Quest for Excellence

MAHARASHTRA INSTITUTE OF TECHNOLOGY, AURANGABAD

An Autonomous Institute Affiliated to

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra (India)

First Year and second Year

M. Tech. - Embedded Systems

Syllabus

w. e. f. 2022-23

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus Structure w. e. f. 2022-2023 (Choice Based Credit System)

M. Tech. Embedded Systems

Semester-I

Course Code	Course Name	Teaching Scheme (Hours/ Week)			Examination Scheme and Marking Scheme							Credit			
		Lecture	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	Lecture	TW/PR/OR	Tutorial	Total
MTM101	Research Methodology and IPR	3	1	-	15	15	20	50	-	-	100	3	-	1	4
MES102	System Design using Embedded Processors	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES103	Embedded Programming	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES104	Advanced Digital System Design	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES105	Professional Elective-I	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES106	Lab-I-System Design using Embedded Processors	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES107	Lab-II- Advanced Digital System Design	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES108	Lab-III-Programming Lab	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES109	Seminar	-	-	4	-	-	-	-	-	50	50	-	2	-	2
	Total (Semester-I)	15	1	10	75	75	100	250	75	50	625	15	5	1	21

Semester-II

CourseCode	CourseName	Teaching Scheme (Hours/ Week)			Examination Scheme and Marking Scheme							Credit			
		Lecture	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	T W	PR/OR	Total	Lecture	TW/PR/OR	Tutorial	Total
MTE141	Advanced OptimizationTechniques	3	1	-	15	15	20	50	-	-	100	3	-	1	4
MES202	Embedded OS and RTOS	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES203	Design and Analysis of Algorithm	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES204	Internet of Things	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES205	Professional Elective-II	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MES206	Lab-IV-Advanced Optimization Techniques	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES207	Lab-V-Design and Analysis of Algorithm	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES208	Lab-VI- Internet of Things	-	-	2	-	-	-	-	25	-	25	-	1	-	1
MES209	Minor Project	-	-	4	-	-	-	-	-	50	50	-	2	-	2
	Total(Semester-II)	15	1	10	75	75	100	250	75	50	625	15	5	1	21

MSE-Mid Semester Examination ,ESE-End Semester Examination, OR-Oral, TA-Teacher Assessment, TW-Term Work, PR-Practical

M. Tech. (First Year)

Grand Total				150	150	200	500	150	100	1250	30	10	2	42	

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Semester-III															
Course Code	CourseName	Teaching Scheme (Hours/ Week)			Examination Scheme and Marking Scheme							Credit			
		Lecture	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	Lecture	TW/PR/OR	Tutorial	Total
MES301	MOOC Course	3	-	-	-	-	-	100	-	-	100	3	-	-	3
MES302	Dissertation-I	-	-	18	-	-	-		50	100	150	-	9	-	9
	Total (Semester- III)	3		18				100	50	100	250	3	9	-	12

Semester-IV															
CourseCode	CourseName	Teaching Scheme (Hours/ Week)			Examination Scheme and Marking Scheme							Credit			
		Lecture	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	Lecture	TW/PR/OR	Tutorial	Total
MES401	Dissertation-II	-	-	24	-	-	-		100	100	200	-	12	-	12
	Total (Semester-IV)			24					100	100	200	-	12	-	12
MSE- Mid Semester Examination, ESE-End Semester Examination, OR-Oral, TA- Teacher Assessment, TW-Term Work, PR-Practical															
M. Tech. (Second Year)															
Grand Total					-	-	-	100	150	200	450	3	21	-	24

M. Tech. (Embedded Systems)															
Grand Total (M. Tech.)				150	150	200	600	300	300	1700	33	31	2	66	

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Professional Elective–I Courses (MES105)

Course Name with Code
MES105A-Artificial Neural Networks and Applications
MES105B- Block Chain
MES105C –Automotive Embedded Systems

Professional Elective–II Courses (MES205)

Course Name with Code
MES205A- Data Science
MES205B- Product Design and Quality Management
MES205C- Network and Cyber Security

Lab-III –Programming Lab (MES108)

- Python Programming
- C/C++ Programming
- R Programming

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Faculty of Science and Technology
Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MTM101 Course: Research Methodology and IPR **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: 01 Hr./ Week	Credits: 3-1-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Research Problems and Research Design:** Meaning of research, types of research, steps in involved in research process, criteria of good research, importance of ethics in research, codes and policies for research ethics. Selection of research problem, steps involved in defining research problem, need for research design, types of research designs, basic principles of experimental design, formal and informal experimental design **(5 Hrs.)**
Unit-II	**Sampling Design:** Need for sampling, steps in sampling design, different types of sampling designs, sampling distributions, concept of central limit and standard error, sources of errors, population mean and proportion, sample size calculations, tests of measurements for validity, reliability and practicality **(5 Hrs.)**
Unit-III	**Data collection, Processing and Analysis:** Methods for collection of data, selection of data collection method, data processing operations, statistics in research, confidence level, measures of central tendency, dispersion, asymmetry and relationship Spearman's and Pearson's coefficient of correlation, simple and multiple regression analysis, analysis of variance (ANOVA), factor analysis methods **(8 Hrs.)**
Unit-IV	**Hypothesis Test and Report Writing:** Concept of research hypothesis, concept of testing of hypothesis, Parametric tests (z, t, F and chi-square tests), Hypothesis testing of means and correlation coefficient, Non parametric tests, significance of research report writing, types of reports, structure of the research report, steps in report writing, precautions and ethics in writing report **(7 Hrs.)**

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Unit-V	**Introduction to IPR:** Origin and evolution of IPR to its present form and use, Different Tools of IPR and what is the nature of these rights, Balancing Rights and Responsibilities, Societal implications of IPR **(5 Hrs.)**
Unit-VI	**Patents:** Concept of inventions/discoveries, patents protect; benchmarks for patentability of inventions; Exceptions to patentability; Patenting issues in BIO Technology and computer based inventions, process to apply for patents in India and in other countries around the world. The steps to granting of a patent; Opposing grant of a patent; term of a patent; rights of a patent holder; challenging validity of a patent licensing of patent rights; using patent rights in the market place; compulsory license **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Research Methodology: Methods and Techniques,	C. R. Kothari and G. Garg	New Age International,2019	Fourth Edition
2.	Research Methodology	R. Pannerselvam	PHI Learning,2014	Second Edition
3.	Research Methodology-As Theoretical Approach	D. Napolean and B.Narayan	Laxmi Publication,	2014
4.	Research Methods and Statistics	Bernard C. Beins and Maureen A. McCarthy	Pearson Education Inc.	2012
5.	Research Methods Handbook, CLES	Stuart MacDonald and Nicola Headlam	Centre for Local Economic Strategies	2008
6.	Intellectual PropertyRights--Unleashing the Knowledge Economy	Ganguli Prabuddha	Tata McGraw Hill	2001
7.	Intellectual Property Rights	Neeraj Pandey and Khushdeep Dharni.	PHI Learning,2014	First Edition
8.	Fundamentals of Intellectual Property Rights	Ramakrishna B	Notion Press,2017	First Edition
9.	The Indian Patents Act 1970 (as amended in 2005)			

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES102	Credits: 3-0-0
Course: System Design using Embedded Processors	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Lectures: 03 Hrs./ Week	Teacher Assessment: 20 Marks
Tutorial: ---	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 02 Hrs.

Unit-I	**Embedded Concepts:** Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, and Software architecture, Application Software, Communication Software, Development and debugging Tools **(5 Hrs.)**
Unit-II	**ARM**: Architecture, Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture **(5 Hrs.)**
Unit-III	**Overview of Cortex-M3:** Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions **(6 Hrs.)**
Unit-IV	**Cortex-M3 Implementation Overview:** Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus. Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested

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	Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency **(6 Hrs.)**
Unit-V	**Cortex-M3/M4 Programming:** Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection UNIT and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication **(8 Hrs.)**
Unit-VI	**Cortex-M3/M4 Microcontroller STM32L15xxx ARM Cortex M3/M4 Microcontroller:** Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc. **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	The Definitive Guide to theARM Cortex-M3	Joseph Yiu	Elsevier Inc. 2010	Second Edition
2.	ARM System Developer's Guide - Designing and OptimizingSystem Software	Andrew N Sloss, Dominic Symes, Chris Wright	Elsevier 2006	2006
3.	ARM System-on-ChipArchitecture	Steve Furber	Pearson Education	Second Edition
4.	Embedded/Real Time Systems Concepts, Design and Programming Black Book	Prasad, KVK	Dreamtech press	January 2003
5.	Microcontroller - Architecture Programming Interfacing and System Design"	Raj Kamal	Pearson Education	First Edition
6.	Microcontroller - Theory and Applications	Ajay Deshmukh	Tata McGraw Hill	2017
7.	STM32L152xx ARM Cortex M3 Microcontroller ReferenceManual	ARM		
8.	Cortex-M series-ARMReference Manual	ARM		2020
9.	ARM v7-M Architecture Reference Manual (ARM v7-MARM).	ARM		2014

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES103 Course: Embedded Programming **Teaching Scheme:** Lecture: 03 Hrs./ Week Tutorial: ---	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction:** Embedded OS Fundamentals (Linux) Introduction: Operating System Fundamentals, General Linux Architecture, Linux Kernel, Linux file systems, ROOTFS, Sysfs and Procfs **(6 Hrs.)**
Unit-II	**Embedded Linux**: Booting Process in Linux, boot loaders, U-boot, Kernel Images,Linux File systems. GNU Tools: gcc, gdb, gprof, Make files **(5 Hrs.)**
Unit-III	**Embedded C Programming Review of data types** : scalar types-Primitive types- Enumerated types Subranges, Structure types-character strings –arrays- Functions Introduction to Embedded C-Introduction, Data types Bit manipulation, Interfacing C with Assembly **(8 Hrs.)**
Unit-IV	**Embedded programming issues**: Reentrancy, Portability, Optimizing and testing embedded C programs. Modelling Language for Embedded Systems: Modeling and Analysis of Real Time and Embedded systems **(6 Hrs.)**

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Unit-V	**Embedded Applications using Data structures Linear data structures:** Stacks and Queues Implementation of stacks and Queues- Linked List - Implementation of linked list, Sorting, Searching, Insertion and Deletion, Nonlinear structures – Trees and Graphs Object Oriented programming basics using C++ and its relevance in Embedded systems combinational logic circuit design, Introduction to Design for Testability, BST **(5 Hrs.)**
Unit-VI	**Scripting Languages for Embedded Systems:** Shell scripting, Programming basics of Python, Comparison of scripting languages **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	C Programming language, Embedded C	Kernighan, Brian W, Ritchie, Dennis M , Michael J. Pont,	Addison-Wesley	Second Edition
2.	Exploring C for Microcontrollers- A Hands on Approach	Jivan S. Parab, Vinod G. Shelake, Rajanish K.Kamot, and Gourish M.Naik,	Springer	2010
3.	Fundamentals of embedded software where C and assemblymeet	Daniel W. Lewis	Pearson Education	2002
4.	Developing efficient objects for embedded systems	Bruce Powel Douglas, Real time UML	Pearson Education.	Third Edition 1999
5.	Embedded systemdesign	Steve Heath	Elsevier	2003

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES104 Course: Advanced Digital System Design **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ---	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02Hrs.

Unit-I	**Introduction:** Introduction to Digital Design Combinational Circuit Design, Synchronous Sequential Circuit Design - Mealy and Moore model, State machine design, Analysis of Synchronous sequential circuit, State equivalence, State Assignment and Reduction, Analysis of Asynchronous Sequential Circuit, flow table reduction, races, state assignment **(6 Hrs.)**
Unit-II	**Design of Asynchronous Sequential Circuit, Designing with PLDs:** Overview of PLDs – ROMs, EPROMs – PLA – PAL - Gate Arrays – CPLDs and FPGAs,Designing with ROMs - Programmable Logic Arrays - Programmable Array logic, PAL series 16 and 22 – PAL22V10 - Design examples **(4 Hrs.)**
Unit-III	**VHDL Basics:** Introduction to HDL – Behavioral modeling – Data flow modeling – Structural modeling – Basic language elements – Entity – Architecture – Configurations – Subprograms and operator overloading – Packages and libraries – Test Bench – Advanced Features – Model simulation **(8 Hrs.)**
Unit-IV	**Realization of combinational and sequential circuits using HDL:** Registers – Flip flops – counters – Shift registers –Multiplexers – sequential machine – Multiplier – Divider, Introduction to Synthesis and Synthesis Issues. **(7 Hrs.)**

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Unit-V	**Testing, Fault Modeling And Test Generation:** Introduction to testing – Faults in Digital Circuits – Modeling of faults – Logical Fault Models – Fault detection – Fault Location – Fault dominance – Logic simulation – Test generation for combinational logic circuits – Testable combinational logic circuit design, Introduction to Designfor Testability, BST **(5 Hrs.)**
Unit-VI	**FPGA:** FPGAs - Logic blocks, Routing architecture, Design flow technology – mapping for FPGAs, Xilinx FPGA Architecture, Xilinx XC4000 – ALTERA's FLEX 8000, Design flow for FPGA Design, Case studies: Virtex II Pro **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	"A VHDL Primer"	J. Bhasker	Addison-Wesley Longman Singapore Pvt. Ltd.	1992
2.	"VHDL Analysis and Modeling of Digital Systems"	Z. Navabi,	McGRAW-Hill	1998
3.	"Fundamentals of Logic Design"	Charles H. Roth	Cengage Learning.	Fifth Edition
4.	" Digital Circuits and Logic Design"	Samuel C. Lee	Prentice Hall -India	2007

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES105A Course : Professional Elective –I Artificial Neural Networks and Applications **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ----	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Overview:** Brain Style Computing: Origins and Issues, Biological neural networks, Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Artificial Neurons. **(6 Hrs.)**
Unit-II	**Neural Networks and Architectures Pattern analysis tasks:** Classification, Clustering, mathematical models of neurons, Structures of neural networks, Learning principles **(6 Hrs.)**
Unit-III	**Feed forward neural networks:** Pattern classification using perceptron, Multilayer feed forward neural networks (MLFFNNs), Pattern classification and regression using MLFFNNs, Error back propagation learning **(6 Hrs.)**
Unit-IV	**Fast learning methods:** Conjugate gradient method. Auto-associative neural networks, Pattern storage and retrieval, Hopfield model, recurrent neural networks Bayesian neural networks, Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification **(6 Hrs.)**
Unit-V	**Self-organizing maps:** Pattern clustering, Topological mapping, Kohonen's self-organizing map **(6 Hrs.)**
Unit-VI	**Recent Trends in neural networks:** Introduction to deep neural network, convolutional neural network, RNN, LSTM

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					(6 Hrs.)
References	Sr. No.	Title	Author	Publication	Edition
	1.	Introduction to Artificial NeuralNetworks	Jacek Zurada	Publishing House	1997
	2.	Neural Networks, A Classroom Approach	Satish Kumar	Tata McGraw-Hill,	2003
	3.	Tata McGraw-Hill, 2003	S. Haykin	Prentice Hall	1998
	4.	Pattern Recognition and MachineLearning	C. M. Bishop	Springer	2006

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES105B	Credits: 3-0-0
Course : Professional Elective –I	Mid Semester Examination-I: 15 Marks
Block Chain	Mid Semester Examination-II: 15 Marks
Teaching Scheme:	Teacher Assessment: 20 Marks
Lectures: 03 Hrs./ Week	End Semester Examination: 50 Marks
Tutorial: ----	End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction and Basic Distributed Computing:** Need for Distributed Record Keeping, Modeling faults and adversaries Byzantine Generals problem, Consensus algorithms and their scalability problems Why Nakamoto Came up with Block chain based crypto currency? Technologies Borrowed in Block chain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc. Atomic Broadcast, Consensus, Byzantine Models of fault tolerance **(6 Hrs.)**
Unit-II	**Basic Crypto primitive:** Hash functions, Puzzle friendly Hash, Collision resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge system **(6 Hrs.)**
Unit-III	**Block chain 1.0:** Bit coin block chain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bit coin consensus, Bit coin scripting language and their use **(6 Hrs.)**
Unit-IV	**Block chain 2.0:** Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts **(6 Hrs.)**

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Unit-V	**Block chain 3.0:** Hyper ledger fabric, the plug and play platform and mechanisms in permissionblock chain **(6 Hrs.)**
Unit-VI	**Privacy, Security issues in Block chain:** Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Block chains – such as Sybil attacks, selfish mining, 51% Attacks - advent of algorand, and Sharding based consensus algorithms to prevent these **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Block chain Revolution: How the Technology Behind Bit coin Is Changing Money, Business, and the World	Don Tapscott, Alex Tapscott	Google Books	2016
2.	Block chain Basics	Daniel Drescher	Google Books	2017
3.	Block chain: Blueprint for a New Economy	Melanie Swan	ACM	2015
4.	Distributed Ledger Technology (blockchain)	Roger Wattenhofer	Google Books	2016

ADDITIONAL Resources

1. Joseph Bonneau et. al., SoK: Research perspectives and challenges for Bit coin and crypto currency, IEEE Symposium on security and Privacy, 2015 (article available for free download) {curtain raiser kind of generic article, written by seasoned experts and pioneers}.
2. J. A. Garay et. al., The bit coin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048). (Serious beginning of discussions related to formal models for bit coin protocols).
3. R. Pass et. al., Analysis of Block chain protocol in Asynchronous networks, EUROCRYPT 2017, (eprint.iacr.org/2016/454). A significant progress and consolidation of several principles).
4. R. Pass et. al., Fruit chain, a fair block chain, PODC 2017(eprint.iacr.org/2016/916).

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Faculty Of Engineering and Technology
Syllabus of M. Tech. Embedded Systems Semester-I

Course Code : MES105C Course: Professional Elective –I Automotive Embedded Systems **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ----	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction:** Introduction To Embedded System, Automotive Embedded System Controllers,Fuel Injection System, Alternator, Applications. **(6 Hrs.)**
Unit-II	**Body Electronics:** Instrument Panel Design Using HCS12 CPU Core, System Basis Chip MC33904, Remote Key, Keyless Entry, Door, Window Anti-Pinch System, Lighting, Air Bag,Seat Belt. **(6 Hrs.)**
Unit-III	**Chassis And Safety:** Breaking And Stability Control, Pre-Crash Safety, Parking Assistance, Lane Keeping Assistance, Electronic Power Steering. **(6 Hrs.)**
Unit-IV	**Power train:** Engine, Automatic Transmission, Hybrid Control, Steering, Brake, Suspension.Engine Management System, Drive By Wire System. **(6 Hrs.)**
Unit-V	**Diagnosis And Sensors:** OBD-2, Sensors: Crankshaft Position Sensor, MAP Sensor, Manifold Absolute Pressure, Mass Flow Sensor, Or Mass Airflow (MAF) Sensor, Oxygen Sensor, Throttle Position Sensor (TPS), Variable Reluctance Sensor. **(6 Hrs.)**
Unit-VI	**Vehicle Network:** CAN, Flex ray, Local Interconnect Network, Power Line Communication. NoiseSources And Protections. **(6 Hrs.)**

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Web Resources	1. http://www.ti.com/ 2. http://www.freescale.com 3. http://www.atmel.com

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Faculty of Science and Technology
Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES106 Course: Lab I– System Design using Embedded Processors **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ 10 Experiments based on the syllabus shall be performed by the student. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Faculty of Science and Technology
Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES107 Course: Lab II – Advanced Digital System Design **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ 10 Experiments based on the syllabus shall be performed by the student. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Faculty of Science and Technology Syllabus of M. Tech. Embedded Systems Semester-I	
Course Code: MES108 Course: Lab-III-Programming Lab **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ Student will learn Python / C-C++ / R etc. programming language. Student shall perform 8/10 experiments in the above mentioned language. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Syllabus of M. Tech. Embedded Systems Semester-I

Course Code: MES109 Course: Seminar **Teaching Scheme:** Practical : 04Hrs./ Week	Credits: 0-0-1 Term Work: --- PR/OR: 50 Marks

	▪ Student should deliver Seminar of the topic in front of External Examiners and Internal Examiners, Staff and student colleagues. Prior to presentation student should carry the details of literature survey from standard references such as international journals and periodicals, recently published reference books etc. student should submit a report on same along with computer based presentation copy to the concerned examiner/guide at the end of seminar. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

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Faculty of Science and Technology
Syllabus of M. Tech. Embedded Systems Semester-II

Course Code: MTE 141 Course: Advanced OptimizationTechniques **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: 01 Hr./ Week	Credits: 3-1-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction:** Optimal Problem Formulation, Engineering Optimization Algorithms, Optimization Problems **(2 Hrs.)**
Unit-II	**Single Variable Optimization Algorithms:** Optimality Criteria, Bracketing Methods, Region Elimination Methods, Point Estimation Methods, Gradient Base, Root Finding Using Optimization Techniques **(6 Hrs.)**
Unit-III	**Multivariable Optimization Algorithms:** Optimality Criteria, Unidirectional Search, Direct Search Methods, Gradient BasedMethods, Computer Programs On Above Methods **(8 Hrs.)**
Unit-IV	**Constrained Optimization Algorithms:** Kuhn-Tucker Conditions, Transformation Methods, Sensitivity Analysis, Direct Search For Constrained Minimization, Liberalized Search Techniques, Feasible Direction Method, Generalized Reduced Gradient Method, Gradient Projection Method, Computer Programs On Above Methods **(8 Hrs.)**
Unit-V	**Special Optimization Algorithms:** Integer Programming, Geometric Programming, Genetic Algorithms, Simulated Annealing, Global Optimization, Computer Programs On Above Methods **(8 Hrs.)**
Unit-VI	**Optimization In Operations Research:** Linear Programming Problem, Simplex Method, Artificial Variable Techniques, Dual Phase Method, Sensitivity Analysis **(8 Hrs.)**

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	Sr. No.	Title	Author	Publication	Edition
References	1.	Engineering Optimization Theory and Practice	Singiresu Rao	Wiley	Forth Edition
	2.	Optimization for Machine Learning	Suvrit SraSebastian Nowozin Stephen J. Wright	The MIT Press Cambridge Massachusetts London, England	First Edition
	3.	Optimization for Engineering Design Algorithms and Examples	Kalyanmoy Deb	Prentice Hall	First Edition
	4.	Nature-Inspired Optimization Algorithms	Xin-SheYang	Elsevier ISBN: 978012416742	First Edition

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Course Code: MES202 Course: Embedded OS and RTOS **Teaching Scheme:** Lecture: 03 Hrs./ Week Tutorial: ---	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Embedded OS (Linux) Internals Linux internals:** Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication – Semaphore, Pipes, FIFO **(6 Hrs.)**
Unit-II	**Shared Memory Kernel:** Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block and Network **(5 Hrs.)**
Unit-III	**Open source RTOS Basics of RTOS:** Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS and RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards, RTOS Issues – Selecting a Real Time Operating System, RTOS comparative study **(8 Hrs.)**
Unit-IV	**Converting a normal Linux kernel to real time kernel, Xenomai basics:** Overview of Open source RTOS for Embedded systems (Free RTOS/ Chibios RT) and application development **(6 Hrs.)**

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Unit-V	**VxWorks / Free RTOS VxWorks/ Free RTOS Scheduling and Task Management :** Real time scheduling, Task Creation, Inter task Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems – General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral **(5 Hrs.)**
Unit-VI	**Case study:** Cross compilers, debugging Techniques, Creation of binaries and porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board (), Testing a real time application on the board **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Essential Linux Device Drivers	Venkateswaran Sreekrishnan	Prentice Hall	First Edition, 2001
2.	Writing Linux Device Drivers: A Guide with Exercises	J. Cooperstein	Create Space Independent Pub	2009
3.	Embedded Systems Architecture Programming and Design:	Raj Kamal	Tata McGrawHill	Third Edition , 2017
4.	Embedded/Real Time Systems Concepts, Design and Programming	KVK Prasad	Prentice Hall -India	Black Book
5.	Structured Development for Real - Time Systems V1 : Introduction and Tools	Ward, Paul T and Mellor, Stephen J	Pearson	1986

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Course Code: MES203 Course: Design and Analysis of Algorithms **Teaching Scheme:** Lecture: 03 Hrs./ Week Tutorial: ---	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction :** Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – asymptotic Notations and its properties – Mathematical analysis for Recursive and Non-recursive algorithms **(6 Hrs.)**
Unit-II	**Brute Force And Divide-And-Conquer:** Brute Force - Closest-Pair and Convex-Hull Problems-Exhaustive Search – Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and conquer methodology – merge sort – Quick sort – Binary search – Multiplication of Large Integers – Strassen's Matrix Multiplication Closest-Pair and Convex-Hull Problems **(5 Hrs.)**
Unit-III	**Dynamic Programming And Greedy Technique:** Computing a Binomial Coefficient – Warshall's and Floyd's algorithm – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique– Prim's algorithm- Kruskal's Algorithm - Dijkstra's Algorithm-Huffman Trees **(7 Hrs.)**
Unit-IV	**Iterative Improvement:** The Simplex Method-The Maximum-Flow Problem – Maximum Matching in BipartiteGraphs- the Stable marriage Problem **(7 Hrs.)**

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Unit-V	**Coping With The Limitations Of Algorithm Power:** Limitations of Algorithm Power-Lower-Bound Arguments-Decision Trees-P, NP and NP-Complete Problems--Coping with the Limitations - Backtracking – n-Queens problem **(5 Hrs.)**
Unit-VI	**Hamiltonian Circuit Problem:** Subset Sum Problem-Branch and Bound – Assignment problem – Knapsack Problem – Traveling Salesman Problem- Approximation Algorithms for NP – Hard Problems – Traveling Salesman problem – Knapsack problem **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson Education	Third Edition, 2012
2.	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein	PHI Learning Private Limited	Third Edition, 2012
3.	Data Structures and Algorithms	Alfred V. Aho, John E.Hopcroft and Jeffrey D.Ullman	Pearson Education	Reprint 2006
4.	The Art of Computer Programming,	Donald E. Knuth	Volumes 1and 3 Pearson Education	2009
5.	The Algorithm Design Manual	Steven S. Skiena	Springer	Second Edition, 2008

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Course Code: MES204 Course: Internet of Things **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ----	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

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 **(6 Hrs.)**
Unit-II	**Fundamental IoT Mechanisms and 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 **(6 Hrs.)**
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 **(6 Hrs.)**
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 54 its low-energy profile, IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication (DSRC) and related protocols. Comparison of WPAN technologies cellular and mobile network technologies for IoT/M2M **(6 Hrs.)**

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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 **(6 Hrs.)**
Unit-VI	**Internet of Things Application Examples:** Smart Metering, advanced metering infrastructure, e-Health/Body area network, Cityautomation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control application examples **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	The Internet of Things, Connecting Objects to theWeb	Hakima Chaouchi	Wiley Publications	2010
2.	Building the Internet of Things with IPv6 and MIPv6 The Evolving Worldof M2M Communications	Daniel Minoli,	Wiley Publications	2013
3.	Architecting the Internet ofThings	Bernd Scholz-Reiter, Florian Michahelles	Springer	2011
4.	The Internet of Things KeyApplications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley Publications	2012

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Course Code: MES205A Course: Professional Elective –II Data Science **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ---	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Introduction:** Introduction to data, big data, data sciences, big data and data science hype, datafication, current landscape of perspective of data sciences, types of data and its measure **(6 Hrs)**
Unit-II	**Statistics and Probability:** Introduction to Statistics, Populations and samples, statistical modeling, Descriptive Statistics, Summary Statistics Basic probability theory, Statistical Concepts (univariate and bivariate sampling, distributions, resampling, statistical Inference, prediction error) **(6 Hrs.)**
Unit-III	**Machine Learning:** Introduction to machine learning, Supervised, Semi Supervised, Unsupervised Learning and reinforced learning, Uses of Machine learning Clustering, K means, Hierarchical Clustering, Decision Trees, Oblique tree **(6 Hrs.)**
Unit-IV	**Feature Generation and Selection:** Feature generation's algorithms, feature selection algorithms: filters, wrappers, random forest. Algorithmic ingredients of a recommendation engine, dimensionality reduction, singular value decomposition, principal component analysis **(6 Hrs.)**
Unit-V	**Social Network Graphs:** Social Networks as graphs, clustering of graphs, direct discoveries of communitiesin graphs, portioning of graphs, neighborhood properties of graphs **(6 Hrs.)**

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Unit-VI	**Data visualization:** Basic principles, ideas and tools for data visualization, creation of visualization for complex data set. Case study. Data and models for Business analytics, problemsolving, Visualizing and Exploring Data **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Mining of MassiveDatasets.	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman	Cambridge University Press. 2014	Version 2.1
2.	Machine Learning	Tom Mitchell	McGraw-Hill, 1997	First Edition
3.	Applied NumericalLinear Algebra	J. Demmel	SIAM, 1997	First Edition

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Course Code MES205B	Credits: 3-0-0
Course: Professional Elective –II	Mid Semester Examination-I: 15 Marks
Product Design and Quality Management	Mid Semester Examination-II: 15 Marks
Teaching Scheme:	Teacher Assessment: 20 Marks
Lectures: 03Hrs./ Week	End Semester Examination: 50 Marks
Tutorial:----	End Semester Examination (Duration): 02 Hrs.

Unit-I	**Product Design and Development I:** Development processes, Identifying customer needs, Establishing product specifications, Concept generation, Concept selection, Product architecture, Industrial design **(6 Hrs.)**
Unit-II	**Product Design and Development II:** Design for Manufacturing, Prototyping, Robust Design, Patents and Intellectual property **(6 Hrs.)**
Unit-III	**Product Development Economics:** Product Development Economics, Managing Product Development Projects **(6Hrs.)**
Unit-IV	**Total Quality Management I:** Principles and Practices: Definition of quality, Customer satisfaction and Continuous improvement. **(6 Hrs.)**
Unit-V	**Tools and Techniques:** Statistical Process Control, Quality Systems, Bench Marking **(6 Hrs.)**
Unit-VI	**Total Quality Management II:** Quality Function Deployment, Product Liability, Failure Mode and Effect Analysis, Management Tools **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Total Quality Management	Dale H. Besterfield	Pearson Education Asia	Second Edition
2.	Product Design and Development	Karl T Ulrich and Steven D Eppinger	McGraw Hill	Third Edition

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Course Code: MES205C Course: Professional Elective –II Network and Cyber Security **Teaching Scheme:** Lectures: 03 Hrs./ Week Tutorial: ----	Credits: 3-0-0 Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs.

Unit-I	**Network Access Control:** Network Access Control, Extensible Authentication protocol, IEEE 802.1X Port-based Network Access Control. IP Security: IP security overview, IP security policy, Encapsulating Security Payload, Internet Key Exchange (IKE) **(5 Hrs.)**
Unit-II	**Transport Layer Security**: Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, Padding HTTPS Connection Initiation, and Connection Closure. Secure Shell (SSH) Transport Layer Protocol, User Authentication Protocol, Connection Protocol **(8 Hrs.)**
Unit-III	**Web Security**: Web Security Threats, Web Traffic Security Approaches. Secure Sockets Layer: SSL Architecture, SSL Record Protocol, and Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. Block Chain: Introduction to block chain, block chain technologies and its application **(5 Hrs.)**
Unit-IV	**Intrusion Detection and Prevention:** Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, and Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation. **(7 Hrs.)**

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Unit-V	**Cryptography and Network Security:** Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec **(5 Hrs.)**
Unit-VI	**Understanding Computer Forensics:** Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Cyber forensicsand Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography., Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti forensics **(6 Hrs.)**

References

Sr. No.	Title	Author	Publication	Edition
1.	Cryptography and Network Security	William Stallings:	Pearson 2013	Sixth Edition
2.	Cyber Security: Understanding Cyber Crimes, Computer ForensicsAnd Legal Perspectives"	T Sunit Belapure and Nina Godbole	Wiley India Pvt. Ltd	Second Edition
3.	Cyber security: Managing Systems , Conducting Testing, and Investigating Intrusions	R Thomas J. Mowbray	John Wiley and Sons	2013
4.	Network Security: Private communications in a Public World,	M. Speciner, R. Perlman, C. Kaufman.	Prentice Hall	2002

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Course Code: MES206 Course: Lab IV– Advanced Optimization Techniques **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ 10 Experiments based on the syllabus shall be performed by the student. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Course Code: MES207 Course: Lab V– Design and Analysis of Algorithms **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ 10 Experiments based on the syllabus shall be performed by the student. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Course Code: MES208 Course: Lab VI – Internet of Things **Teaching Scheme:** Practical : 02 Hrs./ Week	Credits: 0-0-1 Term Work: 25 Marks
	▪ 10 Experiments based on the syllabus shall be performed by the student. Teacher will observe the progress of a student, based on his/her performance final term work assessment can be done.

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Course Code: MES209 Course: Minor Project **Teaching Scheme:** Practical: 04 Hrs./ Week	Credits: 0-0-2 PR /OR Exam : 50 Marks

- Student Should Deliver Seminar on the Minor Project Topic of Recent Technologyin front of the External Examiners and Internal Examiners, Staff and Student Colleagues. Prior to Presentation student should carry the details of Literature Survey Standard References such as International Journals and Periodicals, Recently Published Reference Books etc. Student should submit a report on the same along with Computer based presentation copy to the Concerned Examiner/Guide At The end of Minor Project along with demo of the Project. The Assessment shall be based on selection of topic, its relevance to present context, Report documentation and Presentation Skills.

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Course Code: MES301 Course: MOOC Course **Teaching Scheme:** Online Course (Minimum 12 Weeks)	Credits: 3-0-0 End Semester Exam : 100 Marks

- It is mandatory for the student to complete one MOOC course related to the program of study. Student will have to complete the MOOC course which will be available on the SWAYAM portal (Free online education portal). Registered MOOC courses should not have similar oroverlapping content to that of the regular courses in the curriculum of the program. The credits can be given to the students after successful completion of the MOOC course of 12 Weeks or more. The credits will be transferred by evaluation in terms of assignments orexaminations or viva-voce. In case the student is unable to clear MOOC Course examination; the student will have to appear for an Institute-level examination for the respective MOOC course.

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Course Code: MES302	Credits: 0-0-9
Course: Dissertation- I	Term Work: 50 Marks
Teaching Scheme:	PR/OR: 100 Marks
Practical: 18 Hrs./ Week	

- The Dissertation Seminar will consist of a typed written Report of Dissertation Part I covering the problem selected for final Dissertation. This should include the problem definition, literature survey, objective, its limitations, technical details and related data required for the proposed Dissertation work. The candidate shall deliver the Dissertation Seminar on the topic or the problem selected for final dissertation which will be judged by two examiners (one external and one internal guide). The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills, utility of the Dissertation work and publication based on the same.

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Course Code: MES401 Course: Dissertation- II **Teaching Scheme:** Practical: 24 Hrs./ Week	Credits: 0-0-12 Term Work : 100 Marks PR/OR: 100 Marks

- The student shall be allowed to submit the Dissertation-II Report only after the completion of Dissertation-I. Student should deliver Viva-Voce presentation on topic of Dissertation-II in front of the External Examiners and Internal Examiners, Staff and Student colleagues. The assessment shall be based on design and implementation aspects, report documentation and presentation skills, utility of the dissertation work and publication based on the same.

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