Specialization/Minor in Robotics Engineering

Eligible Branches to adopt as Specialization

1. B.Tech.- Mechanical Engineering
2. B.Tech.- Electronics and Communication Engineering
3. B.Tech.- Electronics Engineering

EFFECTIVE FOR 2021-22 BATCH
2\textsuperscript{ND} YEAR TO 4\textsuperscript{TH} YEAR
# Evaluation Schemes for Specializations/Minor in B.Tech

## Specialization in Robotics Engineering

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Code</th>
<th>Sem</th>
<th>Subject</th>
<th>Periods</th>
<th>Evaluation Scheme</th>
<th>Total Marks</th>
<th>Credits</th>
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<td>L T P</td>
<td>Internal</td>
<td>External</td>
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<tr>
<td>1.</td>
<td>SRE301</td>
<td>3rd</td>
<td>Robotics &amp; Control</td>
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<td>2.</td>
<td>SRE401</td>
<td>4th</td>
<td>Robotic Engineering</td>
<td>3 0 0</td>
<td>50</td>
<td>100</td>
<td>150</td>
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<td>3.</td>
<td>SRE501</td>
<td>5th</td>
<td>Introduction to Artificial Intelligence</td>
<td>3 0 0</td>
<td>50</td>
<td>100</td>
<td>150</td>
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<tr>
<td>4.</td>
<td>SRE601</td>
<td>6th</td>
<td>Machine Learning</td>
<td>3 0 0</td>
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<td>100</td>
<td>150</td>
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<tr>
<td>5.</td>
<td>SRE701</td>
<td>7th</td>
<td>Computer Programming in Python</td>
<td>3 0 0</td>
<td>50</td>
<td>100</td>
<td>150</td>
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<td>6.</td>
<td>SRE801</td>
<td>8th</td>
<td>Embedded System Design</td>
<td>3 0 0</td>
<td>50</td>
<td>100</td>
<td>150</td>
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<td>18 0 0</td>
<td>300</td>
<td>600</td>
<td>900</td>
</tr>
</tbody>
</table>
Contents

**Unit 1**
UNIT I Introduction: Definition, automation principles and strategies, scope of automation, socio-economic consideration, low cost automation, basic elements of advanced functions, Information processing in manufacturing industry, Production concepts and automation strategies.


**Hours**

**Unit 2**


**Hours**

**Unit 3**


**Hours**

**Unit 4**

**Hours**

**Unit 5**
Multi Loop & Nonlinear Systems: Cascade control, Feed forward control, feedback-feed forward control, Ratio control, Selective Control , Split range control- Basic principles, Design Criteria , Performance, Controller Algorithm and Tuning, Implementation issues, Examples and any special features of the individual loop and industrial applications. Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance, Improvement in nonlinear process performance through: Deterministic Control Loop Calculations, Calculations of the measured variable, final control element selection, cascade control design, Real time implementation issues.

**Hours**

**Text Books:**

### SRE401 ROBOTIC ENGINEERING

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1</strong></td>
<td>Introduction History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology-Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td>Drive systems and Sensors Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.</td>
<td>10</td>
</tr>
<tr>
<td><strong>Unit 3</strong></td>
<td>Kinematics and Dynamics of Robots 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representationof robots, Basics of Trajectory Planning.</td>
<td>8</td>
</tr>
<tr>
<td><strong>Unit 4</strong></td>
<td>Robot Control, Programming and Applications Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples.</td>
<td>10</td>
</tr>
<tr>
<td><strong>Unit 5</strong></td>
<td>Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.</td>
<td>9</td>
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</tbody>
</table>

### Text Books:

SRE501  INTRODUCTION TO ARTIFICIAL INTELLIGENCE  

<table>
<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Overview: foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents. Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, mini-max, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.</td>
<td>8</td>
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<tr>
<td>Unit 2</td>
<td>Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications. Planning: planning as search, partial order planning, construction and use of planning graphs</td>
<td>12</td>
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<tr>
<td>Unit 3</td>
<td>Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.</td>
<td>8</td>
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<tr>
<td>Unit 4</td>
<td>Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. Learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.</td>
<td>8</td>
</tr>
<tr>
<td>Unit 5</td>
<td>Languages for AI problem solving: Introduction to PROLOG syntax and data structures, representing objects and relationships, built-in predicates. Introduction to LISP- Basic and intermediate LISP programming. Expert Systems: Architecture of an expert system, existing expert systems like MYCIN, RI, Expert system shells.</td>
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Text Books:
<table>
<thead>
<tr>
<th>SRE601</th>
<th>MACHINE LEARNING</th>
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<td>0</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Contents</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit 1</strong></td>
<td><strong>Introduction:</strong> well posed learning problem, designing a learning system: training experience, target function, final design. Issues in machine learning Concept, Learning and General to specific ordering: concept learning task, concept learning as search, version spaces and candidate elimination, inductive bias.</td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td><strong>Decision Tree learning (DTL):</strong> introduction, decision tree representation, problems for DTL, DTL algorithm, hypothesis space search, inductive bias in DTL, issues in DTL. Bayesian Learning: introduction, Bayes Theorem, concept learning, least square hypothesis, predicting probabilities, Bayes optimal classifiers, EM algorithm.</td>
</tr>
<tr>
<td><strong>Unit 3</strong></td>
<td><strong>Instance Based Learning:</strong> introduction, K-nearest neighbor learning, locally weighted regression, case based reasoning. Learning set of rule: introduction, sequential covering algorithm, learning rule sets, first order rules.</td>
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<tr>
<td><strong>Unit 4</strong></td>
<td><strong>Analytical learning:</strong> introduction, perfect domain theory, explanation based learning. Inductive analytical approaches to learning.</td>
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</tbody>
</table>

**Text Books:**
2. Ethem Alpaydin, "Introduction to machine learning", PHI learning, 2008.
SRE701  COMPUTER PROGRAMMING IN PYTHON  L  T  P  C

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<thead>
<tr>
<th>Unit</th>
<th>Contents</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Python Programming Language. : Introduction to Python Language, Strengths and Weaknesses, IDLE, Dynamic Types, Naming Conventions, String Values, String Operations, String Slices, String Operators, Numeric Data Types, Conversions, Built In Functions</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Data Collections and Language Component : Introduction, Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical, Operators, True or False, Bit Wise Operators, The while Loop, break and continue, The for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Object and Classes : Classes in Python, Principles of Object Orientation, Creating Classes, Instance Methods, File Organization, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Functions and Modules : Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope, Functions - &quot;First Class Citizens&quot;, Passing Functions to a Function, Mapping Functions in a Dictionary, Lambda, Modules</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>I/O and Error Handling In Python : Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data From a File, Additional File Methods, Using Pipes as Data Streams, Handling IO Exceptions, Working with Directories, Metadata, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions</td>
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</table>

Text Books:

1. Dive into Python, Mike
2. Learning Python, 4th Edition by Mark Lutz
## EMBEDDED SYSTEM DESIGN

<table>
<thead>
<tr>
<th>SRE801</th>
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<tbody>
<tr>
<td><strong>Contents</strong></td>
<td><strong>Hours</strong></td>
</tr>
<tr>
<td><strong>Unit 1</strong></td>
<td>Introduction to Embedded System Design, Categories of ES, Overview of Embedded System Architecture, Recent Trends in Embedded Systems, Hardware Architecture of Embedded System, Real-time Embedded Systems and Robots, Robots and Robotics, Microprocessors and Microcontrollers, Microcontroller or Embedded Controller</td>
</tr>
<tr>
<td><strong>Unit 2</strong></td>
<td>Robotics: Classification of Robots, Degree of freedom, Kinematics; Multidisciplinary approach: Motors-DC motors, Stepper Motors, Servo Motors; Power Transmission-Type of Gears, Gear Assembly, CAM follower, Sensors, Open-loop and Closed-loop Controls, Architecture of 8051 Microcontroller-Assembly language programming (data types, directives, flag bits, PSW, register banks and Stacks)</td>
</tr>
<tr>
<td><strong>Unit 3</strong></td>
<td>Jump, Loop and Call instruction, Time delay for various 9051 chip, I/O programming and I/O bit manipulation, Interface of LED module, Key Scanning Case studies to design sensor(LDR), Motor Driver(H-bridge)module</td>
</tr>
<tr>
<td><strong>Unit 4</strong></td>
<td>Case studies of Closed-loop control and a learning robot-Hardware requirement, Locomotion and obstruction sensing, Learning process, Picking another set of points Addressing Modes of 8051, Power Management of 8051, Timer Interrupts, Multiplexed displays Case studies to Design an Intelligent Clock</td>
</tr>
</tbody>
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### Text Books: