## VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
### SCHEME OF TEACHING AND EXAMINATION FOR
#### M.Tech. Automotive Electronics

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Teaching hours/week</th>
<th>Duration of Exam in Hours</th>
<th>Marks for Total Marks</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>14EAE11</td>
<td>Mechatronics</td>
<td>4 Lecture 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3 50 100 150</td>
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<tr>
<td>14EAE12</td>
<td>Automotive Materials</td>
<td>4 Lecture 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3 50 100 150</td>
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<tr>
<td>14EAE13</td>
<td>Design of Automotive Dynamics Systems</td>
<td>4 Lecture 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3 50 100 150</td>
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<tr>
<td>14EAE14</td>
<td>Digital Control Systems</td>
<td>4 Lecture 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3 50 100 150</td>
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<tr>
<td>14EAE15X</td>
<td>Elective -1</td>
<td>4 Lecture 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3 50 100 150</td>
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<tr>
<td>14EAE16</td>
<td>Automotive Electronics Lab</td>
<td>-- Lecture 3 Practical / Field Work / Assignment / Tutorials</td>
<td>3 25 50 75</td>
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<tr>
<td>14EAE17</td>
<td>Seminar on Advanced topics from refereed journals</td>
<td>-- Lecture 3 Practical / Field Work / Assignment / Tutorials</td>
<td>-- 25 25 2</td>
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### Total

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Practical / Field Work / Assignment / Tutorials</th>
<th>Duration of Exam in Hours</th>
<th>Marks for Total Marks</th>
<th>CREDITS</th>
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<tr>
<td>20</td>
<td>16</td>
<td>18</td>
<td>300 550 850 23</td>
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### Elective -1:

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
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<tbody>
<tr>
<td>14 EAE 151</td>
<td>Safety and Security of Mechatronics Systems</td>
</tr>
<tr>
<td>14 EAE 152</td>
<td>Design of Mechanical Systems</td>
</tr>
<tr>
<td>14 EAE 153</td>
<td>Automotive Networking</td>
</tr>
<tr>
<td>14 EAE 154</td>
<td>Automotive Electrical Systems and Electronics</td>
</tr>
<tr>
<td>14 EAE 155</td>
<td>CAD Design</td>
</tr>
</tbody>
</table>
## Scheme of Teaching and Examination for M.Tech. Automotive Electronics

### II Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Teaching hours/week</th>
<th>Duration of Exam in Hours</th>
<th>Marks for</th>
<th>Total Marks</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>14EAE21</td>
<td>Applied Thermal Engineering</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>50 I.A.</td>
<td>100 Exam</td>
<td>150</td>
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<tr>
<td>14EAE22</td>
<td>Vehicle Engineering</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>50 I.A.</td>
<td>100 Exam</td>
<td>150</td>
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<tr>
<td>14EAE23</td>
<td>Automotive Instrumentation</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>50 I.A.</td>
<td>100 Exam</td>
<td>150</td>
</tr>
<tr>
<td>14EAE24</td>
<td>Modeling &amp; Analysis of Dynamic Systems</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>50 I.A.</td>
<td>100 Exam</td>
<td>150</td>
</tr>
<tr>
<td>14EAE25X</td>
<td>Elective-2</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>50 I.A.</td>
<td>100 Exam</td>
<td>150</td>
</tr>
<tr>
<td>14EAE26</td>
<td>Advanced Embedded System Lab</td>
<td>3 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
<td>3</td>
<td>25 I.A.</td>
<td>50 Exam</td>
<td>75</td>
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<tr>
<td>14EAE27</td>
<td>Seminar on Advanced topics from refereed journals</td>
<td>-- Lecture, 3 Practical / Field Work / Assignment / Tutorials</td>
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<td>25 I.A.</td>
<td>-- Exam</td>
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**Elective -2:**

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
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<tbody>
<tr>
<td>14 EAE 251</td>
<td>System Simulation Technology</td>
</tr>
<tr>
<td>14 EAE 252</td>
<td>Vehicle Dynamics</td>
</tr>
<tr>
<td>14 ELD 253</td>
<td>MEMS</td>
</tr>
<tr>
<td>14 EAE 254</td>
<td>CAD Application for Automotive Engineering</td>
</tr>
<tr>
<td>14 EIE 255</td>
<td>PLCs and Industrial Automation</td>
</tr>
</tbody>
</table>

**Project Phase-I (6 week Duration)**

- Total: 20 Lecture, 16 Practical, 18 Field Work, 300 I.A., 550 Exam, 850 Total Marks, 23 CREDITS

** Note: Between the II Semester and III Semester, after availing a vocation of 2 weeks. **
## III Semester: INTERNSHIP #

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject</th>
<th>Teaching hours/week</th>
<th>Duration of the Exam in Hours</th>
<th>Marks for</th>
<th>Total Marks</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>14EAE31</td>
<td>Midterm Presentation on Internship (After 8 weeks from the date of commencement) *</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>25</td>
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<tr>
<td>14EAE32</td>
<td>Report on Internship (After 16 weeks from the date of commencement)</td>
<td>-</td>
<td>-</td>
<td>75</td>
<td>75</td>
<td>15</td>
</tr>
<tr>
<td>14EAE33</td>
<td>Evaluation and Viva-voce</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>50</td>
<td>4</td>
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<tr>
<td><strong>Total</strong></td>
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<td>-</td>
<td><strong>100</strong></td>
<td><strong>50</strong></td>
<td><strong>150</strong></td>
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</table>

* The student shall make a midterm presentation of the activities undertaken during the first 8 weeks of internship to a panel comprising Internship Guide, a senior faculty from the department and Head of the Department.

# The College shall facilitate and monitor the student internship program.

**The internship report of each student shall be submitted to the University.**
## IV Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Teaching hours/week</th>
<th>Duration of Exam in Hours</th>
<th>Marks for Total Marks</th>
<th>CREDITS</th>
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<tr>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical / Field Work / Assignment/ Tutorials</td>
<td>I.A.</td>
<td>Exam</td>
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<tr>
<td>14EAE41</td>
<td>Vibration, Isolation &amp; Control</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>50</td>
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<tr>
<td>14EAE42X</td>
<td>Elective-3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>14EAE43</td>
<td>Evaluation of Project Phase-I</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
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<tr>
<td>14EAE44</td>
<td>Phase-II : Midterm evaluation of Project</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
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<tr>
<td>14EAE45</td>
<td>Evaluation of Project Work and Viva-voce</td>
<td>–</td>
<td>-</td>
<td>3</td>
<td>-</td>
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<tr>
<td>Total</td>
<td></td>
<td>8</td>
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<td>09</td>
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</tbody>
</table>

**Grand Total (I to IV Sem.) : 2400 Marks; 94 Credits**

### Elective -3:

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 EAE 421</td>
<td>Engine Design</td>
</tr>
<tr>
<td>14 EAE 422</td>
<td>Embedded System Design</td>
</tr>
<tr>
<td>14 EAE 423</td>
<td>Virtual Instrumentation</td>
</tr>
<tr>
<td>14 EAE 424</td>
<td>Microcontroller &amp; Signal Processing</td>
</tr>
<tr>
<td>14 ELD 425</td>
<td>Advanced Microcontrollers</td>
</tr>
</tbody>
</table>
Note:

1) Project Phase – I: 6 weeks duration shall be carried out between II and III Semesters. Candidates in consultation with the guides shall carry out literature survey / visit to Industries to finalize the topic of dissertation.

2) Project Phase – II: 16 weeks duration during III Semester. Evaluation shall be taken during the Second week of the IV Semester. Total Marks shall be 25.


Marks of Evaluation of Project:

- The I.A. Marks of Project Phase – I & II shall be sent to the University along with Project Work report at the end of the Semester.

4) During the final viva, students have to submit all the reports.

5) The Project Valuation and Viva-Voce will be conducted by a committee consisting of the following:

   a) Head of the Department (Chairman)
   b) Guide
   c) Two Examiners appointed by the university. (Out of two external examiners at least one should be present).


Reference Books:

   
   PDF files online available at [www.engnetbase.com](http://www.engnetbase.com).
Automotive Materials

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>IA Marks</th>
<th>No. of Lecture Hours /week</th>
<th>Exam Hours</th>
<th>Total no. of Lecture Hours</th>
<th>Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>14EAE12</td>
<td>50</td>
<td>04</td>
<td>03</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Crystal structure: BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number


Reference Books:

5. For more details, visit www.annauniv.edu


Battery Energy: Batteries in Electric & Hybrid Vehicles, Battery basis, Battery parameters, Electromechanical Cell Fundamentals, Battery Modeling, Traction Batteries, Battery Pack Management.


Electric Motor Drivers: Electric Drive Components, DC Drives, Operating Point, Analysis of SRM Drives.

Reference Book:
Digital Control Systems

Subject Code : 14AEA14 
IA Marks : 50 
No. of Lecture Hours /week : 04 
Exam Hours : 03 
Total no. of Lecture Hours : 50 
Exam Marks : 100

Digital Control Systems: Review of difference equations and Z — transforms, Z- transfer function (Pulse transfer function), Z-. Transforms analysis sampled data systems.

Stability analysis: Jury’s Stability Test and Bilinear Transformation, Pulse transfer functions and different configurations for closed loop Discrete-time control systems.

Modern Control Theory: I, State model for continuous time and discrete time systems, Solutions of state equations (for both continuous and discrete systems).

Concepts of controllability and observability: (For both continuous and discrete systems), Pole Placement by state feedback (for both continuous and discrete systems), Full order and reduced order observes (for both continuous and discrete systems)

Dead beat control by state feedback; Optimize control problems using state variable approach, State Regulator and output regulator.

Concepts of Model reference control systems: Adaptive Control systems and design.

Non Linear Control Systems: Common nonlinearities, Singular Points, Stability of nonlinear systems - Phase plane analysis and describing function analysis, Liapunoy’s stability criterion, Popov’s criterion.

Reference Books:
1. Ogata. K. “Modern Control Engineering”, PHI
Safety & Security of Mechatronics Systems

Subject Code : 14EAE151  IA Marks : 50
No. of Lecture Hours /week : 04  Exam Hours : 03
Total no. of Lecture Hours : 50  Exam Marks : 100

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
Transmission System – Clutches – operation and fault finding of clutches, Fluid Flywheel, Gear Box-types, Steering Systems, Chassis Springs, Suspension
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
Miscellaneous – Special gadgets and accessories for fire fighting vehicles. Automobile accidents. CMV Rules regarding Safety devices for drivers, passengers.

References Books:
1. William H. Crouse, "Automobile Chassis and Body Construction, Operation and Maintenance".
3. GBS Narang, "Automobile Engineering".
4. Kirpal Singh, "Automobile Engineering".
6. P. L. Kohli, "Automotive Electrical Equipments".
Design Mechanical Systems

Subject Code : 14EAE152        IA Marks : 50
No. of Lecture Hours /week : 04      Exam Hours : 03
Total no. of Lecture Hours : 50    Exam Marks : 100


Gears: Gear tooth geometry, tooth systems, gear trains, gear box design, design of helical, bevel and worm gears from strength and wear considerations.

Flywheel design; Bearings and lubrication: selection procedure of antifriction bearings, journal bearings, hydrodynamic theory. Design factors, the relation of the variables, heat balance, hydrostatic bearings. Concept of concurrent and simultaneous engineering. Example problems in design of mechanical systems.

References:

Automotive Networking

Review of fundamentals of wireless communication and networks. Wireless communication channel specifications, wireless communication systems, wireless networks, switching technology, communication problems, wireless network issues and standards.

Wireless body area networks (WBAN). Properties, network architecture, components, technologies, design issues, protocols and applications.


Wireless LANS. Network components, design requirements, architectures, IEEE 802.11x, WLAN protocols, 802.11 p and applications.

WMANs. IEEE 802.16, architectures, components, WiMax mobility support, protocols, broadband networks and applications. WWANs. Cellular networks, Satellite networks, applications.


Design of Network Protocols. Case studies with references to Automotive Vehicles.

Reference Books:

Automotive Electrical Systems & Electronics


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.


Automotive Electronics: Current trends in modern automobiles Open and close loop systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control

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 carburetor systems. Throttle body injection and multi port 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, Contact less electronic ignition system, and electronic spark timing control

References:

CAD Design

Subject Code : 14EAE155  IA Marks : 50
No. of Lecture Hours /week : 04  Exam Hours : 03
Total no. of Lecture Hours : 50  Exam Marks : 100

Design and drawing of Cam and Camshaft, Cam profile generation

Design of combustion chamber.

Design and drawing of engine complete assembly with cylinder block, cylinder head, crankcase, valve ports, water jackets, front and rear end details.


References Books:

Automotive Electronics Lab

Subject Code : 14EAE16
IA Marks : 25
No. of Lecture Hours /week : 03
Exam Hours : 03
Total no. of Lecture Hours : 42
Exam Marks : 50

1. Frequency domain response measurement (Bode plot, Nyquist plot, Nicols chart etc.)
2. Sensor/Actuator (interfacing, calibration, frequency domain characterization, MATLAB serial interface, serial LCD display)
3. System Identification of a DC Motor system (3 lab sessions)
4. DC Motor position tracking (internal model principle)
5. DC Motor position setpoint control via PID controller using relay automatic tuning technique.
6. Independent modeling, analysis, and design of a mechatronic control system (Select two “mechatronic plants” from the Quanser rotary family).
7. Independent modeling, analysis, and design of a mechatronic system (e.g. fan-and-plate etc) using the existing QIC target or other special Quanser plants.
Introduction – Concept of Energy, Fuels, Calorific values

Carnot Cycle - Concept of Source, Sink, Ideal efficiency, PV Diagram

Engine Cycles - Otto Cycle, Diesel Cycle, PV diagram, T-S diagram combined cycle, Gas cycle, Problems.

Fuel Testing and Evaluation – Flash, Fine part testing, Calorie value, Calorimeter.

Comfort Cycle – Refrigeration Cycle, Air refrigeration Cycle, Calculation of COP, Refrigerant, Properties of good refrigerant

Heat Source, and Heat & Ventilation, Sources of Heat, Cabin heat sources,

Air conditioning, Airflow, Ton of a/c needed.

Fuel Supply System and Ignition System – Carburettor, Injector, MPF,

Spark plugs, Electronic Ignition, Auto Ignition, Emission – Measurement of HC - Co - NOX, particulate matters, Smoke types.

Modeling and Simulation Studies of SI and CI engine.

References Books:


REFERENCES BOOKS:

Automotive Instrumentation

Subject Code : 14EAE23
IA Marks : 50
No. of Lecture Hours /week : 04
Exam Hours : 03
Total no. of Lecture Hours : 50
Exam Marks : 100

Basic concepts: Definition of terms, calibration, standards, generalized measurement systems static and dynamic performance characteristic
Analysis of experimental data; Instrumentation for measurement of position and displacement, force, velocity, temperature, proximity and range.
Concept of feedback; Open and close loop control systems, transducers and devices for engineering applications, digital readouts, data acquisition and processing.
Metrology: Standards, slip gauges, Measurement of angles, tapers, threads, coordinates, inspection of straightness, flatness, alignment and surface finish, gear measurements
Measurements of various product features using Mechanical, Pneumatic, Optical and Electronic Instruments, Interferometer and use of optical flats.

Reference Books:
4. Instrumentation, Measurement and Analysis by B.C.Nakra and K.K.Chaudhary, TMH.


Rotational Mechanical System: Diagram Block, Combining the blocks to solve Modeling, Running Simulink using MATLAB, Repetition Inputs.


Analysis of Liner Models: Linearization of element law, Linearization of the Model, Computer Simulation, Piecewise Linear System.


Transfer Function Analysis: I/O Model, Resistive Circuits, Obtaining the state-variable model, Op-Amps, Computer Simulation.

Developing as Linear Model: Basic consideration, Transformation of function, Transformation of Properties, 1st order system, The step function Impulse, Transform Inversion, Additional Transform properties.


Thermal System: Dynamic Models of thermal system. Analysis of thermal system.


Reference Books:

System Simulation Technology

Subject Code : 14EAE251 IA Marks : 50
No. of Lecture Hours /week : 04 Exam Hours : 03
Total no. of Lecture Hours : 50 Exam Marks : 100

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

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

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

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


References Books:
**Vehicle Dynamics**

<table>
<thead>
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<th>IA Marks</th>
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<th>Exam Hours</th>
<th>Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>03</td>
<td>100</td>
</tr>
</tbody>
</table>

| Total no. of Lecture Hours | 50         |

**Introduction:** Fundamentals of vibration, Mechanical vibrating systems. Modeling & simulation. Model of an automobile-Single, two, multi degrees of freedom systems-Free, forced and damped vibration. Magnification factor-Transmissibility, Vibration absorber

**Multi Degree Of Freedom Systems:** Closed coupled system, Eigen value problems, Far coupled systems-Orthogonality of mode shapes-Modal analysis, Forced vibration by matrix inversion.

**Suspension and Tyres:** 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. Ride characteristics of tyres, behavior while cornering, power consumed by tyre, effect of driving and braking torque-Gough’s tyre characteristics.


**Stability of Vehicles:** Load distribution. Calculation of tractive effort and reactions for different drives-Stability of a vehicle on a slope, on a curve and a banked road.

**Numerical Methods:** Approximate methods for fundamental frequency, Dunker-Ley’s lower bound, Rayleigh’s upper bound-Holzer method for close-coupled systems and branched systems.

**Reference Books:**

Overview of MEMS & Microsystems: MEMS & Microsystems, Typical MEMS and Microsystem products — features of MEMS, The multidisciplinary nature of Microsystems design and manufacture, Applications of Microsystems in automotive industry, health care industry, aerospace industry, industrial products, consumer products and telecommunications.

Scaling Laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling electrostatic forces, electromagnetic forces, electricity, scaling in fluid mechanics & heat transfer.

Transduction Principles in MEMS & Microsystems: Introduction, Micro sensors — thermal, radiation, mechanical, magnetic and biosensors, Micro actuation, MEMS with micro actuators.


Micro System Design and Modeling: Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: ANSYS / Multiphysics or Intellisuite or MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS (MOEMS), Design and Modeling: case studies - i) Cantilever beam ii) Micro switches iii) MEMS based SMART antenna in mobile applications for maximum reception of signal in changing communication conditions and iv) MEMS based micro mirror array for control and switching in optical communications.

Micro system packaging: Over view of mechanical packaging of micro electronics micro system packaging, Interfaces in micro system packaging, Packaging technologies.

REFERENCE BOOKS
CAD Application for Automotive Engineering

Subject Code : 14EAE254
No. of Lecture Hours /week : 04
Total no. of Lecture Hours : 50
IA Marks : 50
Exam Hours : 03
Exam Marks : 100

Design and drawing of Cam and Camshaft, Cam profile generation.
Design of combustion chamber.
Design and drawing of engine complete assembly with cylinder block, cylinder head, crankcase, valve ports, water jackets, front and rear end details.
Clutch: Components and assembly drawing using CAD Software.
Gear Box: Gear train calculations. Layout of gearbox. Calculation of bearing loads and selection of bearings. Complete assembly drawing using CAD Software.

Reference Books:
**Introduction:** What Is A PLC, Technical Definition Of PLC, What Are Its Advantages, Characteristic Functions Of A PLC, Chronological Evolution Of PLC, Types Of PLC, Unitary PLC Modular PLC, SMEEI PLC, Medium PLC, Large PLC, Block Diagram Of PLC, Input / Output ( I / O ) Section, Processor Section, Power Supply, Memory, Central Processing Unit, Processor Software / Executive Software, Multitasking, Languages, Ladder Language.

**Bit Logic Instructions:** Introduction, Input And Output Contact Program, Symbols, Numbering System Of Inputs And Outputs, Program Format, Introduction To Logic, Equivalent Ladder Diagram Of AND Gate, Equivalent Ladder Diagram Of OR Gate, Equivalent Ladder Diagram Of NOT Gate, Equivalent Ladder Diagram Of XOR Gate, Equivalent Ladder Diagram Of NAND Gate, Equivalent Ladder Diagram Of NOR Gate, Equivalent Ladder Diagram To Demonstrate De Morgan Theorem, Ladder Design

**Plc Timers And Counters:** Timer And Its Classification, Characteristics Of PLC Timer, Functions In Timer, Resetting – Retentive And Non-Retentive, Classification Of PLC Timer, On Delay, And Off Delay Timers, Timer-On Delay, Timer Off Delay, Retentive And Non-Retentive Timers, Format of a Timer Instruction. PLC Counter, Operation Of PLC Counter, Counter Parameters, Counter Instructions. Overview, Count Up (CTU), Count Down (CTD).


**Plc Input Output (I/O) Modules And Power Supply:** Introduction, Classification Of I/O, I/O System Overview, Practical I/O System And Its Mapping, Addressing Local And Expansion I/O, Input-Output Systems, Direct I/O Parallel I/O Systems, Serial I/O Systems, Sinking And


**Reference Books:**

1. Use the EDA (Electronic Design Automation) tools to learn the Embedded Hardware Design and for PCB design.
2. Familiarize the different entities for the circuit diagram design.
3. Familiarize with the layout design tool, building blocks, component placement, routings, design rule checking etc.

**Embedded Programming Concepts (RTOS):**

1. Create ‘n’ number of child threads. Each thread prints the message “I’m in thread number …” and sleeps for 50 ms and then quits. The main thread waits for complete execution of all the child threads and then quits. Compile and execute in Linux.
2. Implement the multithread application satisfying the following:
   a. Two child threads are created with normE priority.
   b. Thread 1 receives and prints its priority and sleeps for 50ms and then quits.
   c. Thread 2 prints the priority of the thread 1 and raises its priority to above normE and retrieves the new priority of thread 1, prints it and then quits.
     The main thread waits for the child thread to complete its job and quits.
3. Implement the usage of anonymous pipe with 512 bytes for data sharing between parent and child processes using handle inheritance mechanism.
4. Test the program below using multithread application:
   a. The main thread creates a child thread with default stack size and name ‘Child_Thread’.
   b. The main thread sends user defined messages and the message ‘WM_QUIT’ randomly to the child thread.
   c. The child thread processes the message posted by the main thread and quits when it receives the ‘WM_QUIT’ message.
   d. The main thread checks the termination of the child thread and quits when the child thread complete its execution.
   e. The main thread continues sending the random messages to the child thread till the ‘WM_QUIT’ message is sent to child thread.
   f. The messaging mechanism between the main thread and child thread is synchronous.
5. Test the program application for creating an anonymous pipe with 512 bytes of size and pass the ‘Read Handle’ of the pipe to a second process using memory mapped object. The first process writes a message ‘Hi from Pipe Server’. The 2\textsuperscript{nd} process reads the data written by the pipe server to the pipe and displays it on the console. Use event object for indicating the availability of data on the pipe and mutex objects for synchronizing the access in the pipe.

6. Create a POSIX based message queue for communicating between two tasks as per the requirements given below:-
   a. Use a named message queue with name ‘MyQueue’.
   b. Create two tasks(Task1 & Task2) with stack size 4000 & priorities 99 & 100 respectively.
   c. Task 1 creates the specified message queue as Read Write and reads the message present, if any, from the message queue and prints it on the console.
   d. Task2 open the message queue and posts the message ‘Hi from Task2’.
   e. Handle all possible error scenarios appropriately.
Vibration, Isolation and Control

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>: 14EAE41</th>
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<tbody>
<tr>
<td>IA Marks</td>
<td>: 50</td>
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<tr>
<td>No. of Lecture Hours /week</td>
<td>: 04</td>
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<tr>
<td>Exam Marks</td>
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**Measurement of Vibration**: Vibration Control materials, Characteristics, Configuration. Frequency and density relationship for vibration control, Vibration of dashboard, Cabin Isolation through damping materials


**Noise measurement**: Units of Noise, Noise – pressure, Power and Intensity, Point source, line source and plane source.

**Noise Isolation**: Materials for noise control, cabin noise measurement, Damping and screen for noise control/ isolation.

**Vibration / Noise Control**: Use of vibration absorbing materials, Use of noise absorbing material, configuration of materials.

**New and advanced methods of control**: Noise/ vibration simulation studies through Lab view / MatLab programs. Use of artificial intelligence in Vibration and noise control.

**Reference Books:**
Engine Design

Subject Code : 14EAE421  
IA Marks :  50
No. of Lecture Hours /week : 04  
Exam Hours :  03
Total no. of Lecture Hours : 50  
Exam Marks : 100


**Fuel Injection System:** Requirements, Air and solid injection, function of components, Jerk and distributor type Pumps. Pressure waves, Injection lag, Unit injector, Mechanical and Pneumatic governors. Fuel injector-types of injection nozzle, Spray characteristics, injection timing, pump calibration


**Supercharging and Turbo charging:** Necessity and limitation, Charge cooling, Types of supercharging and turbo charging, relative merits, matching of turbocharger.


**References Books:**
Embedded System Design

Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components Characteristics and Quality Attributes of Embedded Systems


Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages Real-Time Operating System (RTOS) based Embedded System Design

Operating System Basics: Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS.

The Embedded System Development Environment: The Integrated Development Environment (IDE), Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.


Reference Books:

3. Raj KaMEE, “Embedded systems Architecture, Programming and Design”, TMH.
Virtual Instrumentation

Subject Code : 14EAE423
IA Marks : 50
No. of Lecture Hours /week : 04
Exam Hours : 03
Total no. of Lecture Hours : 50
Exam Marks : 100

Review of Digital Instrumentation: Representation of analog signals in the digital domain – Review of quantization in amplifier and time areas, sample and hold, sampling theorem, ADC and DAC.


Graphical Programming Environment in VI: Concepts of graphical programming – Lab-view software – Concept of VIs and sub VIs – Display types – Digital – Analog – Chart – Oscilloscope types Loops – Case and sequence structures – Types of data – Arrays – Formulate nodes – Local and Global variables – String and file I/O.


Reference Books:
Motivation for MSP430 Microcontrollers:– Low Power embedded systems, On-chip peripherals (analog and digital), low-power RF capabilities. Target applications (Single-chip, low cost, low power, high performance system design)


Using the Low-power features of MSP430: Clock system, low-power modes, Clock request feature, Low-power programming and Interrupts


ARM -32 bit Microcontroller family: Architecture of ARM Cortex M3 – General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Register, Nested Vector Interrupt Controller.


Applications: Wireless Sensor Networking with MSP430 and Low-Power RF circuits; Pulse Width Modulation(PWM) in Power Supplies.

References Books:
4. "Sample Programs for MSP430" downloadable from msp430.com
Advanced Microcontrollers

Subject Code : 14 ELD425  IA Marks : 50
No. of Lecture Hours /week : 04  Exam Hours : 03
Total no. of Lecture Hours : 50  Exam Marks : 100

Note: Microcontrollers have become prevalent in a number of applications such as instrumentation, industrial electronics, automotive electronics, robotics, etc. Advances in VLSI technology permit the integration of not only the processor but also the analog electronics, memory and peripherals necessary for system implementation; this allows low-cost system implementation. Some microcontrollers used in industrial electronics also provide some digital signal processing capability to further reduce the system cost.

Power dissipation is often a consideration in many systems and modern microcontrollers address it through the support of several low-power modes of operation. The aim of the course is to introduce advanced microcontrollers (16-bit and 32-bit).

Motivation for advanced microcontrollers – Low Power embedded systems, On-chip peripherals, low-power RF capabilities. Examples of applications.

MSP430 – 16-bit Microcontroller family. CPU architecture, Instruction set, Interrupt mechanism, Clock system, Memory subsystem, bus –architecture. The assembly language and „C” programming for MSP-430 microcontrollers. On-chip peripherals. WDT, Comparator, Op-Amp, Timer, Basic Timer, Real Time Clock (RTC), ADC, DAC, Digital I/O. Using the low-power features of MSP430. Clock system, low-power modes, Clock request feature, Low-power programming and interrupts.


Applications – Wireless Sensor Networking with MSP430 and Low-Power RF circuits; Pulse Width Modulation(PWM) in Power Supplies.

Reference Books:
4. Sample Programs for MSP430 downloadable from msp430.com