A student can exercise option I and Option II according to the following:

Option-I

<table>
<thead>
<tr>
<th>Ref No.</th>
<th>Subject</th>
<th>Schedule Of Teaching</th>
<th>Scheme of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L  T  P  Total</td>
<td>Int  Ext  Hrs  Total</td>
</tr>
<tr>
<td>EE-801</td>
<td>Non – Conventional Energy Sources</td>
<td>3  1  -  4</td>
<td>50   50   3  100</td>
</tr>
<tr>
<td>EE-807</td>
<td>Embedded System Design</td>
<td>3  1  -  4</td>
<td>50   50   3  100</td>
</tr>
<tr>
<td>EE-857</td>
<td>Embedded System Design (Lab)</td>
<td>-  -  2  2</td>
<td>-    -   -  -</td>
</tr>
<tr>
<td>EE-808</td>
<td>Elective –II</td>
<td>3  1  -  4</td>
<td>50   50   3  100</td>
</tr>
<tr>
<td>EE-805</td>
<td>Major Project</td>
<td>-  -  6  6</td>
<td>-    -   -  -</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>9  3  8  20</strong></td>
<td><strong>150 150 09 300</strong></td>
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</tbody>
</table>

Elective-II
(i)  Electrical Machine Design
(ii) High Voltage AC-DC
(iii) Advance Control Systems

Option II

Industrial Training  EE-850  Total Marks-450

A student may opt for one semester training in lieu of subjects of 8th Semester. The marks for six months training will be equal to the total marks of 8th Semester study. A student can opt for six semester training under following conditions:-

a) The student got selected for job in campus placement and the employer is willing to take that student for the training.

b) The student got offer of pursuing training from reputed government research organization/govt. sponsored projects/govt. research institution provided that student should not be paying any money to get trained. For pursuing this training student needs the prior approval from the Chairperson/Coordinator of the respective branch.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Non-Conventional Energy Sources</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-801</td>
<td>04</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>310</td>
<td></td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Power Plant Engineering and Energy Management and Auditing</td>
<td>N</td>
</tr>
</tbody>
</table>
| Course Objectives | 1. To understand the limitation of conventional energy sources, need and growth of alternative energy source.  
2. To understand the thermoelectric generators, MHD generator, their applications and economic aspects.  
3. To understand photovoltaic cells, fuel cells, their characteristics, solar batteries, solar collectors, solar furnaces and their applications.  
4. To understand geothermal, hydro, wind and tidal energy resources |         |
| Course Outcome(s) | 1. Students will understand about limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.  
2. Students will demonstrate an understanding of Basic principle of MHD generator, thermoelectric generators, their types, applications and economic aspects.  
3. Students will be able to demonstrate photovoltaic effect, different types of photovoltaic cells, characteristics of photovoltaic cells, solar batteries, solar collectors, solar furnaces and their applications.  
4. Students will understand about fuel cells, their types, characteristics and application.  
5. Students will be able to demonstrate geothermal system, their characteristics, hydro-plants, wind energy and tidal energy. |         |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Introduction**  
Limitation of conventional energy sources, need and growth of alternative energy source, basic scheme and application of direct energy conservation.  
   (4 hours)

2. **MHD Generators**  
Basic principles, gaseous, conduction and hall effect, generator and motor effect, different types of MHD generator, types of MHD material, conversion effectiveness, analysis of constant area MHD generator, practical MHD generator, application and economic aspects.  
   (8 hours)

3. **Thermo-Electric Generators**  
Thermoelectric effects, Seeback effect, Peltier effect, Thomson effect, thermoelectric converters, figures of merit, properties of thermoelectric material, brief description of the
construction of thermoelectric generators, application and economic aspect.

4. **Photo Voltaic Effect And Solar Energy**
   Photovoltaic effect, different types of photovoltaic cells, cell fabrication, characteristics of photovoltaic cells, conversion efficiency, solar batteries, application, solar radiation analysis, solar energy in India, solar collectors, solar furnaces and applications.

5. **Fuel Cells**
   Principle of action, Gibb’s free energy, general description of fuel cells, types, construction, operational characteristics and application.

6. **Miscellaneous Sources**
   Geothermal system, characteristic of geothermal resources, choice of generator set, electric equipment precautions low hydro-plants, definition of low head hydrometer, choice of site, choice of turbine wind power, history of wind power, wind machines, theory of wind power, characteristic of suitable wind power site, tidal energy, idea of tidal energy, tidal electric generator.

**RECOMMENDED BOOKS**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Embedded Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-807</td>
</tr>
<tr>
<td>Credits</td>
<td>04</td>
</tr>
<tr>
<td>L T P</td>
<td>3 1 0</td>
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<tr>
<td>Contact Hours</td>
<td>45</td>
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<tr>
<td>Max Marks</td>
<td>50</td>
</tr>
<tr>
<td>Internal Assessment</td>
<td>50</td>
</tr>
<tr>
<td>Elective</td>
<td>N</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Introduction to Micro controllers</td>
</tr>
</tbody>
</table>

**Course Objectives**

1. To impart knowledge on embedded hardware and software.
2. To learn about architecture, programming, application and interfacing of Cortex-M0 ARM processor.
3. To study various types of software architectures and tools used in embedded system.
4. To learn about RTOS, operating system and MCU peripheral services.

**Course Outcome(s)**

1. Understand the fundamentals of embedded hardware and software
2. Understand the fundamentals and programming of Cortex-M0 ARM processor which is a latest ARM® embedded processor with 32-bit performance.
3. Gain the knowledge of designing RTOS such as RTOS using Keil RTX, Free RTOS, MC/OS-II.
4. Gain the experience of working in a group towards a final project that will involve the use of Cortex-M0 (NU-LB-NUC140) learning board.

**Note for Examiner**

Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART A**

1. **Introduction to Embedded Hardware and Software**
   
   (8 hours)

2. **Cortex-M0 MCU Architecture and Programming**
   - Cortex-M0 MCU (NUC140): Architecture, Instruction Set, Thumb Instruction Set, Interrupt handling mechanism, Instruction cycle timings, Development tools and ‘C’ compiler programming.
   
   (8 hours)

3. **Cortex-M0 MCU (NU-LB-NUC140) Application and Interfacing**
   - GPIO, A/D converter, LCD Interfacing, SD card interface, keypad matrix USB and CAN 2.0
   
   (7 hours)

**PART B**

4. **Software Development and Tools**

(8 hours)

5. **Introduction to Real Time Operating Systems**
   Task And Task States, Tasks and Data, Semaphores and shared data, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS, RTOS using Keil RTX, Free RTOS, MC/OS-II
   
   (8 hours)

6. **Operating System and MCU Peripheral Services**
   Message queues, Mailboxes and Pipes, Timer Function, Events, Memory Management and peripheral services
   
   (6 hours)

**TEXT BOOKS**

**OTHER BOOKS:**
3. Ramani Kalpathi : ARM Based system design ,Sigma Publication, Chennai, 2013
List of Experiments

1. Introduction to Cortex-M0 (NU-LB-NUC140) learning board.
2. To learn about embedded C programming using Keil µvision4.
3. LED interface using NU-LB-NUC140 learning board.
4. LCD interface using NU-LB-NUC140 learning board.
7. SD card interface using NU-LB-NUC140 learning board.
10. CAN 2.0 using NU-LB-NUC140 learning board.
Course Title: Electrical Machine Design  
Credits: 04

Course Code: EE-808 (a)  
L T P: 3 1 0

Contact Hours: 45  
Max Marks: 50  
Internal Assessment: 50  
Elective: Y

Pre-requisites: Basic of transformer, Alternator and Induction motors.

Course Objectives:
1. To understand the role of machine design for engineers.
2. To understand the steps of a transformer design.
3. To understand the steps of an induction motor.
4. To understand the steps of an alternator design.

Course Outcome(s):
1. Student will be able to design a transformer, induction motor and alternator while selecting its material and its various components for a given size.
2. Students can design transformer, alternator and induction motor for projects/real time applications.

Note for Examiner: Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

PART-A

1. Principles of design of Machines
   Specific magnetic and electric loadings output, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines.  
   (8hours)

2. Heating cooling and ventilation
   Cooling of machines, types of ventilation, continuous and intermittent rating.  
   (4hours)

3. Design of Transformers
   General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, calculation of losses, efficiency and regulation, forces winding during short circuit.  
   (10hours)

PART-B

4. Three Phase Induction Motors: General considerations, output equation, choice of specific electric and magnetic loadings, efficiency, power factor, number of slots in stator and rotor, elimination of harmonic torques, Design of stator and rotor winding, slot leakage flux, leakage reactance, equivalent resistance of squirrel cage rotor, magnetizing current, efficiency from design data.  
   (12 hours )
5. **Alternators**  
Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions.  


**Books Suggested:**  
<table>
<thead>
<tr>
<th>Course Title</th>
<th>High Voltage AC-DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-808(b)</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>45</td>
</tr>
<tr>
<td>Elective</td>
<td>Y</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Basics of Power Systems, Power Electronics and Basic Electronics</td>
</tr>
<tr>
<td>Course Objectives</td>
<td>1. To introduce the need and concepts of HVDC.</td>
</tr>
<tr>
<td></td>
<td>2. To understand the selection of various components in HVDC system.</td>
</tr>
<tr>
<td></td>
<td>3. To understand the concept of generation of impulse voltage.</td>
</tr>
<tr>
<td></td>
<td>4. To understand the HVDC measurement and testing.</td>
</tr>
<tr>
<td>Course Outcome (s)</td>
<td>1. Students can understand importance of HVDC and its components.</td>
</tr>
<tr>
<td></td>
<td>2. Students can design circuits for impulse generation.</td>
</tr>
<tr>
<td></td>
<td>3. Students can understand the testing of generated voltage.</td>
</tr>
</tbody>
</table>

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Introduction**
   Introduction of DC Power transmission technology – Comparison of AC and DC transmission-Application of DC transmission – Description of DC transmission system–Planning for HVDC transmission – Modern trends in DC transmission. (7 hours)

2. **Analysis of HVDC Converters**
   Pulse number – Choice of converter configuration – Review of Graetz circuit – valve rating, Transformer rating, Simplified analysis of Graetz circuit, without overlap only, Principles of DC link control, converter bridge characteristics – Characteristics of a twelve pulse converter – Detailed analysis of converters. (10 hours)

3. **Harmonics And Filters**
   Sources of harmonics in HVDC systems – Smoothing reactors – Corona and radio interference effects – harmonic distortion factor, types of AC filters, DC filters. (6 hours)

**PART-B**

4. **Generation of Impulse Voltage And Current**
   Introduction to standard lightning and switching impulse voltages, analysis of single stage impulse generator, expression for output impulse voltage, multistage impulse generator, components of multistage impulse generator, generation of switching impulse voltage, generation of high impulse current. (8 hours)

5. **Measurement Of High Voltages**

89
Chubb for HVAC measurement. Standard sphere gap measurements of HVAC, HVDC and impulse voltages, Factors affecting the measurements, Surge current measurement Klydanograph and magnetic links.

(6 hours)

6. Non-Destructive Insulation Testing Techniques
   Dielectric loss and loss angle measurements using Schering Bridge, transformer ratio Arms Bridge, need for discharge detection, factor affecting the discharge detection, discharge detection methods-straight and balanced methods.

(8 hours)

TEXT BOOKS RECOMMENDED:


OTHER BOOKS:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Advanced Control Systems</th>
<th>Credits</th>
<th>04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>EE-808(c)</td>
<td>L T P</td>
<td>3 1 0</td>
</tr>
<tr>
<td>Contact Hours</td>
<td>45</td>
<td>Max Marks-50</td>
<td>Internal Assesment-50</td>
</tr>
<tr>
<td>Pre-requisites</td>
<td>Knowledge of Control Engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Course Objectives            | 1. To understand the introductory concepts of digital control systems and their illustrative examples.  
                              | 2. To understand the state space techniques of control systems.  
                              | 3. To study the concepts of robust control systems. | |
| Course Outcome (s)           | 1. Learn about the basic concepts of digital and robust control systems.  
                              | 2. Learn about the various state space techniques. |

**Note for Examiner**- Examiner will set 7 questions of equal marks. First question will cover whole syllabus, having 10 conceptual questions of 1 mark each and is compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

**PART-A**

1. **Review of Control Engineering**  
   Time response and Frequency response methods, Root locus method; Compensation Techniques and Controllers: Design of feedback control system; Types of compensation: Series or cascade, feedback, state feedback, series feedback; Lead compensator; Lag compensator; Lag-lead compensator, Controllers: PI, PD, PID.  
   (12 hours)

2. **State Space Techniques**  
   Review of state space representation of systems by various methods. Solution of state equations-state transition matrix. Transfer function from state variable model; Controllability & observability of state variable model; optimal control systems; pole placement using state variable; limitations of state variable feedback.  
   (10 hours)

**PART-B**

3. **Digital Control Systems**  
   Introduction to sampled data control systems: Sampler and hold circuit; z-transform; Pulse transfer function; Stability analysis of discrete systems.  
   (10 hours)

4. **Robust Control Systems**  
   Robust control systems and system sensitivity analysis of robustness; Systems with uncertain parameters; Design of Robust control systems; Three term PID controller.  
   (13 hours)

**RECOMMENDED BOOKS**

1. Automatic Control Systems by B.C.Kuo, Prentice Hall of India  
2. Modern Control Engineering by Ogatta, Prentice Hall of India.  
4. Modern Control Systems by Dorf and Bishop, Addison Wesley.