KLS Gogte Institute of Technology, Belagavi-08
Department of Electronics and Communication Engineering

M. Tech. (Automotive Electronics)

Scheme of Teaching & Syllabus

2016-17

Scheme of Teaching for M.Tech.

Curriculum frame work:

S.No.	Subject Area		Credits
1	Professional Core (Theory & Practicals)	PC	36
2	Professional Elective	PE	16
3	Lab	PC	4
4	Seminar	PC	2
5	Internship	SS	10
6	Project	PR	22
7	Term Assignment		4
	Total		94

Lecture (L): One Hour /week – 1 credit

Practicals (P): Three Hours /week – 2 credits

Distribution of credits

Semester	Credits
1	25
2	25
3	26
4	18
Total	94

Department of Electronics and Communication Engineering

M. Tech. (Automotive Electronics)

First Semester								
Subject Code	**Subject**		**Credits**	**Total credits**	**Contact Hours/ week**	**Marks**		
			L – T - P			**CIE**	**SEE**	**TOTAL**
16AE11	Automotive Electrical Systems and Electronics	PC1	4 – 0 – 0	4	4	50	50	100
16AE12	Automotive Control System	PC2	4 – 0 – 0	4	4	50	50	100
16AE13	Automotive Software Engineering	PC3	4 – 0 – 0	4	4	50	50	100
16AE14	Automotive Instrumentation	PC4	4 – 0 – 0	4	4	50	50	100
16AE15Ax	Elective -1	PE- A	4 – 0 – 0	4	4	50	50	100
16AE16	Automotive Instrumentation Lab		0 – 0 – 2	2	3	25	25	50
16AE17S	Seminar on Advanced topics from refereed journals		0 – 0 – 1	1		25		25
16PTA18	Term Assignment – 1	Mandatory	0 – 0 – 2	2	4	25		25
	Total			25	27	325	275	600

Elective – A: List of subjects

Subject Code	Subjects
16AE15A1	Reliability Engineering
16AE15A2	Hybrid and Propulsion Systems
16AE15A3	Vehicle Dynamics
16AE15A4	Mechatronics And Robotics Automation

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.
- Term Assignment: The performance is continuously evaluated by the faculty member and Grade is given.

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Second Semester								
Subject Code	**Subject**		**Credits** L – T - P	**Total Credits**	**Contact Hours/ week**	**Marks**		
						CIE	**SEE**	**TOTAL**
16AE21	Telematics And Infotainment System	PC1	4 – 0 - 0	4	4	50	50	100
16AE22	Intelligent Vehicle Technologies	PC2	4 – 0 - 0	4	4	50	50	100
16AE23	Automotive Networking	PC3	4 – 0 - 0	4	4	50	50	100
16AE24	Modeling, Simulation And Analysis of Engineering Systems	PC4	4 – 0 - 0	4	4	50	50	100
16AE25Bx	Elective-2	PE – B	4 – 0 - 0	4	4	50	50	100
16AE26	Model Based Design Lab	PE – L	0 – 0 – 2	2	3	25	25	50
16AE27S	Seminar on Advanced topics from refereed journals		0 – 0 – 1	1		25		25
16PTA28	Term Assignment – 2	Mandatory	0 – 0 – 2	2	4	25		25
	Total			25	27	325	275	600

Elective – B: List of subjects

Subject Code	Subjects
16AE25B1	System Simulation Technology
16AE25B2	Safety and Security of Mechatronics Systems
16AE25B3	CAD Application for Automotive Engineering
16AE25B4	Soft Computing

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.
- Term Assignment: The performance is continuously evaluated by the faculty member and Grade is given.

Department of Electronics and Communication Engineering

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Third Semester								
Subject Code	**Subject**		**Credits**	**Total Credits**	**Contact Hours/ week**	**Marks**		
			L – T - P			**CIE**	**SEE**	**TOTAL**
16AE31	Advanced Automotive Fault Diagnosis	PC1	4 – 0 - 0	4	4	50	50	100
16AE32Cx	Elective – C	PE-C	4 – 0 - 0	4	4	50	50	100
16AE33Dx	Elective – D	PE-D	4 – 0 - 0	4	4	50	50	100
16A34I	# Internship			10				
16AE35P1	* Dissertation Phase-1	PR		4		25		25
	Total			26	12	175	150	325

Internship report and presentation to be submitted at the end of semester

* Finalization of Project Title and Literature Review

** Term assignments to be added in the scheme

Elective – C: List of subjects

Subject Code	Subjects
16AE32C1	Automotive Safety and Regulations
16AE32C2	Automotive Chassis Design
16AE32C3	Vehicle Aerodynamics
16AE32C4	Automotive Materials

Elective – D: List of subjects

Subject Code	Subjects
16AE32D1	Electric and Hybrid Vehicles
16AE32D2	Automotive Security
16AE32D3	Finite Element Methods in Automobile Engineering
16AE32D4	Tribology and Preventive Maintenance

- SEE: SEE (Theory exam) will be conducted for 100 marks of 3 hours duration. It is reduced to 50 marks for the calculation of SGPA and CGPA.

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Fourth Semester								
Subject Code	**Subject**		**Credits**	**Total Credits**	**Contact Hours/ week**	**Marks**		
			L – T - P			**CIE**	**SEE**	**TOTAL**
16AEXX	[$]Project Phase-2	PR		4		25		25
16AEXX	[#]Project Phase-3	PR		4		25		25
16AEXX	Viva – Voce	PR		10			100	100
	Total			18		50	100	150

[$#] Internship report and presentation to be submitted at the end of semester

[*]Finalization of Project Title and Literature Review

SEMESTER I

AUTOMOTIVE ELECTRICAL SYSTEMS AND ELECTRONICS

Course Code	**16AE11**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. Explain batteries, starting system, charging and ignition system, lighting and other electrical systems inside an automobile.
2. Understand all the sensors and actuators used in automotive systems.
3. Explain the Power train, transmission of different types of automobiles with every detail parts of the system.
4. Explain the functioning of Chassis and Brake System.

Detailed Syllabus:

UNIT I

Batteries: Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery.

Starting System: Condition at starting. Behaviour of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units, care and maintenance of starter motor. Starter Switches.

9 Hours

UNIT II

Charging system: Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators. Compensated voltage regulator alternators principle & constructional aspects and bridge benefits.

Ignition Systems: Types, Construction & working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems.

9 Hours

UNIT III

Lighting system & accessories: Insulated & earth return systems. Positive & negative earth systems. Details of headlight & sidelight. Headlight dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system

9 Hours

UNIT IV

Sensors and actuators: Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors. Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays Electronic Fuel Injection and Ignition Systems: Introduction, feedback carburettor systems. Throttle body injection and multiport or point fuel injection, fuel injection systems, Injection system controls. Advantages of electronic ignition

systems: Types of solid-state ignition systems and their principle of operation, Contactless electronic ignition system, and electronic spark timing control

9 Hours

UNIT V

Power-Train and Body Chassis: Automotive transmissions: Transmission fundamentals, Types-MT, AT, CVT and DCT. Vehicle braking fundamentals: Vehicle dynamics during braking, hydraulic brake system components, Introduction to antilock braking systems. Steering Control: Steering system basics, Fundamentals of electronically controlled power steering: type, electronically controlled hydraulic systems and Electric power Braking systems, Traction control, Steering and Tires, Electronic management of chassis system.

9 Hours

Text Books

1. William B. Ribbens, Understanding Automotive Electronics, 5th Edition, Butterworth, Heinemann Woburn, 1998.
2. Tom Denton, Automobile Electrical and Electronics System, Elsevier Publications, Third Edition, 2004.

Reference Books

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992.
2. Vinal. G.W. , Storage Batteries, John Wiley & Sons Inc., New York, 1985.

Course Outcome (COs):

1. Explain all the sub-systems of an Automobile and 4 stroke IC Engine. [L1]
2. Explain the concepts of automotive sensors and actuators, their application and uses [L2]
3. Define the details of automobile sub-systems like Engine System, Chassis, Transmission, Power train, Braking Systems etc. [L2]

Program Outcomes (POs) of the course:

1. [PO1] Fundamentals of Engineering:

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Automotive Electronics

2. [PO2] Design of Experiments:

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. [PO12]: Self-motivated Learning:

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**).

SEMESTER I

AUTOMOTIVE CONTROL SYSTEM

Course Code	**16AE12**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. The student should be able to review the background material on engine modeling, vehicle dynamics, and human factors.
2. The student should understand systems such as air–fuel ratio control, idles speed, control, spark-timing control, control of transmissions, control of hybrid electric vehicles, and fuel-cell vehicle control.
3. The student should comprehend the physics and underlying principles behind Vehicle Control Systems covers cruise control and headway-control systems, traction-control systems (including antilock brakes), active suspensions, vehicle stability control, and four-wheel steering.
4. The student should be able to review Intelligent Transport systems, Collision detection and avoidance systems, automated highways, platoons, and automated steering.

Prerequisite:

1. Control Systems Basics.

Detailed Syllabus:

UNIT I

Introduction: Motivation, Background, and Overview, Automotive Control-System Design Process, Review of Engine Modeling

9 Hours

UNIT II

Vehicle Dynamics and Human Factors: Review of Vehicle Dynamics, Coordinates and Notation for Vehicle Dynamics, Longitudinal Vehicle Motion, Lateral Vehicle Motion, Vertical Vehicle Motion, Human Factors and Driver Modeling, Human Factors in Vehicle Automation, Driver Modeling

9 Hours

UNIT III

Power train Control Systems: Air–Fuel Ratio Control, Control of Spark Timing, Idle-Speed Control, Transmission Control, Control of Hybrid Vehicles, Modeling and Control of Fuel Cells for Vehicles.

9 Hours

UNIT IV

Vehicle Control Systems: Cruise and Headway Control, Antilock Brake and Traction-Control Systems, Vehicle Stability Control, Four-Wheel Steering, Active Suspensions.

9 Hours

UNIT V

Intelligent Transportation Systems: Overview of Intelligent Transportation Systems, Preventing Collisions, Longitudinal Motion Control and Platoons, Automated Steering and Lateral Control.

9 Hours

Text Books:

1. Ali G Ulsoy_ Huei Peng_ Melih Çakmakci,"Automotive control systems"-Cambridge University Press (2012).
2. William B. Ribbens, Understanding Automotive Electronics, 6th Edition, Newnes(2003)

Reference Books:

1. Ronald K Jurge , "Automotive Electronics Handbook",McGraw-Hill,1995

Web Reference

1. www.engin.umich.edu/group/ctm

Course Outcome (COs):

1. Understand the basics control-system concept and design for automotive applications.[L2,L5]
2. Determine automotive system parameters viz air fuel ration, idle speed etc
3. Analyze automotive control systems.
4. Model automotive control subsystems.

Program Outcomes (POs) of the course:

1. PO2: Design of Experiments:
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data

2. PO 4: Engineering Cognizance:
Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 5: Modern tool Usage:
Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

4. PO 6: Impact of Engineering:
Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

5. **PO 6: Collaboration:** Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

AUTOMOTIVE SOFTWARE ENGINEERING

Course Code	**16AE13**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To understand what software engineering is and its significance
2. To study the concepts of software processes and software process models
3. To understand the overview of Vehicle electronic systems
4. To study the design, implementation and testing of software components
5. To study integration, testing and calibration of software functions

Detailed Syllabus:

UNIT I

Introduction and Overview

Professional software development, Software Engineering Ethics, Software process models, Process activities, Coping with change, The rational unified process, The Driver-Vehicle-Environment system, Overview of Vehicle Electronic systems, Overview of Logical system, Processes in vehicle development, Methods and Tools for the development of software for Electronic systems

9 Hours

UNIT II

Essential System Basics

Open-Loop and Closed-Loop Control systems, Discrete systems, Embedded systems, Real-Time systems, Distributed and Networked systems, System Reliability, Safety, Monitoring, and Diagnostics

9 Hours

UNIT III

Support Processes for Electronic Systems and Software Engineering

Basic definitions of system theory, Process models and standards, Configuration management, Project management, Subcontractor management, Requirements management, Quality assurance

9 Hours

UNIT IV

Core Processes for Electronic Systems and Software Engineering

Requirements and Prerequisites, Basic definitions and Notations, Analysis of User requirements and Specification of logical system architecture, Analysis of logical system architecture and specification of Technical system architecture, Specification of Software components, Design and implementation of software components, Software component testing, Integration of software components, System integration test, Calibration, System and acceptance test

9 Hours

UNIT V

Methods and Tools for Development

Offboard Interface between Electronic control units and tools, Analysis of logical system architecture and specification of technical system architecture, Specification of software functions and validation of specification, Design and implementation of software functions, Integration and Testing of software functions, Calibration of software functions

9 Hours

Self-Learning Topics:

1. **AUTOSAR Architecture and its significance**

Text Books

1. Jorg Schauffele and Thomas Zurawka, Automotive Software Engineering Principles, Processes Methods and Tools, SAE International Publishers
2. Ian Sommerville, Software Engineering, Pearson, 9th Edition, 2011

Course Outcome (COs):

1. To describe and compare the software process models [L1] [L4]
2. To summarize the essential system basics [L2]
3. To discuss the implementation, development and testing of software components [L2]
4. To discuss the Integration, Testing and calibration of software functions [L2]

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

3. PO 9: Soft skills

Graduates shall possess proficiency in oral and written communication skills.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

AUTOMOTIVE INSTRUMENTATION

Course Code	**16AE14**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To instill a fundamental understanding of various instrumentation and control detection circuits as they relate to temperature, pressure, flow, and level monitoring of various processes.
2. Introduce various data acquisition systems, and converters relevant to instrumentation and its applications
3. Learn professional measurement techniques used to engineer thermal and mechanical systems
4. Students shall be familiar with data acquisition systems

Detailed Syllabus:

UNIT I

Basic Concepts: Introduction, Fundamental methods of measurement, generalized measuring system, types of input quantities, Measurement standards, Calibration (Textbook1)

9 Hours

UNIT II

Measurements - I:

Pressure Measurement: Static and Dynamic pressure in fluids, Pressure measuring transducers, Bourdan-tube gages (Textbook2)

Temperature Measurement: Use of thermal expansion, Calibration and stern correction, Bimetal Temperature-sensing elements, Thermocouples, Application laws of thermocouples (Textbook2)

Force and Torque Measurements: Mass balance measurements, Torque measurements, Measurement of angular velocity (Textbook1)

Motion measurements: Elementary vibrometers and vibration detectors, Elementary accelerometers (Textbook2)

9 Hours

UNIT III

Measurements – II:

Light intensity, Level measurements, Sound measurements: Microphone, Sound level meter, Frequency spectrum analysis, Equivalent sound level (Textbook2)

Warning Systems: Oil pressure, Engine over heat, Air pressure, Speed

9 Hours

UNIT IV

Data acquisition and processing: General data acquisition system examples, storage, processing, recording and display devices.

9 Hours

UNIT V

Air-pollution Sampling and Measurement: Introduction, Units, Standards, General Air-sampling train, Gas sampling techniques, Particulate sampling techniques, Combustion products measurements, Opacity measurements, Odor measurement (Textbook 1)

9 Hours

Text Books

1. J. P. Holman, Experimental methods for Engineers, Tata McGraw Hill Book Co., 7th Edition, 2007.
2. Thomas G. Beckwith, John H. Lienhard V, Roy D. Marangoni, Mechanical Measurements, Pearson, 6th Edition.

Reference Books

1. Ernest O Doeblin, Measurement Systems: Application and design, TMH, 5th Edition, 2004.

Course Outcome (COs):

1. Understand the fundamental elements of instrumentation, measurement and control systems [L1].
2. Handle various instruments for engineering applications Design and set a data acquisition system for mechanical application [L3, L4]

Program Outcomes (POs) of the course:

1. PO 3: Social Engineering

Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 6: Impact of Engineering

Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

4. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

ELECTIVE - I

RELIABILITY ENGINEERING

Course Code	**16AE15A1**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To analyze data related to reliability questions and use the analytical results to predict the reliability of simple and complex systems.
2. To introduce to probability calculus for continuous and discrete random variables, statistical failure time models, estimation of model parameters, model comparison and prediction of future failures.
3. To introduce to reliability for simple and complex systems and the relationship to component reliability
4. To apply theoretical techniques with data sets from different engineering disciplines.

Detailed Syllabus:

UNIT I

Importance and Concepts of Reliability: Definitions, Failure, Life characteristic pattern, Modes of failure, Classification of system, Measures of reliability, Derivation of the reliability function, Hazard rate, Mean time between failures, Areas of reliability (Textbook 1)

9 Hours

UNIT II

Statistical Methods in Reliability: Review of probability theory and Random variables, Discrete Distributions: Variance, Covariance, Correlation coefficient, Expectation & variance of a linear combination of random variables, Moment generating function, Cumulants, Probability distributions used in reliability analysis, Continuous Distributions: Mean and variance, Uniform, Normal, Gamma, Exponential, Gamma, Beta, Erlang, Weibull and Lognormal distributions. Numerical examples (Textbook 2)

9 Hours

UNIT III

Data Analysis and Reliability Estimation: Introduction, Definitions, Point estimation and interval estimation, Goodness-of-Fit tests, Moment estimation, Maximum Likelihood Estimator, Least Square Estimates (Textbook 2)

9 Hours

UNIT IV

System Reliability and Modelling: Types of systems, Basic configuration: Series, Parallel, Series-Parallel, Parallel-Series, Standby, Standby redundancy, r-out-of-n configuration (Textbook 1)

9 Hours

UNIT V

Maintainability, Availability and Replacement Policies:

Maintainability: Objectives of maintenance, Forms of maintenance, Examples, Cost Analysis, Maintainability equation, Measures of maintainability

Availability: Definitions, Availability and Maintainability trade-off, Provision of spares

Replacement Policies: Replacement processes, General assumptions, Replacement due to economic design, Replacement of items whose efficiency deteriorates with time or use (Discrete and Continuous function), Replacement of items that fail, Policies, Failure tree (Textbook 1)

9 Hours

Text Books

1. A K Govil, Reliability Engineering, TMH, 1983 Edition.
2. V. N. A. Naikan, Reliability Engineering and Life Testing, PHI Learning Private Limited, Eastern Economy Edition, 2009

Reference Books

1. L. S. Srinath, Reliability Engineering, East-West Press, 4th Edition

Dr. David J Smith, Reliability, Maintainability and Risk, Elsevier, 8th Edition

Course Outcome (COs):

1. Understand and gain the ability to apply concepts and methods of reliability analysis to failure data from different engineering disciplines [L1].
2. Understand and be able to develop probability distribution models (exponential, Weibull, etc.) for failure time analysis [L2].
3. Acquire ability to model system reliability [L3].
4. Acquire ability to root cause, correct, and document system failures [L4]
5. Acquire ability to apply system reliability analyses [L3]

Program Outcomes (POs) of the course:

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

4. PO 12: Self motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

ELECTIVE - I

HYBRID AND PROPULSION SYSTEMS

Course Code	**16AE15A2**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To present an overview about hybrid electric vehicle system design architecture and its subsystems.
2. To study different motor drives and controllers used in xEV / HEVs.
3. To study thermal management of hybrid systems
4. To enable students to improve the operation of internal combustion engines and (hybrid-) electrical propulsion systems through system-level analysis, and analysis of the underlying (electro-) mechanical, fluid-dynamic and thermo-chemical processes

Detailed Syllabus:

UNIT I

HEV/ xEV System Design Architecture

Design & Engineering: xEV : micro to mild to PHEV to HEV to REEV to EV - Hybrid-Electric Vehicle Power trains - Vehicle Energy Storage System (VESS) Design - Computational Systems Design (CSD) - Transportation Electrification

Introduction to Advanced Electric Vehicles: Fundamentals of xEVs and key challenges and opportunities of AEV technologies - Engineering philosophy of various xEVs (HEV, PHEV and BEV, REEV)

Hybrid Electrical Vehicles: Introduction - System Overview - Power train architecture - Parallel, Series and Combined - Types of xEVs - Vehicle layout and packaging options. - Energy devices & combinations - examples & Case Studies - Environmental Impact - Regulatory Issues (CO_2 gas and particulate emissions) - Duty Cycles in Indian cities; performance (off cycle, durability) - Sustainability assessment; cradle to grave environmental impact. - Industry Activity and Market Reaction - HEV market drivers and technology trends - Customer related issues - HEV technology readiness levels - Vehicle Based HEV Performance specifications.

9 Hours

UNIT II

xEV Motor Drives And Controllers

xEV components and architecture: Internal combustion engine-characteristics General architecture of xEV-Energy source, electric machines, power electronics converters, controllers, sensors, loads. Types of xEVs - series, parallel, series-parallel etc. Mild hybrid, PHEV, REEV, EV.

Energy source: Batteries, parameters(capacity, SOC, charge/discharge ratesetc.);Lead-acid batteries, Li-Ion batteries, Battery management systems, Fuel cells ,Ultra capacitors.

Electric machines: DC machines-Characteristics, AC machines-Induction machines, permanent magnet machines, switched reluctance machines

xEV Motor: Different configuration of xEV, series, parallel,series-parallel Electric Drive Architecture: Battery bank, inverter, controller, sensors, DC-DC converter, load

9 Hours

UNIT III

Thermal Management of Hybrid Systems:

Thermal Management of Motors: Motor Sizing vs Heat Generation - Operational Temperature Limitations of Electrical Insulation - Design concepts for Heat Extraction in Motors for xEV systems - Modelling and simulation of heat transfer in motors - Rendering of Heat extraction solutions - Sensors and Protection solutions.

Thermal Management for Batteries and Power Electronics: Introduction - Thermal control in vehicular battery systems: battery performance degradation at low and high temperatures - Passive, active, liquid, air thermal control system configurations for HEV and EV applications - Battery Heat Transfer - Introduction to battery modeling: tracking current demand, voltage, and State of Charge as functions of time for given drive cycles - Development of thermodynamic relationships for cell heat generation - Lumped cell and pack models for transient temperature response to drive cycles - Model parametric study results

9 Hours

UNIT IV

Design and performance of Spark-Ignition (SI) and Compression-Ignition (CI) engines (8L)

SI performance and limits to performance: Mean effective pressure; efficiency; performance maps.

Limits to efficiency and pressure: auto ignition, rate of combustion, heat losses.

SI enhancing performance and emissions: Improving performance: scavenging efficiency, flow exchange processes and tuning, direct injection. Emission control; catalysts and cycle control.

CI performance and limits to performance: Mean effective pressure; efficiency; performance maps.

Limits to efficiency and pressure: auto ignition, rate of combustion, heat losses.

CI enhancing performance and emissions: Fuel injection systems and spray structure multiple injection in CI engines. Principles and performance of particle trapping and oxidation systems; Selective Catalytic Reduction.

Turbocharging: Turbocharger technology and intercooling; turbocharger matching.

9 Hours

UNIT V

Low-carbon propulsion:

Anticipated developments in combustion engines: downsizing; low-temperature combustion / HCCI; alternative fuels; continuous/longer gearing; hybridization.

Series and parallel hybrids, and power management.

Electric motor drive technology (review of technology suited to automotive propulsion –induction, permanent magnet brushless, VRPM, SRM, DC) and performance metrics.

Automotive battery and fuel cell systems – balance of plant requirements, performance metrics.

Power-train testing and simulation:

Experimental investigation of engine design: performance, combustion behavior, and emissions (engine dynamometer, fuel maps, mini-map testing; chassis-dyno; legislative drive-cycles).

Emission measurements (HC, CO, NOx and particulate emissions).

Optical diagnostics: Data required for in cylinder flow structure, Optical diagnostics (PIV, PTV, LIF, LII, etc.), Thermodynamics models, CFD models, averaging techniques, in-cylinder flow and combustion models, modelling flame propagation in SI engines, spray structure and modelling techniques.

Calculation of heat transfer (Eichelberg approach, dimensional analysis, Annand and Woschni models.

Chemical rate kinetics.

Hybrid propulsion case-study: Southampton University Peace of Mind Series Hybrid Electric Vehicle.

9 Hours

Text Books:

1. Iqbal Husain, ”Electric and Hybrid Vehicles –Design Fundamentals”, CRC Press
2. Mehrdad Ehsani, Yimin Gao, Sebastian E.Gsay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Celll vehicles-Fundamentals - Theory and Design”, CRC Press

Reference Books:

1. Nag.P.K, “Engineering Thermodynamics”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013. 2. Jerry Sergent, Al Krum, “Thermal Management Handbook: For Electronic Assemblies Hardcover”, 1998, Mc Graw- Hill “ Vehicle thermal Management Systems Conference Proceedings”, 1st Edition; 2013, Coventry Techno centre, UK
2. Chang Liang Xia,”Permanent Magnet Brushless Dc Motor Drives and Controls” Wiley 2012.

Course Outcome (COs):

1. Understand HEV/ xEV System Design Architecture [L1].
2. Explain theory behind xEV Motor Drives And Controllers [L2].
3. Interpret thermal management of Hybrid Systems [L3].
4. Undertake experimental evaluation of internal combustion engines and power-train components [L4].
5. Perform computational simulations in order to predict and to optimize the performance of automotive power-train for a given drive-cycle [L5].

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 5: Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

3. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

ELECTIVE - I

VEHICLE DYNAMICS

Course Code	**16AE15A3**	**Credits**	
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4-0-0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. Understand vibrating systems and its analysis, modeling and simulation and modal analysis
2. Understand various Suspension systems, selection of springs and dampers Understand the stability of vehicles on curved track and slope, gyroscopic effects and cross wind handling
3. Know about tyres, ride characteristics and effect of camber, camber thrust
4. Learn about vehicle handling under different steering conditions and directional stability of vehicles

Detailed Syllabus:

UNIT I

Introduction: Classification of vibration, definitions, mechanical, vibrating systems, mechanical vibration and human comfort. Modelling and simulation studies. Model of an automobile, one degree of freedom, two degree of freedom systems, free, forced and damped vibrations - Random vibration - Magnification and Transmissibility .Vibration absorber. Multi degree of Freedom Systems-Closed and far coupled system, Orthogonality of modal shapes, Modal analysis.

9 Hours

UNIT II

Suspension: Requirements. Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions. Hydraulic dampers and choice of damper characteristics. Independent, compensated, rubber and air suspension systems. Roll axis and vehicle under the action of side forces.

9 Hours

UNIT III

Stability of Vehicles: Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking, overturning and sliding. Rigid vehicle – stability and equations of motion. Crosswind handling.

9 Hours

UNIT IV

Tyres: Types. Relative merits and demerits. Ride characteristics. Behaviour while cornering, slip angle, cornering force, power consumed by a tyre. Effect of camber, camber thrust.

9 Hours

UNIT V

Vehicle Handling: Over steer, under steer, steady state cornering. Effect of braking, driving torques on steering. Effect of camber, transient effects in cornering. Directional stability of vehicles.

9 Hours

References:

1. Thomas D. Gillespie, Fundamentals of vehicle dynamics,SAE,1992
2. J.G. Giles, 'Steering, Suspension and Tyres, Illiffe Books Ltd., 1968.
3. J. Y. Wong, 'Theory of Ground Vehicles', John Wiley and Sons Inc., New York, 2001.

Course Outcome (COs):

1. Understand and analyse the various dynamic aspects of the vehicle. [L2, L3]
2. Be able to analysis more complex problems. [L4]

Program Outcomes (POs) of the course:

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

ELECTIVE - I

MECHATRONICS AND ROBOTICS AUTOMATION

Course Code	**16AE15A3**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To broaden the understanding of Mechatronics systems
2. To underline the importance of control systems.
3. To introduce Stress, Strain and Force measurement methods.
4. To broaden the importance of Robotics and automation

Detailed Syllabus:

UNIT I

Overview of Mechatronics: What is Mechatronics? Mechatronic Design Approach. System Interfacing, Instrumentation and Control Systems. Microprocessor Based Controllers and Microelectronics. An Introduction to Micro-and Nanotechnology Mechatronics: New Directions in Nano-, Micro-, and Mini-Scale Electromechanical Systems, Design, and Engineering Curriculum Development.

9 Hours

UNIT II

Physical System Modelling : Modelling Electromechanical Systems, Structures and Materials, Modeling of Mechanical Systems for Mechatronics Applications ,Fluid Power System, Electrical Engineering, Engineering Thermodynamics, Modelling and Simulation for MEMS, Rotational and Translational Micro electromechanical Systems: MEMS Synthesis, Micro fabrication, Analysis, and Optimization, The Physical Basis of Analogies in Physical System Models.

9 Hours

UNIT III

Sensors and Actuators: Introduction to Sensors and Actuators, Fundamentals of Time and Frequency, Sensor and Actuator Characteristics, Sensors, Linear and Rotational Sensors, Acceleration Sensors, Force Measurement, Torque and Power Measurement, Flow Measurement ,Temperature Measurements, Distance Measuring and Proximity Sensors, Light Detection, Image, and Vision Systems, Integrated, Micro-sensors, Actuators, Electromechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro transducers Analysis, Design and Fabrication.

9 Hours

UNIT IV

Systems and Controls: The Role of Controls in Mechatronics, The Role of Modelling in Mechatronics Design, Signals and Systems, Continuous-and Discrete-time Signals, Transforms and Digital Systems, Continuous-and Discrete- time State-space Models, Transfer Functions and Laplace Transforms, State Space Analysis and System Properties, Response of Dynamic Systems, Root Locus Method, Frequency Response Methods, Kalman Filters as Dynamic System State Observers, Digital Signal Processing for Mechatronic Applications, Control System Design Via H2 Optimization, Adaptive and Nonlinear Control

Design, Neural Networks and Fuzzy Systems, Advanced Control of an Electro hydraulic Axis, Design Optimization of Mechatronic Systems.

9 Hours

UNIT V

Computers and Logic Systems: Introduction to Computers and Logic Systems, Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Logic System Design, Synchronous and Asynchronous Sequential Systems, Architecture, Control with Embedded Computers and Programmable Logic Controllers.

Software and Data Acquisition: Introduction to Data Acquisition, Measurement Techniques: Sensors and Transducers, A/D and D/A Conversion, Signal Conditioning, Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.

9 Hours

References:

1. John G. Webster. Editor-in-chief. “Measurement, Instrumentation, and Sensors Handbook”, CRC Press. 1999. 0-8493-2145-X.PDFfilesonline available atwww.engnetbase.com.

Course Outcome (COs):

1. Analyze various Mechatronics systems like sensors, actuators [L3].
2. Determine the stress, strain, force and other parameters using suitable devices [L2].
3. Design the components of Mechatronics systems [L6].
4. Write the programme for robots, automation [L4].

Program Outcomes (POs) of the course:

1. PO1: Fundamentals of Engineering:

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Automotive Electronics.

2. PO4 Engineering Cognizance:

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 5: Modern tool Usage:

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER I

AUTOMOTIVE INSTRUMENTATION LAB

Subject Code:	**16AE16L1**	**Credits:**	1
Course Type:	PC – L	**CIE Marks:**	25
Hours/week: L – T – P	0 – 0 – 1	**SEE Marks:**	25
Total Hours:		**SEE Duration:**	2 Hours

After successfully completing this course the student should be able to:

1. Measure various measurement parameters related automobiles
2. Measure various product features
3. Calibrate measuring instruments
4. Use modern software tools to analyze and interpret the data received from vehicle inspection

List of Experiments

1. Lab experiments involving: Measurements of position, displacement, velocity, force, temperature, proximity/range.
2. Measurements of various product features using mechanical, pneumatic, optical and electronic instruments, interferometer, surface roughness measurements, measurements of threads and gears.
3. Calibration of various measuring instruments
4. Laboratory experiments and exercises involving hardware and software modular based off-line and on-line product gauging and inspection, information recording and processing etc.

SEMESTER II

TELEMATICS AND INFOTAINMENT SYSTEM

Course Code	**16AE21**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To introduce about automotive telematics and security systems.
2. To introduce about the various advance driver assistance system.
3. At the end of the course students are exposed to various automotive communication systems.

Detailed Syllabus:

UNIT 1

Telematics and security systems: Telematics-Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems. Security Systems- Vehicle Immobilzers, Anti theft technologies, smart card system, number plate coding.

9 Hours

UNIT II

Comfort Systems: Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring -HMI Systems-collapsible and tilt table steering column, power windows, X-by wire technologies-Steer by wire system, Brake by wire system and Drive by wire system.

9 Hours

UNIT III

Advanced driver assistance and safety system: Active Safety Systems -and Passive Safety Systems, Advanced Driver Assistance Systems (ADAS)-Combining computer vision techniques as pattern recognition, feature extraction, learning, tracking, 3D vision to assist the driving activity. Examples of assistance applications- Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.

9 Hours

UNIT IV

Infotainment systems fundamentals: Introduction to In Vehicle Infotainment (IVI) systems - Use of operating systems in IVI, GENIVI Alliance-Tuner- AM/FM, XM/Sirrus, DAB/DMB, Software Defined Radio, Ensemble, Traffic Announcements, Spread Spectrum-Multimedia: Types of Media. Navigation- Points of Interests, Routes, Waypoints, Dead Reckoning position, Traffic Info, GLONASS, GNSS, RTK, GPS, and SBAS/GBAS,INS, System Architecture – Design Patterns - Proxies, Adaptors, Interfaces, Singleton, Factory method.

9 Hours

UNIT V

Automotive communication systems: Introduction to Bluetooth – Pairing, HFP, A2DP, PAN, PBAP, DUN. Concepts of MOST network, DLNA, AVB. Concepts of TCP/IP, Ethernet, WiFi, WiFi Direct, MyWiFi and CAN, Mirror link, Tethering.

9 Hours

Text Books

1. Ronald K Jurgen, "Navigation and Intelligent Transportation Systems – Progress in Technology", Automotive Electronics Series, SAE, USA, 1998.
2. William B Ribbens, "Understanding Automotive Electronics", 7th edition, Butter worth Heinemann Woburn -2012.

References

1. Dennis Foy, Automotive Telematics, Red Hat, 2002.
2. Yilin Zhao, Vehicle Location and Navigation Systems, Artech House, 1997.
3. Jay Farrell and Matthew Barth, The Global Positioning System and Inertial Navigation, McGraw-Hill, 1999.

Course Outcome (COs):

1. To study and analyze various vision systems for vehicles [l4].
2. To understand the architecture for autonomous vehicles and study the overview of the architecture [L2].
3. To study the fundamentals about Autonomous vehicle with case study [L2].

Program Outcomes (POs) of the course:

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Automotive Electronics.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Automotive Electronics.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)
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SEMESTER II

INTELLIGENT VEHICLE TECHNOLOGIES

Course Code	**16AE22**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. Learn the various driver support systems and sensor technologies.
2. Understand the principle of operation of VANETs and need for telematics.
3. Understand the need of safety and security systems in vehicles.
4. Understand the working of vision sensor system and the need to build intelligent systems.
5. Understand the need of autonomous vehicles and their operation.

Detailed Syllabus:

UNIT I

Driver Assistance Systems: Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring.

Intelligent vehicle sensor technologies: The CAN bus – Introduction, Functional concepts, Hierarchical organization, Implementations, CAN applications, , The future of CAN.

Self-Study Topic: CAN-related standards

9 Hours

UNIT II

Vehicle information system and intelligent transportation: Intelligent transportation system (ITS) - Vision for ITS communications-Multimedia communication in a car-Current ITS communication systems and services. Vehicle–vehicle and road–vehicle communication systems-Inter and Intra Vehicular Communication-VANETS-Device technologies-Optical Technologies and millimeter wave technologies.

Telematics - Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

9 Hours

UNIT III

Safety Systems & Security Systems

Safety Systems: Airbags, seat belt tightening system, collision warning systems, child lock, anti lock braking systems.

Security Systems: Anti-theft technologies, smart card system, number plate coding.

9 Hours

UNIT IV

Towards intelligent automotive vision systems: Introduction and motivation, Applications of vision in driver assistance systems, Operating principles - Components of a vision sensor system, Sensor raw data analysis, Applications and results - Autonomous driving, Heavy truck coupling

Principles and applications of computer vision for driver assistant systems: Introduction, Driver assistance on highways - Lane recognition, Traffic sign recognition (TSR), Driver assistance in urban traffic - Stereo vision, Shape-based analysis, Road recognition, Object recognition as a classification problem - Traffic lights and signs, Pedestrian recognition ,

Self-Learning Topics: Building intelligent systems **-** ANTS: a multi-agent system, UTA II on the road

9 Hours

UNIT V

Autonomous vehicles case studies: DARPA Challenge-ARGO prototype vehicle-The GOLD System-The inverse perspective mapping , Lane detection, Obstacle detection, Vehicle detection, Pedestrian detection, software systems architecture, Computational performance. ARGO prototype vehicle Hardware-Functionalities, data acquisition system, processing system, output system, control system, Other vehicle equipments and emergency features, The MilleMiglia in Automatico test

9 Hours

Text Books

1. Ljubo Vlacic, Michel Parent and Fumio Harashima,"Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001-ISBN 0 7506 50931.
2. Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei "Autonomous Vehicles Intelligent Transport Systems And Smart Technologies",Nova Publishers-2014–ISBN-978-1- 63321-326-5

References

1. Ronald K Jurgen, "Automotive Electronics Handbook", Automotive Electronics Series, SAE, USA, 1998.
2. William B Ribbens, "Understanding Automotive Electronics", 7th edition, Butter worth Heinemann Woburn, 2012.

Course Outcome (COs):

1. Identify and explain the various intelligent sensor technologies and different driver assistant systems. [L1, L2]
2. Analyze the vehicular ad hoc network technologies and to combine them with telematics. [L3]
3. Illustrate the deployment of safety and security systems. [L2]
4. Analyze sensors needed for vehicular communications and the deployment of intelligent vehicles. [L3]
5. Design the model of autonomous vehicles needed in road applications. [L5]

Program Outcomes (POs) of the course:

1. [PO2] Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

2. [PO4] Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. [PO5] Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

4. [PO10] Entrepreneurship

Graduates shall imbibe project management and finance skills to pursue entrepreneurial endeavours.

5. [PO11] Research and Innovation

Graduates shall have the ability to pursue research and provide innovative solutions.

6. [PO12] Self-motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments**	**Quiz/Seminar/ Project**	Class participation	Total Marks
Maximum Marks	25	10	10	5	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**).

SEMESTER II

AUTOMOTIVE NETWORKING

Course Code	**16AE23**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To analyze, simulate and implement automotive communication protocols.
2. To impart in depth knowledge on data communication and networking, automotive communication and diagnostic protocols and their working.
3. The conceptual studies of this module will be complemented with laboratory sessions on simulation and analysis of In-Vehicle Networks (IVN) using appropriate Tools

Detailed Syllabus:

UNIT I

Basics of Data Communication Networks and Automotive Communication Protocols:

Need for networks, Types of networks, Need for standards, TCP/IP model, Topologies, Error detection and correction mechanisms, Encoding schemes, Serial/parallel transmission, Bits, Baud and bandwidth, Synchronous and asynchronous, Need and benefits of IVN, Classes of IVN protocols, Multiplexed electrical systems, Vehicle multiplexing, Bitwise contention, Network elasticity, Error processing and management and Case Study

9 Hours

UNIT II

Controller Area Network (CAN) Protocol:

History and foundation of CAN, CAN Applications, Main characteristics of CAN, CAN in OSI Reference Model, CAN Data Link Layer, Principles of data exchange in CAN, Arbitration, Data Frame, Remote Frame, Error detection and management in CAN, CAN physical Layer, Bit encoding, Bit timing and synchronization, Relationship between data rate and bus length, Single wire and twin wire media, CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), Comparison with other IVN protocols, CANoe based applications development

9 Hours

UNIT III

CAN Higher Layer Protocols and LIN:

CAN Higher Layer Protocols: CAN in Automation (CiA), CANopen, CANopen device model, CANopen features, DeviceNet, DeviceNet Model, Device Object Model, DeviceNet Features, SAEJ1939, SAE J1939 Reference Model, CANKingdom and Case Study

Local Interconnect Network (LIN) Protocol: Introduction to LIN, LIN consortium, LIN specification, LIN features, Technical overview, Work flow concept, LIN operation, LIN frame format, Scheduling table, Network management of LIN cluster, LIN Transport Layer, LIN node configuration and identification, LIN diagnostics, LIN physical layer, Comparison with other IVN protocols and Case Study

9 Hours

UNIT IV

FlexRay and MOST Protocol:

FlexRay Protocol: Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, FlexRay Features, Application requirements, Working of FlexRay, Network topologies, ECU architecture, Segment Configuration, Communication Cycles, FlexRay frame format, Timing of configuration protocol, Error control, and FlexRay core mechanisms, Coding and Decoding, Medium Access Control, Frame and Symbol Processing, Clock Synchronization, FlexRay Components, Comparison with other IVN protocols and Case Study

Media Oriented System Transport (MOST) Protocol: Emerging in car systems, Introduction to MOST, MOST goals, Features, Cables and Connectors, Data Types, Topology, Frame Format, Application Areas, System Description, Specification, Device Model, Device Implementation, Diagnostics and Case Study

9 Hours

UNIT V

In Vehicle Network Diagnostics:

Process of Automotive Fault Diagnostics, Fault Codes, Vehicle Systems (open-loop and closed-loop)

On- and Off- Board Diagnostics, OBD-I, OBD-II, Engine Analyzers, Steps taken to diagnose a fault, Diagnostics Protocol-KWP2000, SAE-J1587, SAE-J1708 and Case Study

9 Hours

Text Books

1. Gilbert Held. (2007) Inter- and Intra-Vehicle Communications, CRC Press.
2. Behrouz Forouzan. (2003) Data Communications and Networking, McGraw-Hill.
3. Ronald k. Jurgen. (1999) Automotive Electronics Handbook, McGraw-Hill.

Course Outcome (COs):

1. Establish the need of Networking in an Automobile [L2]
2. Explain and analyze the principles and functionalities of various Automotive Communication Protocols (ACPs) [L2]
3. Design, simulate, emulate and analyze CAN and LIN based automotive embedded networks [L6]
4. Design ACP based In-Vehicle Networks (IVNs) [L6]
5. Proficiently use CANoe tool to develop IVN applications as well as to simulate, analyze and Troubleshoot ACP based IVNs [L5]

Program Outcomes (POs) of the course:

1. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

2. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

3. PO 12: Self motivated Learning

Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

MODELING, SIMULATION AND ANALYSIS OF ENGINEERING SYSTEMS

Course Code	**16AE24**	**Credits**	4
Course type	PC	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course learning objectives (CLOs):

1. To provide a clear understanding on the basic concept, and building blocks of an Embedded System.
2. To address the issues in the hardware software co-design.
3. To emphasize on the study and understanding of real time operating system concepts with case studies, and
4. Comprehensive discussion on the architecture and programming of the ARM, and to understand the embedded design life cycle.

Pre-requisites:

1. Engineering Mathematics
2. Signal and Systems
3. Control Systems

UNIT I

Fundamental concepts in mathematical modeling: Abstraction, linearity and superposition, balance and conservation laws and the system, boundary approach.

9 Hours

UNIT-II

Lumped element modeling: Mechanical systems-Translational, rotational. Hydraulic systems. Thermal systems. RLC Electrical Systems.

9 Hours

UNIT III

Modeling of first order and second order systems: Governing equations for free and forced responses, transient response specifications, experimental determination, Laplace transform.

9 Hours

UNIT IV

Time domain, frequency domain and state space: Frequency response of Linear, Time invariant systems , frequency response of first order and second order systems, state space formulations of systems problems relating frequency response to pole location – transient response-poles and frequency response.

9 Hours

UNIT V

Feedback systems: Systems with feedback – block diagrams – properties of feedback systems – relative stability-phase and gain margins.

9 Hours

Text Books:

1. Philip D Cha, James J Rosenberg and Clive L Dym, Fundamentals of Modeling and Analyzing Engineering Systems, Cambridge University, 2000.
2. Amalendu Mukherjee, Ranjit Karmakar, Modeling and Simulation of engineering Systems through Bondgraphs, Narosa, 2000. Close Frederick, Modeling and Analysis of Dynamic Systems, Wiley.
3. Woods, Robert L., and Lawrence Kent L, Modeling and Simulation of Dynamic Systems, Prentice Hall, 1997.

Course Outcome (COs):

1. Understand the fundamental concepts of mathematical modeling [L1].
2. Understand lumped element modeling [L2].
3. Assess the modeling of higher order systems [L3].
4. Analyze time and frequency domain, and state space [L4].
5. Explain feedback systems [L2].

Program Outcomes (POs) of the course:

1. [**PO1] Fundamentals of Engineering:**
Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Automotive Electronics

2. [PO2] Design of Experiments:
Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

3. [PO5] Modern tool Usage:
Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

4. [PO11]: Research and Innovation:
Graduates shall have the ability to pursue research and provide innovative solutions.

5. [PO12]: Self motivated Learning:
Graduates shall continue to upgrade the skills and possess the motivation for continuing education and professional growth

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):
1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

ELECTIVE -II

SYSTEM SIMULATION TECHNOLOGY

Course Code	**16AE25B1**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To impart knowledge about simulation modeling of systems
2. To explore various probability distributions related to modeling of systems

Detailed Syllabus:

UNIT I

Basic simulation modeling: Nature of simulation, system models, discrete event simulation, single server simulation, alternative approaches, other types of simulation.

9 Hours

UNIT II

Building valid, credible and detailed simulation models. Techniques for increasing model validity and credibility, comparing real world observations.

9 Hours

UNIT III

Selecting input probability distributions. Useful probability distributions, assessing sample independence, activity I, II and III. Models of arrival process.

9 Hours

UNIT IV

Random numbers generators: linear congruential, other kinds, testing random number generators. Random variate generation: approaches, continuous random variates, discrete random variates, correlated random variates.

9 Hours

UNIT V

Output data analysis. Statistical analysis for terminating simulations, analysis for steady state parameters. Comparing alternative system configurations. Confidence intervals. Variance reduction techniques. Antithetic and Controlvariates.

9 Hours

References

1. Averill Law, “Simulation modeling and analysis”, MGH, 4thedition, 2007
2. Jerry Banks, “Discrete event system simulation”, Pearson, 2009.
3. Seila, Ceric, Tadika MEEla, “Applied simulation modeling”,Cengage, 2009.
4. George S. Fishman, “Discrete event simulation”, Springer, 2001.

5. N. Viswanadham, Y. Narahari, “Performance modeling of automated manufacturing systems”, PHI, 2000.
6. Frank.L. Severance, “System modeling and simulation”, Wiley,2009.
7. K. S. Trivedi, “Probability and stastistics with reliability queuing and computer science applications”, PHI, 2007.

Program Outcomes (POs) of the course:

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Automotive Electronics.

2. PO 8: Collaboration

Graduates shall have the ability to collaborate productively in multidisciplinary teams with leadership attributes.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments**	**Quiz/Seminar/ Project**	Class participation	Total Marks
Maximum Marks	25	10	10	5	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**).

SEMESTER II

ELECTIVE II

SAFETY AND SECURITY OF MECHATRONICS SYSTEMS

Course Code	**16AE25B2**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives (CLOs):

1. To impart basic understanding of various types of automobiles
2. To understand electrical system & air conditioning systems of mechatronics systems
3. To explore different components of mechatronic systems
4. To acknowledge modern gadgets used to secure mechatronics systems

Detailed Syllabus:

UNIT I

Types of automobiles. Limiting Dimensions as per Central Motor Vehicles Rules. Engines – Classification, Construction, Materials of engine components. Prototype Testing as per Central Motor Vehicles Rules Fuel System – Fuel tank, Fuel filter, Types of Fuel system. Carburetor – Simple and Modern, Fuel injection System. Emission Standards as per CMV Rules.

9 Hours

UNIT II

Electrical System – Storage Battery Operations and Maintenance. Ignition System – Coil and Magneto Ignition System. Starting System, Lighting System, Horn System – Wind ShiEAE.

9 Hours

UNIT III

Wiper Motors, Fans, Heaters, Traficators. Automobile air conditioning. Central Motor Vehicles Rules regarding Lighting, WindshiEAEs, Wipers. Transmission System – Clutches – operation and fault finding of clutches, Fluid Flywheel, Gear Box-types, Steering Systems, Chassis Springs, Suspension

9 Hours

UNIT IV

Differential, Dead and Live axles, Rims, Tyre etc. Brakes – Types, construction and fault finding. CMV Rules – Brakes, Steering & Tyre. Lubrication Systems – Types, Components, Lubricating oil, Cooling system – Details of components, Study of Systems, Types

9 Hours

UNIT V

Special gadgets and accessories for fire fighting vehicles. Automobile accidents. CMV Rules regarding Safety devices for drivers, passengers.

9 Hours

References

1. William H. Crouse, "Automobile Chassis and Body Construction, Operation and Maintenance".
2. William H. Crouse, "Automobile Machines –Principles& Operations".
3. GBS Narang, "Automobile Engineering".
4. Kirpal Singh, "Automobile Engineering".
5. Joseph Heitner, "Automotive Mechanics-Principles & Practices".
6. P. L. Kohli, "Automotive Electrical Equipments".
7. "The Central Motor Vehicles Rules", 1989

Course Outcome (COs):

1 Explain simple and modern fuel injection systems [L2]
2 Analyze numerous parameters involved in assuring safety and security of mechatronics systems [L3]
3 Explore modern gadgets involved in safety and security of mechatronics systems [L3]

Program Outcomes (POs) of the course:

1. PO 3: Social Engineering

Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.

2. PO 4: Engineering Cognizance

Graduates shall be able to stay abreast with recent developments in the field of Electronics and Communication Engineering.

3. PO 6: Impact of Engineering

Graduates shall be able to understand the impact of engineering solutions in a global, economic, environmental and societal context.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

ELECTIVE -II

CAD APPLICATION FOR AUTOMOTIVE ENGINEERING

Course Code	**16AE25B3**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives:

1. To introduce a 3D modeling software.
2. To design automotive components with specifications using a 3D modeling software

Detailed Syllabus:

Application software: CATIA, Pro/Engineer or similar 3D modeling software

UNIT I

3D modeling: introduction, approach, advantages, Learning different tools of modeling software with exercise, Design, modeling and drawing of some automotive engine/mechanical components like Inlet & exhaust valve, Piston, gudgeon pin, piston rings

9 Hours

UNIT II

Design, modeling and drawing of complete connecting rod including small end and big end, shank, end caps bolts, Wire frame and Surface modeling: Modeling of complicated shaped solid using surface modeling with exercise. Surface modeling of exterior parts like bonnet, trunk lid etc.

9 Hours

UNIT III

Design, modeling and drawing of Fly wheel, Ring gear. Design, modeling and drawing of Crankshaft, balancing weight calculation, front end and rear end details.

9 Hours

UNIT IV

Design and drawing of Cam and Camshaft, Cam profile generation.
Assembly modeling of automotive mechanicals like: Connecting Rod, Piston and its accessories.

9 Hours

UNIT V

Flywheel, Ring Gear and studs. Overview of Finite Element Modeling and Analysis with exercise.

9 Hours

Text Books:

1. R.S.Khurmi, A Text Book of Machine Design, Eurasia, 2005.
2. Sham Tickoo, Catia for Engineers & Designers, Dreamtech, 2005.
3. P.N.Rao, CAD/CAM principle and application, Tata McGraw Hill, 2004

Course Outcomes:

Upon completion of the course, you should be able to:

1. Design, model and draw complete Connecting rod, Fly wheel, Ring gear [L6]
2. Design and draw Cam and Camshaft [L6]

Program Outcomes (POs) of the course:

1. PO 2: Design of Experiments

Graduates shall possess the ability to design and conduct experiments, analyse and interpret data.

2. PO 5: Modern tool Usage

Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

3. PO 11: Research and Innovation

Graduates shall have the ability to pursue research and provide innovative solutions.

Scheme of Continuous Internal Evaluation (CIE):

Components	Average of best two tests out of three	**Average of two assignments/ activity**	**Seminar/ Mini Project**	Total Marks
Maximum Marks	30	10	10	50

Scheme of Semester End Examination (SEE):

1. It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.

2. Question paper contains 08 questions each carrying 20 marks. Students have to answer FIVE full questions. SEE question paper will have two compulsory questions (any 2 units) and choice will be given in the remaining three units. **(Kindly incorporate/mention the changes in the pattern of SEE question paper, if required, based on the content of course**)

SEMESTER II

ELECTIVE -II

SOFT COMPUTING

Course Code	**16AE25B4**	**Credits**	4
Course type	PE	**CIE Marks**	50
Hours/week: L-T-P	4 – 0 – 0	**SEE Marks**	100
Total Hours:	45	**SEE Duration**	3 Hours

Course Learning Objectives:

1. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
3. To provide the mathematical background for carrying out the optimization associated with neural network learning.
4. To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.

UNIT I

Introduction to Soft Computing: What is Soft Computing? Fuzzy Systems, Artificial Neural Networks, Evolutionary Search Strategies

Fuzzy Set Theory: Crisp Sets- A Review, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Fuzzy Extension Principle

Fuzzy Logic: Crisp Logic- A Review, Fuzzy Logic Basics, Fuzzy Truth in Terms of Fuzzy Sets, Fuzzy Rules, Fuzzy Reasoning

9 Hours

UNIT II

Fuzzy Inference Systems: Introduction, Fuzzification of the Input Variables, Application of Fuzzy, Operators on the Antecedent Parts of the Rules, Evaluation of the Fuzzy Rules, Aggregation of Output Fuzzy Sets Across the Rules, Defuzzification of the Resultant Aggregate Fuzzy Set, Fuzzy Controllers

9 Hours

UNIT III

Artificial Neural Networks: Basic Concepts- Introduction, Computation in Terms of Patterns, The McCulloch–Pitts Neural Model, The Perceptron, Neural Network Architectures, Activation Functions, Learning by Neural Nets

9 Hours

UNIT IV

Pattern Classifiers: Hebb Nets, Perceptrons, ADALINE, MADALINE

Pattern Associators: Hopfield Networks, Bidirectional Associative Memory

Competitive Neural Nets: Kohonen's Self-organizing Map (SOM), Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART)

Backpropagation: Multi-layer Feedforward Net, The Generalized Delta Rule, The Backpropagation Algorithm

9 Hours

UNIT V

Elementary Search Techniques: State Spaces, State Space Search, Exhaustive Search, Heuristic Search, Production Systems

Advanced Search Strategies: Natural Evolution- A Brief Review, Genetic Algorithms (GAs), Multi-objective Genetic Algorithms, Simulated Annealing

9 Hours

Course Outcomes:

Upon completion of the course, you should be able to:

3. Identify and describe soft computing techniques and their roles in building intelligent machines [L2]
4. Recognize the feasibility of applying a soft computing methodology for a particular problem [L2]
5. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems [L4]
6. Apply neural networks to pattern classification and other engineering problems [L4]
7. Apply genetic algorithms to combinatorial optimization problems [L4]
8. Effectively use existing software tools to solve real problems using a soft computing approach [L4]
9. Evaluate and compare solutions by various soft computing approaches for a given problem [L5]

Text Book:

1. Samir Roy and Udit Chakraborty, "Introduction to Soft Computing- Neuro-Fuzzy and Genetic Algorithms", Pearson, 2013.

References:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
5. R.Eberhart, P.Simpson, and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996.

Program Outcomes (POs):

1. PO 1: Fundamentals of Engineering

Graduates shall be able to understand and apply the basic mathematical and scientific concepts in the field of Electronics and Communication Engineering.

2. PO 3: Social Engineering
Graduates shall possess the ability to identify societal problems and meaningfully contribute with optimal solutions.

3. PO 5: Modern tool Usage
Graduates shall possess critical thinking abilities, problem solving skills and familiarity with the necessary computational tools and procedures.

4. PO 11: Research and Innovation
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Scheme of Continuous Internal Evaluation (CIE):

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SEMESTER II

MODEL BASED DESIGN LAB

Course Code	**16AE26L1**	**Credits**	1
Course type	PC	**CIE Marks**	25
Hours/week: L-T-P	0 – 0 – 1	**SEE Marks**	25
Total Hours:		**SEE Duration**	2 Hours

After successfully completing this course the student should be able to:

1. Build mathematical models for components in a system.
2. Follow a process of continuous refinement and improvement to generate accurate models.
3. Manage the development of large system models
4. Connect component models together to model a larger more complex system.
5. Setup and run Model-in-the-Loop Simulations (MIL).
6. Setup and run Software-in-the-Loop Simulations (SIL).
7. Setup and run real-time simulations for a physical system.
8. Setup and run Hardware-in-the-Loop Simulations (HIL).
9. Deploy a control algorithm on a real-time target.
10. Apply verification and validation methods to a model of a physical system.

List of Experiments:

1. **Modeling a series hybrid-electric vehicle**
   - Introduction to Simulink and SimDriveline
   - Models for the Driver, Battery, and Electric Motors. Creating and Running Drive Cycles
   - Models for Engines.
2. **Real-Time Simulations**
   - Stand-Alone Simulations
   - Verify logical operation
   - Introduction to CAN
   - Message IDs
   - Scaling and Offset
   - Big Endian and Little Endian
   - CAN Message Database
   - Cabling, isolation, and termination
3. **HIL Simulations (Real-Time)**
   - Separate the Plant from the Controller.
   - Controller on real-time target.
   - Plant on real-time target.
   - V&V Using HIL RT Model
   - Setup a standard set of tests for the series controller.
   - Run standard set of tests, record and report results, indicate faults.
   - Verify communications interfaces and A/D inputs and outputs.

References

1. Peter Wilson and H.Alan Mantooth “Model based Engineering for complex Electronics system” 2013,Newness.
2. AgamKumar Tyagi “Matlab and simulink for Engineers” Oxford Higher education,2012
3. Webcourse by Zachariah chambers and Marc Herniter –Rose Hulman institute of technology on “Introduction to model based design and Advanced model based design.”