Hrs.)**
Infrastructure models & its advantages, Private Clouds, Public Clouds, Hybrid Clouds

Important Delivery Mechanisms: **(6 Hrs.)**
Infrastructure as a Service, Platform as a Service, Software as a Service, Data as a Service, other delivery mechanisms like Globalization as a Service, etc.

Key Issues: **(4 Hrs.)**
Recovery, Data Segregation, Underlying Encryption, and the other drawbacks of Cloud Computing

Parallelization Concepts: **(4 Hrs.)**
High Availability, Replication, Load Balancing, Interoperability between Clouds, Internetworking between Clouds (InterClouds)

Case Study: **(6 Hrs.)**
Building and Deploying Social Network Applications on Clouds, Portability of applications and data between different cloud providers, Reliability of applications and services running on the cloud, Content Delivery Networks using Storage Clouds, Building and Hosting Internet Service Applications on Cloud, Experience with Building and Using Cloud Infrastructure, Legal issues in Cloud Computing, Business Computing on Clouds

References:
1. ***"Introduction to Cloud Computing"*** *, Timothy Chou, Active Book Press 2nd Edition*
2. ***"Cloud Computing: Principles and Paradigms"*****,** *R Buyya, Wiley, 2010.*
3. ***"Cloud Computing: Principles, Systems and Applications"*****,** *L Gillam, Springer, 2010.*
4. *Transaction Papers*

VES 601: Automotive Bus Architecture
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Embedded Communication Protocols: Embedded Networking: Introduction - Serial communication protocols: RS232 standard - Synchronous Serial Protocols **(4 Hrs.)**

Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) **(4 Hrs.)**

Bus Systems: CAN ISO 11898 - CAN FD ISO 11898-1 - CAN Bus – Introduction - Frames – Bit stuffing – Types of errors -Nominal Bit Timing - A simple application with CAN - LIN - FlexRay – MOST - K-Line ISO 9141 - SAE J1850 – Ethernet **(8 Hrs.)**

Data Descriptions: ODX ISO 22901-1 - OTX ISO 13209 - ASAM MCD-2MC - A2L – CANdb **(4 Hrs.)**

Programming Interfaces: D-Server (ISO 22900) - D-PDU API (ISO 22900) - PassThru (SAE J2534) - RP1210 **(2 Hrs.)**
Protocols: UDS ISO 14229 - OBD ISO 15031 - SAE J1939 - KWP2000 CAN - KWP2000 K-Line- DoIP ISO 13400 - WWH-OBD ISO 27145 **(4 Hrs.)**

HART and Wireless HART **(2 Hrs.)**

NFC - General Architecture – Barcodes vs RFID tags - Passive vs. Active - Physical Layer – Reader/Writer Mode – Peer-to-Peer Mode - Interfacing with Microcontroller & Applications **(3 Hrs.)**

GPRS - System Architecture – Services – Session Management, Mobility Management and routing - Signalling Plane – Air interface – Authentication and Ciphering & Applications **(3 Hrs.)**

GPS – Working – Triangulating – Measuring Distance – Getting Perfect Timing – Satellite Positions – Differential GPS – Adavced Concepts – NMEA protocol –interfacing with Microcontroller & Applications **(2 Hrs.)**

References

1. "USB Complete: The Developer's Guide", Fourth Edition, Jan Alexson
2. "Embedded Systems", Raj Kamal , 2nd Edition, Tata McGraw Hill, 2004
3. "Designing Embedded Hardware", 2nd edition By John Catsoulis, Orielly
4. Vedat Coskun, Kerem Ok and Busra Ozdenizci , "Near Field Communication", 2011, Wiley Publications.
5. "Wireless communication standards", Todor Cooklev,IEEE Press
6. Jörg Eberspächer,Hans-Jörg Vögel, Christian Bettstetter, Christian Hartmann, "GSM – Architecture, Protocols and Services" Third Edition, Wiley Publications
7. www.trimble.com /gps_tutorial
8. Weblinks & Transaction Papers

VES 602: Data Analytics for Automobiles
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Big Data - Terminology – Challenges - Architectures – Distributed File Systems – Google File System – Hadoop File Systems - Hadoop Ecosystems **(6 Hrs.)**

Statistics - Sampling Techniques - Data classification, Tabulation, Frequency and Graphic reporesentation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis. **(4 Hrs.)**

Databases for Big Data - Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – Big Table vs HBase introduction to NoSQL - HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing **(4 Hrs.)**

Stream Computing in Big Data: Introduction - Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines – Issues in Stream Processing - Phases in Streaming Analytics Architecture - Vital Attributes - High Availability – Low Latency – Horizontal Scalability-Fault Tolerance - Service Configuration and Management - Apache ZooKeeper - Distributed Stream Data Processing: Co-ordination, Partition and Merges, Transactions. Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing a storage system – NoSQL Storage Systems. **(6 Hrs.)**

Data Visualization, Characterisation - DATA WRANGLING: Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions - DATA AGGREGATION, GROUP OPERATIONS ,TIMESERIES - GoupBy Mechanics – Data Aggregation – Groupwise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting - WEB SCRAPING - Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors - Data Visualization Tools **(6 Hrs.)**

Neural Network & Deep learning for Vehicles. **(6 Hrs.)**

ELECTIVE - 2

ESD-604: Device Drivers

[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Device Drivers:	**(3 Hrs.)**
Building & Running Modules:	**(3 Hrs.)**
Character Driver	**(3 Hrs.)**
Debugging Techniques	**(3 Hrs.)**
Concurrency and Race Condition	**(3 Hrs.)**
Advanced Character Driver Operations	**(4 Hrs.)**
Time, Delay and Deferred Work	**(3 Hrs.)**
Allocating Memory	**(4 Hrs.)**
Communicating with Hardware	**(4 Hrs.)**
Interrupt Handling	**(4 Hrs.)**
PCI Drivers, USB Drivers	**(3 Hrs.)**

References:

1. Alessandro Rubini, **"Linux Device Drivers"**, (Nutshell Handbook), O'Reilly Publishers, 2009.
2. John Madieu, **"Linux Device Drivers Development: Develop customized drivers for embedded Linux"**, Packt Publishing, 2017.
3. Robert Love, **"Linux Kernel Development"**, Addison Wesley, Third Edition, 2010.
4. Daniel P. Bovet, Marco Cesati, **"Understanding the Linux Kernel"**, O'Reilly Media, Third Edition, 2008.
5. Wolfgang Mauerer, **"Professional Linux Kernel Architecture"**, Wrox, 2008.
6. Sreekrishnan Venkateswaran, **"Essential Linux Device Drivers"**, Prentice Hall, 2008.
7. W. Richard Stevens, Stephen A. Rago, **"Advanced Programming in the UNIX Environment"**, Addison Wesley, Third Edition, 2013.
8. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, **"Unix Network Programming, Vol1: Sockets",** Pearson Education India, Third Edition, 2015.

CSE-609: Cryptography and Network Security

[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Data Encryption Standard: Services – Mechanisms and Attacks – OSI security Architecture – Model for Network Security –Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques –Transposition Techniques – Rotor Machines– Steganography – Block Ciphers and Data Encryption Standard – Simplified DES – Block Cipher Principles - Data Encryption Standard Strength of DES– Differential and Linear Crypt Analysis, Block Cipher Design Principles – Block Cipher Modes of Operation. **(8 Hrs.)**

Advanced Encryption Standard: Introduction to A5/1 - Advanced Encryption Standard – Evaluation Criteria for AES, AES Cipher– Contemporary - Symmetric Ciphers – Triple DES, Blowfish, RC5 – Characteristics of Advanced Symmetric Block Ciphers – RC4 Stream Cipher – Confidentiality using Symmetric Encryption – Placement of Encryption Function – Traffic Confidentiality – Key Distribution and Random Number Generation. **(8 Hrs.)**

Public Key Encryption and Hash Functions: Public Key Cryptography and RSA – Principles of Public Key Cryptosystems – RSA Algorithm – Key Management and other public key cryptosystems – Key Management– Diffie–Hellman Key Exchange – Elliptic Curve Arithmetic – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Authentication Requirements – Authentication Functions – Message Authentication Codes – Hash Functions and MACs; Hash Algorithms – MD5 Message Digest Algorithm, Secure Hash Algorithm RIPEMD 160, HMAC– Digital Signatures and Authentication Protocols – Digital Signature Standards. **(8 Hrs.)**

Network Security Practice: Authentication Applications – Kerberos – X.509 Authentication Service– Electronic Mail Security –Pretty Good Privacy – S/MIME– IP Security – IP Security Overview– IP Security Architecture – Authentication Header – Encapsulating Security Payload – Combining Security Associations – Web Security – Web Security Considerations – Secure Sockets Layer and Transport Layer - Security – Secure Electronic Transaction. **(6 Hrs.)**

Wireless Network Security: Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network. **(6 Hrs.)**

References

1. *William Stallings, "Network Security Essentials", 2nd edition, Prentice Hall of India New Delhi, 2004.*
2. *Charlie Kaufman, "Network Security Private Communication in Public World" 2nd edition, Prentice Hall of India New Delhi, 2004.*
3. *William Stallings, "Cryptography and Network Security", 3rd edition, Prentice Hall of India, New Delhi, 2004.*
4. *R.K.Nichols and P.C. Lekkas ," Wireless Security" Mc Graw Hill 2002*
5. *Mark S. Merkow, Jim Breithaupt,"Information Security: Principles and Practices", Pearson IT Certification, 2 edition, ISBN-10: 0789753251,ISBN-13: 978-0789753250*
6. *Websites & Transaction Papers*

BDA-613: Machine Learning
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction: Definition of learning systems - Goals and applications of machine learning - Aspects of developing a learning system - Training data, concept representation, and function approximation. **(1 Hr.)**
Inductive Classification: The concept learning task - Concept learning as search through a hypothesis space - General-to-specific ordering of hypotheses - Finding maximally specific hypotheses - Version spaces and the candidate elimination algorithm - Learning conjunctive concepts. The importance of inductive bias. **(3 Hrs.)**

Predictive analytics – Supervised learning
Decision Tree learning: Representing concepts as decision trees - Recursive induction of decision trees - Picking the best splitting attribute - Entropy and information gain - Searching for simple trees and computational complexity **(3 Hrs.)**

Ensemble methods (bagging and boosting): Using committees of multiple hypotheses - Bagging, boosting, and DECORATE - Active learning with ensembles **(3 Hrs.)**

Computational learning theory:
Models of learnability: learning in the limit - Probably approximately correct (PAC) learning - Sample complexity: quantifying the number of examples needed to PAC learn - Computational complexity of training. Sample complexity for finite hypothesis spaces. **(3 Hrs.)**

Bayesian learning: Probability theory and Bayes rule - Naive Bayes learning algorithm - Parameter smoothing - Generative vs. discriminative training - Logistic regression - Bayes nets and Markov nets for representing dependencies. **(5 Hrs.)**

Instance-based learning: Constructing explicit generalizations versus comparing to past specific examples - K-Nearest Neighbour algorithm - Case-based learning. **(3 Hrs.)**

Support Vector Machine (SMV): Maximum margin linear separators - Quadractic programming solution to finding maximum margin separators - Kernels for learning non-linear functions. **(4 Hrs.)**

Descriptive analytics – unsupervised learning
Artificial Neural Networks: Neurons and biological motivation - Linear threshold units - Perceptrons: representational limitation and gradient descent training - Multilayer networks and back propagation - Hidden layers and constructing intermediate, distributed representations - Overfitting, **(6 Hrs.)**

Clustering: Learning from unclassified data - Clustering. Hierarchical Aglomerative Clustering - Non-Hierarchical Clustering - k-means partitional clustering - Expectation maximization (EM) for soft clustering - Semi-supervised learning with EM using labeled and unlabled data. **(5 Hrs.)**

References:

1. ***Pattern Recognition and Machine Learning - Christopher M. Bishop. Springer.***
2. ***Machine Learning - Tom Mitchell. McGraw Hill.***
3. ***An introduction to support vector machines - Cristianini, N. and J. Shawe-Taylor. Cambridge University Press.***
4. ***Machine Learning: The Art and Science of Algorithms that Make Sense of Data - Flach, Peter. Cambridge University Press.***
5. ***Artificial Intelligence: A Modern Approach (Third Edition) - Russell, Stuart and Peter Norvig. Prentice Hall.***
6. ***Pattern Classification (Second Edition) - Duda, R., P. Hart, and D. Stork. Wiley Publishers.***
7. ***A Course in Machine Learning - Hal Daumé III (http://ciml.info/)***
8. ***Analytics in a Big Data World - Bart Baesens. Wiley.***

9. ***Ensemble Learning - Thomas G. Dietteri in The Handbook of Brain Theory and Neural Networks, Second edition, (M.A. Arbib, Editor), Cambridge, MA: The MIT Press, 2002.***
10. ***Generative and discriminative classifiers: naïve Bayes and logistic regression.*** ***http://www.cs.cmu.edu/~tom/mlbook/NBayesLogReg.pdf***

ENP-601: Entrepreneurship
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Entrepreneurship: **(6 Hrs.)**
Meaning and Definition of Entrepreneurship-Employment vs Entrepreneurship, Theories of Entrepreneurship, approach to entrepreneurship, Entrepreneurs VS Manager

Entrepreneurial Traits: **(6 Hrs.)**
Personality of an entrepreneur, Types of Entrepreneurs

Process of Entrepreneurship: **(6 Hrs.)**
Factors affecting Entrepreneurship process

Business Start-up Process: **(6 Hrs.)**
Idea Generation, Scanning the Environment, Macro and Micro analysis

Business Plan writing: **(6 Hrs.)**
Points to be considered, Model Business plan

Case studies of Indian and International Entrepreneurship: **(6 Hrs.)**

References:

1. NVR Naidu and T. Krishna Rao, "**Management and Entrepreneurship**", IK International Publishing House Pvt. Ltd 2008.
2. Mohanthy Sangram Keshari, "**Fundamentals of Entrepreneurship**", PHI Publications, 2005.

VES-604: Autonomous Vehicles
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **(4 Hrs.)**

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. **(4 Hrs.)**

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. **(4 Hrs.)**

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. **(4 Hrs.)**

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. **(4 Hrs.)**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. **(4 Hrs.)**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems **(4 Hrs.)**

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. **(4 Hrs.)**

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **(4 Hrs.)**

References:

1. ***Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.***
2. ***Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.***
3. ***James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.***

VES-605*:* ADVANCED CONTROL SYSTEMS
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

LEAD, LAG AND LEAD-LAG COMPENSATORS: Control system design by root locus method-lead, lag and lead lag compensation. PI, PD and PID controllers design procedures and examples. Control system design by frequency response approach- lead, lag and lead lag compensation. PI, PD and PID controllers design procedures and examples.

EIGEN VALUE AND EIGEN VECTOR SENSITIVITIES IN LINEAR SYSTEM THEORY: Continuous time systems: Introduction, first-order Eigen value sensitivities, first order eigenvector sensitivities, second-order Eigen value sensitivities, first order eigenvector sensitivities, second order Eigenvector sensitivities.

MODE-CONTROLLABILITY MATRIX: Distinct Eigen-values, confluent Eigen-values associated with single Jordan block, confluent Eigen-values associated with number of distinct Jordan blocks, confluent Eigen-values associated with a number of non-distinct Jordan block. Mode –Controllability structure of multivariable linear systems: Introduction, Distinct Eigen-values, confluent Eigen-values associated with single Jordan block, confluent Eigen-values associated with a number of non-distinct Jordan blocs.

OBSERVABILITY MATRIX AND NON-LINEAR SYSTEMS: Distinct Eigen-values, confluent Eigen-values, mode observability structure of multivariable linear systems: Introduction, Distinct Eigen-values, confluent Eigen values. Nonlinear systems: Common physical nonlinearities: the phase plane method – basic concept, singular points, construction of phase trajectories – Isocline and delta methods, describing function – basic concept – derivation of describing functions – stability analysis by describing function method.

LYAPUNOV STABILITY ANALYSIS: Second method of Lyapunov, stability in the sense of Lyapunov, construction of Lyapunov functions – Krasovskii's and variable gradient methods, Lyapunov stability analysis of linear time varying systems.

References:

1. Advanced Control Systems, SARKAR, B. N. PRINT EDITION PAGES: 376 ,ISBN: 978-81-203-4710-6, Pages: 376.
2. Advanced Control Theory, Somanath Majhi, Cengage Learning, 1/e , 2009,Cengage Learning India.
3. Control System Engineering – I J Nagarath, M. Gopal – New Age International – 3rd edition, 2006.
4. Control Systems – N K Sinha – New Age International – 4th edition, 2013
5. Automatic Control Systems – B C Kuo – PHI – 9th edition.

CSE-631: IT Project Management
[L-T-P-C: 3-0-0-3]

Module Duration: 36 Hours

Part I: Tools and Techniques

Software Project Planning: **(3 Hrs.)**
Understand the Project Needs, Create the Project Plan, Diagnosing Project Planning Problems

Estimation: **(3 Hrs.)**
Elements of a Successful Estimate, Wideband Delphi Estimation, Other Estimation Techniques, Diagnosing Estimation Problems

Project Schedules: **(3 Hrs.)**
Building the Project Schedule, Managing Multiple Projects, Use the Schedule to Manage Commitments, Diagnosing Scheduling Problems

Reviews: **(4 Hrs.)**
Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming, Use Inspections to Manage Commitments, Diagnosing Review Problems.

Software Requirements: **(4 Hrs.)**
Requirements Elicitation, Use Cases, Software Requirements Specification, Change Control, Introduce Software Requirements Carefully, Diagnosing Software Requirements Problems

Design and Programming: **(4 Hrs.)**
Review the Design, Version Control with Subversion, Refactoring, Unit Testing, Use Automation, Be Careful with Existing Projects, Diagnosing Design and Programming Problems

Software Testing: **(4 Hrs.)**
Test Plans and Test Cases, Test Execution, Defect Tracking and Triage, Test Environment and Performance Testing, Smoke Tests, Test Automation, Postmortem Reports, Using Software Testing Effectively, Diagnosing Software Testing Problems

Part II: Using Project Management Effectively

Understanding Change: **(3 Hrs.)**
Why Change Fails, How to Make Change Succeed

Management and Leadership: **(2 Hrs.)**
Take Responsibility, Do Everything Out in the Open, Manage the Organization, Manage Your Team

Managing an Outsourced Project : **(3 Hrs.)**
Prevent Major Sources of Project Failure, Management Issues in Outsourced Projects, Collaborate with the Vendor

Process Improvement: **(3 Hrs.)**
Life Without a Software Process, Software Process Improvement, Moving Forward

References:

- *"Applied Software Project Management" By Jennifer Greene, Andrew Stellman (O'Reilly Publications) 2005.*
- *"The Art of Project Management" By Scott Berkun (O'Reilly Publications) 2005 .*

CSE 601L: Data Structure and Algorithms Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in CSE 601: Data Structure and Algorithms

CDC 601L: Cloud Computing Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in CDC 601: Cloud Computing

VES 601L: Automotive Bus Architecture Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in VES 601: Automotive Bus Architecture

VES 602L: Data Analytics for Automobiles Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in VES 602: Data Analytics for Automobiles

Elective – 2 Lab
[L-T-P-C: 0-0-3-1]
Hands on experience on the theory subject studied in elective - 2

VES 696: Mini Project – 2
[L-T-P-C: 0-0-0-4]
Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester.

VES 698: Seminar – 2
[L-T-P-C: 0-0-3-1]
Students have to make a literature survey and select a latest topic in the area of their interest and the area of their specialization and make a presentation in the semester.

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