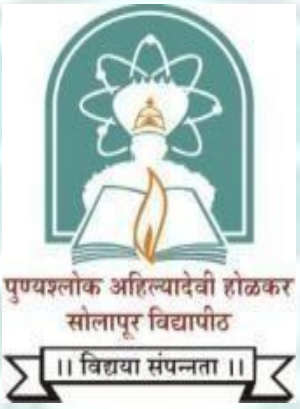
Punyashlok Ahilyadevi Holkar Solapur University, Solapur



NAAC Accredited-2015
'B' Grade (CGPA 2.62)

Name of the Faculty: Science and Technology

CHOICE BASED CREDIT SYSTEM

Structure: Final Year B.Tech. Mechanical Engineering

Name of the Course: Honors Degree

(Syllabus to be implemented from w.e.f. 2023-24)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Mechanical Engineering
Final Year B. Tech. Semester-VII
Choice Based Credit System (CBCS) Structure for B. Tech.
Honors in Robotics Engineering
w.e.f. Academic Year 2021-2022

Theory Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
Hn714	Advanced topics in Robotics	***3***				3	***30***	***70***		***100***
	Sub Total	***3***				3	***30***	***70***		***100***

Laboratory/Tutorial Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
								POE	***OE***	
Hn714	Advanced topics in Robotics		***1***			1				***25***	***25***
	Sub Total		***1***			1				***25***	***25***
	Grand Total	***3***	***1***			4				***25***	***125***

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Mechanical Engineering
Final Year B. Tech. Semester-VII
Choice Based Credit System (CBCS) Structure for B. Tech.
Honors in 3-D Printing Engineering
w.e.f. Academic Year 2021-2022

Theory Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
Hn724	Advanced topics on 3D Printing	***3***				3	***30***	***70***		***100***
	Sub Total	***3***				3	***30***	***70***		***100***

Laboratory/Tutorial Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
								POE	***OE***	
Hn724	Advanced topics on 3D Printing		***1***			1				***25***	***25***
	Sub Total		***1***			1				***25***	***25***
	Grand Total	***3***	***1***			4				***25***	***125***

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Mechanical Engineering
Final Year B. Tech. Semester-VII
Choice Based Credit System (CBCS) Structure for B. Tech.
Honors in Energy Engineering
w.e.f. Academic Year 2021-2022

Theory Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
Hn734	Energy Resources, Economics and Environment	***3***				3	***30***	***70***		***100***
	Sub Total	***3***				3	***30***	***70***		***100***

Laboratory/Tutorial Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
								POE	***OE***	
Hn734	Energy Resources, Economics and Environment		***1***			1			***25***	***25***
	Sub Total		***1***			1			***25***	***25***
	Grand Total	***3***	***1***			4			***25***	***125***

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
Mechanical Engineering
Final Year B. Tech. Semester-VII
Choice Based Credit System (CBCS) Structure for B. Tech.
Honors in Electric Vehicles Engineering
w.e.f. Academic Year 2021-2022

Theory Courses										
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
Hn744	Advanced Topics in Electric Vehicles	***3***				3	***30***	***70***		***100***
	Sub Total	***3***				3	***30***	***70***		***100***

Laboratory/Tutorial Courses											
Course Code	***Name of Laboratory/Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***				
		L	***T***	***P***	**D**		***ISE***	***ESE***		***ICA***	***Total***
								POE	***OE***		
Hn744	Advanced Topics in Electric Vehicles		***1***			1				***25***	***25***
	Sub Total		***1***			1				***25***	***25***
	Grand Total	***3***	***1***			4				***25***	***125***

Note:

1. Curriculum of Honors specialization can be common between different branches of Engineering.
2. Total Credits to be earned for each Honors specialization will be 18 which will be over and above to the overall credits earned in their regular Curriculum.
3. Students can opt for only one Honors specialization along with their regular curriculum
4. Students are advised to take their mini-project (at Semester –VI) in the area of their Honors specialization.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Honors) (Mechanical Engineering)
Semester-VII
ME (HN714) : Advanced topics in robotics

Teaching Scheme
Lectures : 03 Hours/week, 03 Credits
Tutorial: 01 Hours/week, 01 Credit

Examination Scheme
ESE : 70 Marks
ISE : 30 Marks
ICA : 25 Marks

Course Introduction:

This course is designed to give the student an in depth understanding of advance topics in robotics using any suitable Software. This course requires the students to take part in site visits and case study presentations. This course covers the fundamentals of advance topics in robotics, Cameras (CCD, CMOS, Area Scan, and Line Scan), camera specification and selection etc. This course requires the students to take part in site visits and case study presentations. Students are also required to complete a Robot and image processing simulation in suitable simulation software.

Course Objectives:

During this course, student is expected to:

1. Understand the need of advance topics in robotics.
2. Acquaint with existing market distribution and future trends.
3. Understand the technology behind a modern robot such as sensors, actuators, grippers, Controllers, machine vision etc.
4. Understand advanced applications of industrial robots in welding, spray painting, Material transfer operations.
5. Understand the scope and applications of modern machine vision systems.
6. Understand and bridge the gap (regarding industrial robots) between text books & industry

Course Outcomes:

At the end of this course, student will be able to:

1. Select appropriate robot configuration and specifications for a given application.
2. Explain robot workcell layout and their features.
3. Evaluate and compare robots based on their specifications
4. Identify control issues and suggest control techniques based on applications.
5. Explain construction and applications of different types of robots.
6. Evaluate and select sensors& drives used in the construction of an industrial robot and its work cell.

Section I

Unit 1 – Advanced topics in robotics **No. of lectures - 07**

The robotics market and future prospects, Robot Intelligence, Characteristics of future robot tasks, service industry and similar application, current market scenario, concept of UGV.

Unit 2 – Robot Workcells &Programming **No. of lectures - 08**

Multiple Robots and machine interference, Robot cell layout, considerations in work cell design, workcell control, cell safety, human machine interface, robot cell controller. Lead through programming, walk through programming, offline programming.

Unit 3- Modeling and analysis of wheeled mobile robots **No. of lectures - 06**

Introduction and some well-known wheeled mobile robots (WMR), two and three wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics .

Section II

Unit 4 – Industrial Robot Applications. **No. of lectures - 08**

General considerations for selecting robots (including layout and workcell) for material handling and machine tending, spot welding, continuous welding, sealant application, spray painting, assembly, inspection, electronics assembly.

Unit 5 – Approach for Implementing Robots **No. of lectures - 07**

Initial familiarization with robotics technology, selection of best application, detailed economics analysis and capital authorization, planning and Engineering the installation.

Unit 6 – Safety Training, maintenance & quality **No. of lectures -06**

Safety in robotics, Education and Training, maintenance, Plant survey to identify potential application. Robotics and labor.

Internal Continuous Assessment (ICA):
List of Experiments/Assignments/Case Studies (Any eight)

1. Survey assignment on robots, UGVs, control by using machine vision.
2. Theory assignment on wheeled mobile robots.
3. One assignment on workcell simulation in any robot simulation software. (Robot Studio, RobCAD, Workspace, Delmia IGRIP, V-rep, Gazebo)
4. One assignment on Image Analysis using suitable Lab view software.
5. Survey assignment on robots industry and manufacturers and applications.
6. One assignment on Safety Training, maintenance & quality
7. One assignment on Characteristics of future robot tasks
8. One assignment on Plant survey
9. One theory assignment on detailed economics analysis and capital authorization.

Text Books:

1. S.K Saha, Introduction to Robotics, McGraw-Hill.
2. Mikell Groover et.al, Industrial Robotics, McGraw Hill.
3. Stuart Russel & Peter Norvig, Artificial Intelligence a Modern Approach.
4. E. Rich and K. Knight, "Artificial intelligence",TMH.
5. N.J. Nilsson, "Principles of AI", Narosa Publ. House, 2000.

Reference Books

1. Asitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford Press.
2. Siegwart et.al, Autonomous Mobile Robots, Prentice Hall India.
3. Robin R Murphy, Introduction to AI Robotics, PHI Publication, 2000.
4. Bishop et.al, Handbook of Mechatronics, CRC Press.
5. Schilling, Fundamentals of Robotics, Prentice Hall India.
6. Robert Babuška, Fuzzy Modeling for Control, Springer.
7. Dan Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall.
8. International Federation of Robotics - https://www/ifr.org

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
Hn724: Advanced topics on 3D Printing

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Tutorial : 01 Hour/week, 01 Credit

***Examination Scheme**
ESE : 70 Marks
ISE : 30 Marks
ICA : 25 Marks

Course Introduction:
This course is designed to provide students with advanced knowledge and skills in the field of 3D printing. The course will cover various advanced topics related to 3D printing, including advanced modeling techniques, material properties, advanced printer calibration, post-processing techniques, and applications of 3D printing in different industries. Students will also gain hands-on experience through practical sessions and projects using different 3D printing technologies and materials.

Course Objectives:
During this course, student is expected to:

1. Gain an in-depth understanding of advanced 3D printing technologies, their advantages, limitations, and applications in various industries.
2. Master advanced modeling techniques for 3D printing, including CAD optimization, generative design, and multi-material/component design.
3. Develop knowledge of different materials used in 3D printing, their properties, and how they impact print quality and performance.
4. Learn advanced printer calibration techniques to achieve high-quality prints and troubleshoot common printing issues.

Course Outcomes:
At the end of this course, student will be able to:

1. Design and optimize 3D printable models using advanced CAD techniques, generative design, and topology optimization.
2. Select and characterize materials for specific 3D printing applications based on their properties and requirements.
3. Calibrate 3D printers to achieve accurate and reliable prints, and troubleshoot common printing issues.
4. Apply post-processing techniques to improve the surface finish, mechanical properties, and aesthetics of 3D printed part

Section I

Unit-1: Introduction to Advanced 3D Printing **No. of lectures- 08**

Fundamental automated process, process chain, 3D CAD modeling to 3D printer, Overview of 3D printing technologies, Introduction to Post processing for 3D printing.

Unit-2: Advanced 3D printing Technologies **No. of lectures-06**

3D systems SLA, Solid Ground Curing (SGC) System , Solid Creation System, EOS' Stereos system, MEIKO's 3D system for jewelry, Stratasys's 3D printer in FDM system

Unit-3: Advanced Modeling Techniques for 3D Printing **No. of lectures- 06**

Feature based 3D CAD modeling, CAD optimization techniques for 3D printing, including mesh repair, file format conversions, and part orientation

Section II

Unit-4: Rapid Tooling **No. of lectures- 08**

Introduction to Rapid Tooling, classification, Direct tooling, and it's types, Indirect tooling, and it's types

Unit-5: Advanced softwares for 3D printing **No. of lectures- 06**

STL file, common errors in CAD to STL conversion, STL file resolution, Creation of stereolithography files, problems in STL file.

Unit-6: Post Processing in 3D printing **No. of lectures-06**

Introduction, need for post processing, support structure removal, surface finish and geometry improvement, aesthetic improvement techniques, property enhancement techniques.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies (Any six)

1. Assignment on Introduction to Advanced 3D Printing
2. Assignment on Advanced 3D printing Technologies
3. Assignment on Advanced Modeling Techniques for 3D Printing
4. Assignment on Rapid Tooling
5. Assignment on Advanced softwares for 3D printing
6. Assignment on Post Processing in 3D printing
7. Manufacturing of Assembly of any mechanical component using 3D printers

Text Books:

1. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
3. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.

Reference Books:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. 3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
3. DouglesBryden, "CAD and Protyping for Product Design", 2014.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
Hn734:Energy Resources, Economics and Environment

***TeachingScheme**
Lectures:03Hours/week, 03Credits
Tutorial:01Hours/week, 01Credit

***Examination Scheme**
ESE:70Marks
ISE:30Marks
ICA:25Marks

Course Introduction:

The course equips students with the tools necessary for economic analysis and quantification of the impacts of energy systems. A review of the available energy resources and study methods for quantification of resource depletion and scarcity is taken. The course will cover basic concepts in economics and their application to energy systems. Tools and techniques for project economics from an individual/ company perspective and macro-decision-making for society are introduced. We will discuss basic concepts of welfare economics and environmental economics are necessary for energy systems analysis and their environmental impacts.

Course Objectives:
During this course, student is expected to:

1. Understand the importance of energy resources in economic development
2. Understand the principles of energy economics and their role in sustainable development
3. Analyze the environmental impacts of energy production and consumption
4. Identify the economic and policy responses to environmental impacts
5. Study the methods involved in energy resource development and use
6. Develop critical thinking and analytical skills in assessing energy and environmental policy issues.

Course Outcomes:
At the end of this course, the student will be able to:

1. Identify and describe the different types of energy resources and their role in economic development.
2. Analyze the environmental impacts of energy production and consumption on climate change, air pollution, water use, and land use.
3. Explain the role of renewable energy in the transition to a sustainable energy system, including the economics and policy of energy storage.
4. Understand the principles of energy economics and their role in sustainable development.
5. Identify future directions in energy and environmental policy.

Section I

Unit-1: Energy Resources **No. of lectures- 06**

Energy chain -primary energy analysis, Energy Flow Diagram, Global Trends in Energy Use, India and World- Disaggregation by supply, end-use, Energy and Environment, The Kaya Identity, Emission Factor.

Unit-2: Energy Quality **No. of lectures-06**

Energy and Quality of Life, Energy Inequality, Energy Security, life cycle energy assessment, energy and development linkage, Energy Scenarios –need of scenarios, Introduction to Country Energy Balance.

Unit-3: Economics of Energy **No. of lectures-08**

Energy Economics -Need for economic analysis, Simple Payback Period, Time Value of Money- discount rate, Energy and non-energy flows, commercial and non-commercial energy sources, Criteria for Assessing Energy Projects (Net Present Value (NPV), Benefit/Cost Ratio (B/C), Inflation, Internal Rate of Return (IRR),Capital Recovery Factor, National Solar Mission, the economics of renewable energy systems and energy conservation systems, regulations regarding grid interconnections of renewable energy systems.

Section II

Unit-4: Energy & Environment **No. of lectures- 07**

Environmental impacts of energy production and consumption, energy resource management, Environmental impact assessment, environmental audit, Climate change from greenhouse gases – CO_2emissions, Global warming, air pollution, water use, land use, and sustainability, Kyoto Protocol, Carbon credits.

Unit-5:Utility of Energy **No. of lectures-06**

Materials used in renewable energy (Kuznet's Curve, Betting on the planet, Simon's Change), Non-Renewable Energy Economics (Hotelling's Rule), Preferences and Utility, Utility and Social Choice.

Unit-6: Energy Analysis **No. of lectures-07**

Primary Energy Analysis, Net Energy Analysis, Energy Cost, Life Cycle Analysis of constructing the energy balance of a country, Bioenergy, Energy Policy, Future energy demand and supply.

Internal Continuous Assessment (ICA):
List of Experiments/Assignments/Case Studies, etc.

1. Assignment on Energy Resources
2. Assignment on Energy Quality
3. Assignment on Economics of Energy
4. Assignment on Energy & Environment
5. Assignment on materials used in Renewable Energy and Non-Renewable Energy Economics
6. Case Study of Energy Analysis

Text Books:

1. Global Energy Assessment Report (2012), Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria. (Mainly Chapter 1 - Energy Primer pp. 99150, Chapter 3- Energy and Environment-pp. 191-254.Chapter 4 – Energy and Health pp. 255-324).
2. J. M. Conrad, "Resource Economics," 2nd Edition, Cambridge University Press, New Delhi, 2010.
3. J. W. Tester, E. M. Drake, M. J, Driscoll, M.W Golay, W. A. Peters, "Sustainable Energy Choosing Among Options," PHI Learning Private Limited, New Delhi, 2009.
4. "Energy Economics: Concepts, Issues, Markets and Governance" by Subhes C. Bhattacharyya
5. "Energy and the Environment" by Robert A. Ristinen and Jack P. Kraushaar
6. G. M. Masters, W.P. Ela, Introduction to Environmental Engineering and Science, Third Edition, PHI, 2008.
7. Frank Kreith, Jan F. Kreider, Principles of Sustainable Energy, CRC Press, 2011.

Reference Books:

1. J. M. Conrad and C.W. Clark, "Natural Resource Economics," Cambridge University Press, 1987.
2. Charles Kolstad, "Environmental Economics," vol. 1, Oxford University Press, 1999.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Honors) (Mechanical Engineering)
Semester-VII
Hn744: Advanced Topics in Electric Vehicles

Teaching Scheme
Lectures : 03 Hours/week, 03 Credits
Tutorial: 01 Hours/week, 01 Credit

Examination Scheme
ESE : 70 Marks
ISE : 30 Marks
ICA : 25 Marks

Course Objectives:

During this course, student is expected to:

1. Learn the advanced knowledge of the electric vehicle.
2. Explain the various types and working principle of fuel cells
3. Acquaint about working principle of electronics and sensor less control in electric vehicles.
4. Explain principle of operation, construction and applications of various sensors used in modern automobiles.
5. Know the impact of electric vehicles and emerging technologies.

Course Outcomes:

At the end of course students will be able to…

1. Understand the advanced knowledge of the electric vehicle.
2. Illustrate the various types and working principle of fuel cells
3. Understand about working principle of electronics and sensor less control in electric vehicles.
4. Explain principle of operation, construction and applications of various sensors used in modern automobiles.
5. Understand the impact of electric vehicles and emerging technologies.

Section – I

1. **Fuel Cells for Electric vehicles** **No. of Lectures: - 06**

   Fuel cell – Introduction, Technologies & Types, Obstacles. Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity. Lifetime cost of Fuel cell Vehicle – System, Components, maintenance

2. **Controls in electric vehicle** **No. of Lectures: -08**

   Traction control (motor control), Electronic Transmission Control, Adaptive Power Steering, Adaptive cruise control Safety and comfort systems Antilock braking, Traction Control and Electronic Stability, Active suspension control. Body electronics including lighting control, remote keyless entry, immobilizers etc. Electronic instrument clusters and dashboard electronics. Aspects of hardware design for automotive including electro-magnetic interference suppression, Electromagnetic Compatibility etc. An introduction to Future Cars (Hybrid, Hydrogen Fueled, Solar Powered, autonomous vehicle)

3. **Electronics and Sensor-less control in EV** **No. of Lectures: -06**

   Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self-driven Cars, Hacking; Sensor less – Control methods-Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based

Section – II

4. **Autonomous vehicles** **No. of Lectures: -06**

   Layers of autonomy, unmanned ground vehicle (UGV), Advanced Driver Assistance Systems (ADAS), Smart sensors, radar, Lidar, Path control.

5. **EV and security** **No. of Lectures: -08**

   Advantage and disadvantage of EVs, Autocrypt V2G, EV accidents and safety, EV maintenance, Internet of Thing (IoT) for EVs, Intra vehicle security, Vehicle to Data Center security

6. **Future electric mobility** **No. of Lectures: -06**

   Future trends in electric cars, Wireless charging of EVs, Battery Swap, Charging EV from renewables, Case study: Nuna Solar car.

Term Work

Minimum **six** assignments / exercises based on above syllabus.

Books Recommended

Reference Books:

1. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, 2012.
2. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.
4. Tom Denton, “Electric and Hybrid Vehicles”, Routledge, Taylor & Francis Group,2018.
5. Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.
6. Hanky Sjafri. “Introduction to Self-Driving Vehicle Technology”, Chapman & Hall/CRC Artificial Intelligence and Robotics Series, 2019