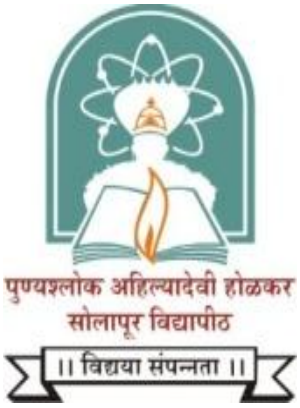
Punyashlok Ahilyadevi Holkar Solapur University, Solapur



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

Name of the Faculty: Science and Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Mechanical Engineering

Name of the Course: Honors Degree

(Syllabus to be implemented from w.e.f. June 2021)

Punyashlok Ahilyadevi Holkar Solapur University
S.Y. B.TECH. Honors in Robotics Engineering
Semester- IV
Hn411: Industrial Robotics

Teaching Scheme	Examination Scheme
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01Hour/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:

This course is designed to give the student an in depth understanding of manipulative robotics and its uses. It covers the following topics.

Automation types, introduction to industrial robotics, Anatomy of an industrial robot, robot history, configurations, sensors and actuators, end effectors and AGVs

Kinematics of multi-degree-of-freedom systems. Jacobean matrices, kinematics, and dynamics. Robot trajectories.

Design of installations. The Work cell —concepts and design.

This course requires the students to take part in site visits and case study presentations. Students are also required to complete a simulation in any Robot Simulation Software and image processing in MATLAB/Scilab/Octave.

Course Objectives:

During this course, the student is expected to:

1. Understand the basic construction of an industrial robot.
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 and bridge the gap (regarding industrial robots) between textbooks to industry.

Course Outcomes:

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

1. Define and explain types of robots including Cobots.
2. Solve simple kinematics and dynamics problems on robot motion.
3. Select appropriate robot specifications for industrial applications.
4. Use any robot simulation software to simulate a robot and its Work cell.
5. Explain sensors and actuators used in robot
6. Solve simple kinematics and dynamics problems on robot motion.

Section I

Unit-1: Introduction, types of robots definitions **No. of lectures - 8**

History and fundamentals of Industrial Robots, Definition as per ISO & IFR, Technology Evolution, components of industrial robots, configuration, typical specifications, current market scenario, "Collaborative Robots", Service Robots.

AGVs, classification, navigation techniques, applications.

Mobile robots: Classification, wheeled and tracked robots, autonomous navigation and control methods and applications, Humanoid robots, Bio mimetics.

Unit-2: Sensors and Actuators **No. of lectures - 8**

Sensors: Sensor classification, joint angle sensors, rotary encoders, proximity sensors & switches, range sensors, GPS, INU,

Actuators: Compare Hydraulic, Pneumatic and Electric drives, Review of DC motors and stepper motors, AC motors, speed control of AC motors, VFD drives, and drive selection criteria.

Unit-3: Grippers and End Effectors **No. of lectures - 4**

End Effectors: End effectors & grippers, classification, applications, design, and selection criteria.

Section II

Unit-4: Kinematics & Dynamics **No. of lectures - 8**

Forward kinematics: Coordinate frames, transformations, arm equations, forward kinematics of 2 DOF and 3 DOF planar manipulator.

Inverse Kinematics: Tool Configuration, inverse kinematics of 2 DOF and 3 DOF planar manipulator. Dynamics: Velocity Jacobian, singularities, induced torque and forces, Lagrange's Equation, Dynamic models of two-axis planar robots.

(Derivations and Numerical Exerciseson simple 2DOFmanipulators only.)

Unit-5: Control and Path Planning **No. of lectures - 6**

Control architecture of robots, Overview of advanced control techniques such as force control, PID control adaptive control, PWM control.

Trajectory planning, joint space schemes, Cartesian space schemes, issues in trajectory planning.

Unit-6: Applications of Industrial Robots **No. of lectures - 6**

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.

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

1. Survey assignment on robots industry and manufacturers and applications
2. Assignment on robot sensors and actuators.

3. Assignment on EOAT.
4. Assignment on forward and inverse kinematics on software supported by hand calculations
5. Assignment on DH notations using software supported by hand calculations.
6. Assignment on manipulator dynamics using software supported by hand calculations
7. Assignment on robot control using software.
8. One software based assignment on path planning and programming techniques.
9. One assignment on various applications in industry.
10. One assignment which involves building a workcell and offline programming using software.

Text Books:

1. S.K Saha, Introduction to Robotics, McGraw-Hill
2. Mikell Groover et.al, Industrial Robotics, McGraw Hill.
3. James, Keramas, Robot Technology Fundamentals, Delmar Cengage Learning.
4. Gunter Ulrich, Automated Guided Vehicle Systems, Springer.

Reference Books

1. Asitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford Press
2. Siegwart et.al, Autonomous Mobile Robots, Prentice Hall India.
3. Shimon Nof, Handbook of Industrial Robotics, Wiley.
4. Schilling, Fundamentals of Robotics, Prentice Hall India.
5. International Federation of Robotics - https://www/ifr.org

Note: *Students are expected to go through websites of top industrial robot manufacturers such as ABB, Yasakawa, Fanuc, Comau, Kuka, Kawasaki, etc. in addition to the IFR website for up to date and real world information including statistical data. Content in textbooks is too generic and may not be up to date.*

Punyashlok Ahilyadevi Holkar Solapur University
Mechanical Engineering
S.Y. B.TECH. Honors in 3-D Printing Engineering
Semester- IV
Hn 421 Introduction to 3D Printing

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

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

Course Introduction:

3D printing is an additive manufacturing process whereby objects are built up from plastic filament, liquid resin, layers of powder, or even bio-compatible and edible materials. Desktop 3D printing is today's printing press, putting rapid prototyping, customizable products, and individualized medical appliances in reach of the general public.

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

1. To understand basics of Additive Manufacturing.
2. To understand various types of Additive Manufacturing.
3. Be familiar with the characteristics of various materials that are used in additive manufacturing.
4. To understand various hardware and software for Additive Manufacturing.
5. To understand various applications of Additive Manufacturing.

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

1. Describe the differences and of the application of a range of additive manufacturing processes.
2. Describe the 3D printing Process.
3. Familiar with all additive manufacturing processes.
4. Familiar in using basic drafting software.
5. Identify Various Materials of 3D Printing

Section I

Unit-1: Introduction to Additive Manufacturing (AM) process No. of lectures-04
Overview, History, Need, Classification -Additive Manufacturing process, Materials for Additive Manufacturing process, Applications of Additive Manufacturing process.

Unit-2: Introduction to Types of Additive Manufacturing (AM) processes No. of lectures-06

Stereo lithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Process (DLP), Multi Jet Fusion (MJF), Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM)

Unit-3: Introduction to Additive Manufacturing Machines No. of lectures-06
Stereo lithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Process (DLP), Multi Jet Fusion (MJF), Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM)

Section II

Unit-4: 3D Modeling Software's used in Additive Manufacturing (AM) process No. of lectures-06
Introduction to CAD and 3D printing software like-Tinker Cad, Fusion 360, Catia etc.

Unit-5: *Introduction to base materials used in* Additive Manufacturing (AM) process No. of lectures-06

Classification per technology, type of printer and application area , Polymers, Metals, Ceramics, Composites.

Unit-6: Application of Additive Manufacturing (AM) process No. of lectures-06

Applications of 3D Printing in Aerospace, Automotive, Manufacturing and Architectural Engineering.

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

One assignment on each unit be submitted by the student.

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.

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

Mechanical Engineering

S.Y. B.TECH. Honors in Energy Engineering

Semester- IV

Hn 431 Renewable Energy Sources

Teaching Scheme	Examination Scheme
Lectures : 03 Hours/week, 03 Credits	ESE : 70 Marks
Tutorial : 01Hour/week, 01 Credit	ISE : 30 Marks
	ICA : 25 Marks

Course Introduction:

Renewable energy is useful energy that is collected from renewable resources, which are naturally replenished on a human timescale, including carbon neutral sources like sunlight, wind, rain, tides, waves, and geothermal heat. This type of energy source stands in contrast to fossil fuels, which are being used far more quickly than they are being replenished. This course helps to identify current and possible future role of renewable energy sources and variety of issues in its harnessing.

Course Objectives:

During this course, student is expected to:

1. The students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.
2. Adequate inputs on a variety of issues in harnessing renewable Energy.
3. Recognize current and possible future role of renewable energy sources.

Course Outcomes:

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

1. To Understand the Need, importance and scope of non conventional and alternate energy resources.
2. To understand role significance of solar energy.
3. To provide importance of Wind Energy.
4. To understand the role of ocean energy in the Energy Generation.
5. To understand the concept of energy Conservation.

Section I

Unit-1: Classification of Energy **No. of lectures-08**

Energy chain and common forms of usable energy - Present energy scenario - World energy status - Energy scenario in India - Introduction to renewable energy resources - Introduction to Solar Energy - Energy from Sun - Spectral distribution of solar radiation - Instruments for measuring of solar radiation - Solar radiation data analysis

Unit-2: Application of Solar Energy **No. of lectures-08**

Thermal application - Introduction to solar thermal collectors – Types - Principle of operation of different collectors - Flat plate - Evacuated tube collectors - Compound parabolic collectors- Solar air heaters - Solar dryers - Solar stills - Solar ponds - concentrating collectors - Line type- Point type - Methods of Solar power generation - Power towers

Unit-3: Introduction to Solar Photovoltaic's **No. of lectures-04**

Physics of solar cells - Cell and module. Manufacturing Process- Characteristics of cells and module- Performance parameters- BoS- PV System applications- Standalone- Grid connected system

Section II

Unit-4: Bio Energy Sources **No. of lectures-06**

Energy through various processes - Energy through fermentation – Gasification - Various types of gasifiers – Pyrolysis - Fixed bed and fast Pyrolysis - Bio energy through digestion - Types of Digesters - factors affecting the yield of products.

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

Resource assessment-Types of wind turbines-Selection of components-Blade materials-Power regulation - Various methods of control-Wind farms-Site selection-Off shore wind farms-Solar Wind Hybrid energy systems.

Unit-6: Small Hydro power System & Ocean Energy **No. of lectures-08**

Introduction – Types - System components, discharge curve and estimate of power potential - Turbines for SHP *Power generation through OTEC systems - Various types- Energy through*

waves and tides - Energy generation through geothermal systems – types.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on different types of energy
2. Assignment on solar energy applications
3. Assignment on solar Photovoltaic's
4. Assignment on different bio energy sources
5. Assignment on wind energy
6. Assignment on small Hydro power system
7. Assignment on ocean energy
8. Estimation of solar radiation: Pyrometer, Pyrtheliometer.
9. Testing of solar PV system in PV training Kit

Text Books:

1. Renewable energy resources: Tiwari and ghosa *Ocean Energy* l, Narosa publication.
2. Non-Conventional Energy Sources /G.D. Rai, Khanna Publishers
3. Non conventional energy source –B.H. Khan- TMH-2nd edition
4. Energy Technology – S. Rao, Parulkar
5. Renewable Energy sources And Emerging Technologies, DP. Kothari, PHI.

Reference Books

1. Non Conventional Energy Systems: K M. Mittal, A H Wheeler Publishing Co Ltd.
2. Solar Energy/ S.P. Sukhatme, Tata McGraw-Hill.
3. Renewable Energy Technologies: Ramesh & Kumar, Narosa publication.
4. Hand Book of Renewable Energy Technology, Ahmed F Zooba, R C Bansal World scientific.

Punyashlok Ahilyadevi Holkar Solapur University
S.Y. B.TECH. Honors in Electric Vehicles Engineering
Semester- IV
Hn441 Introduction to Automobile Engineering

Teaching Scheme	**Examination Scheme**
Lectures : 03 Hours/week, 03 Credits	**ESE : 70 Marks**
Tutorial : 01Hour/week, 01 Credit	**ISE : 30 Marks**
	ICA : 25 Marks

Course Introduction:
The objective of this course is to provide a fundamental understanding of the various systems of a typical automobile.
The systems that are covered are IC engines, their types, components and applications, the clutch and gearbox, calculation of gear ratios, driveline and differential, steering system, types of steering, brakes, ABS, suspension, wheels and tyres and electronics and electrical systems.

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

1. Understand different automobile layouts
2. Understand automobile ICE and their applications
3. Understand the construction and working of different automobile subsystems.
4. Understand how the automobile is serviced and maintained.
5. Understand how an automobile is built.

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

1. Identify automobile body types accurately
2. Explain construction and working of different automobile subsystems
3. Calculate gear ratios, steering angle, steering forces, brake forces etc. using standard formulae.
4. Locate and identify automobile subsystems and components on an actual vehicle.
5. Explain different electrical and electronics systems in an automobile and their functions.

Section I

Unit -1: Automobile body type and powertrain **No. of lectures - 8**

Automobile layout, automobile body styles, chassis construction, Automotive powertrain, Classification of Internal Combustion Engines, Engine Components, Operation of Four Stroke Engines, Two-Stroke Engines, Engine Cycles, Engine Performance, Supercharging, engine subsystems and engine selection. EVs, HEVs

Unit -2: Automotive Clutch, Transmission, Powertrain Analysis **No. of lectures - 6**

Automobile Clutch, Types, basic calculations, automobile transmissions and its types, power train calculation and analysis, transmission matching.

Unit - 3: Brake System **No. of lectures - 6**

Fundamentals of Braking, braking requirements, drum brakes, disc brakes, hydraulic brakes, air brakes, brake selection for 2W, 3W, 4W and commercial vehicles, ABS.

Section II

Unit - 4: Steering System **No. of lectures - 6**

Automotive Steering, components of the steering system, type of steering (R&P, recirculating ball, etc), Ackerman steering, simple calculations for steering ratio and steering angle, power assisted steering.

Unit - 5: Wheels, Tyres and Suspension System **No. of lectures - 8**

Wheel alignment, wheel types, tyres and its tyres, radial tyres, types of suspension for front and rear, requirements of suspension system, independent and dependant suspension, shock absorbers and suspension analysis.

Unit - 6: Automotive Electricals and Electronics **No. of lectures - 6**

Automotive sensors and actuators, microcontrollers in automobiles, electric and electronic components in an automobile, automobile battery and its types, starter, spark plugs etc.

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

1. Survey assignment on 2W, 3W, 4W and CVs.
2. Study of ICEs for 2W, 3W, 4W and CVs
3. Braking calculations and brake selection 2W, 3W, 4W and CVs
4. Study of Clutch and transmission systems for 2W, 4W, CVs
5. Study of steering for 2W, 4W, CVs
6. Study of Suspension System for 2W, 4W, CVs
7. Study of wheels and tyres for 2W, 4W, CVs
8. Study of automotive electrical and electronics.

9. Field visit to a service station.
10. Field visit to an automobile manufacturing plant.

Text Books:

1. D. Crolla, “Automotive Engineering: Powertrain, Chassis System and Vehicle Body”, Elsevier
2. R. Stone and J. K. Ball, “Automotive Engineering Fundamentals”, SAE International, 2004
3. T. K. Garrett, K. Newton, and W. Steeds, The Motor Vehicle, 13th Edition, SAE International, 2001
4. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, BH
5. William B. Ribbens, “Understanding Automotive Electronics”, Newnes

Reference Books

1. D. Crolla, D. E. Foster, T. Kobayashi and N. Vaughan (Editors-in-Chief), “Encyclopedia of Automotive Engineering, Parts 1-6”, Wiley, 2015
2. D. B. Astow, G. Howard and J. P. Whitehead, Car Suspension and Handling, 4th Edition, SAE International, 2004.
3. R. Limpert, Brake Design and Safety, SAE International, 1992.
4. Bosch, Automotive Handbook, 2004
5 The Automotive Chassis, SAE