IEM Salt Lake Campus, IEM Newtown Campus & IEM Jaipur Campus

New Syllabus Outline Structure

For
8th SEMESTER (B.Tech in Mechanical Engineering)

Effective from Academic Year 2026-2027

DEPARTMENT OF MECHANICAL ENGINEERING

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B. Tech Admission Batch 2022-2026

B.Tech ME 8th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Contact Hrs	Credits
Theory Papers								
1	HSMC	HSME801	Universal Human Values	2	0	0	2	2
2	OEC	OECME801	Open Elective-III	3	0	0	3	3
Practical / Sessional Papers								
3	PRJ	PRJME881	Project-VI (Prototype & Testing)	0	0	8	8	4
4	PRJ	INP881	Internship II	0	0	0	0	4
5	PRJ	PRJME882	Comprehensive viva	0	0	0	0	1
TOTAL							**13**	**14**
For B.Tech with Minor Degree (Robotics/ Sustainable Energy Engineering/ Artificial intelligence and Machine learning/Additive manufacturing)								
6	MD	MINOR881A	Project in AIML	0	0	4	4	2
7	MD	MINOR881R	Project in Robotics II	0	0	4	4	2
8	MD	MINOR801S	Solar Energy System Installations and Maintenance	1	1	2	3	3
9	MD	MINOR801M	3D Printing Project	0	0	6	6	3
Mandatory Courses								
10	IFC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0
11	MAR	MAR	Mandatory Additional Requirements (MAR)	0	0	0	0	0
For B.Tech Honours Degree								
12	MOOCS	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-

List of Open Electives for Elective-III

A. Total Quality Management (OECME801A)
B. Maintenance Engineering (OECME801B)
C. Quality & Reliability Engineering (OECME801C)
D. Machine Learning (OECME801D)
E. Biomechanics & Biomaterials (OECME801E)
F. Soft Computing Optimization (OECME801F)

8th Semester

Subject Name: Universal Human Values

Subject Code: HSMME801 **Credit: 2** **Lecture Hours:** 24

Prerequisite: NA

Course Objective(s):

The purpose of learning of this course is to:

1. Encourage students to view life and profession in an integrated manner, considering happiness and prosperity as essential aspects.
2. Help students build a proper understanding of themselves and their relationship with the rest of existence.
3. Aim for meaningful changes in students' lives, shaping their attitudes and values rather than just transferring information.
4. Emphasize experiential learning and self-exploration to ensure that education leads to personal growth and well-being.

Module No.	Topic	Sub-topics	Mapping with Academia	Mapping with Textbook & Chapter	Lecture Hours
1	Introduction to Value Education	Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education , Continuous Happiness and	***International Academia:*** https://ocw.mit.edu/courses/esd-932-engineering-ethics-spring-2006/pages/syllabus/	Human Values and Professional Ethics, Smriti Srivastava, Katson Books, Chapter 1	4

		Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic, Human Aspirations	***AICTE-prescribed syllabus:*** **https://aicte.gov.in/sites/default/files/Final_Mechanical%20Engg.pdf**		
2	Harmony in the Human Being	Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	***International Academia:*** https://ocw.mit.edu/courses/esd-932-engineering-ethics-spring-2006/pages/syllabus/ ***AICTE-prescribed syllabus:*** **https://aicte.gov.in/sites/default/files/Final_Mechanical%20Engg.pdf**	Human Values and Professional Ethics, Smriti Srivastava, Katson Books, Chapter 2	5
3	Harmony in the Family and Society	Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	***International Academia:*** https://ocw.mit.edu/courses/esd-932-engineering-ethics-spring-2006/pages/syllabus/ ***AICTE-prescribed syllabus:*** **https://aicte.gov.in/sites/default/files/Final_Mechanical%20Engg.pdf**	Human Values and Professional Ethics, Smriti Srivastava, Katson Books, Chapter 3	5
4	Harmony in the Nature/Existence	Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	***International Academia:*** https://ocw.mit.edu/courses/esd-932-engineering-ethics-spring-2006/pages/syllabus/ ***AICTE-prescribed syllabus:***	Human Values and Professional Ethics, Smriti Srivastava, Katson Books, Chapter 4	5

			https://aicte.gov.in/sites/default/files/Final_Mechanical%20Engg.pdf		
5	Implications of the Holistic Understanding	Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	***International Academia:*** https://ocw.mit.edu/courses/esd-932-engineering-ethics-spring-2006/pages/syllabus/ ***AICTE-prescribed syllabus:*** **https://aicte.gov.in/sites/default/files/Final_Mechanical%20Engg.pdf**	Human Values and Professional Ethics, Smriti Srivastava, Katson Books, Chapter 5,6	5
		Total			24

Course Outcomes (s) (COs):

After completion of this course, the learner will be able to

1. The students start exploring themselves: get comfortable with each other and with the teacher; they start appreciating the need and relevance for the course.
2. The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.
3. The students are able to use their creativity for education children. The students are able to develop an outline of holistic model for social science and compare it with the existing model.
4. The students are able to present sustainable solutions to the problems in society and nature. The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfilment

Text Book:

1. Human Values and Professional Ethics, Smriti Srivastava, Katson Books (Chapter 1,2,3,4,5,6)
2. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	3	2	1	-	2
CO2	-	-	-	-	-	-	1	3	2	1	-	2
CO3	-	-	-	-	-	-	1	3	2	1	-	2
CO4	-	-	-	-	-	-	1	3	2	1	-	2

Subject Name: Total Quality Management **Credit: 3**

Subject Code: OECME801A **Lecture Hours: 36**

Pre-requisite: Basic Engineering Knowledge

Course Objectives:

To express knowledge about various aspects of quality and total quality management. To understand different tools of TQM and related standards.

Course Content:

Module No.	Description of Topic	Mapping with Industry and International Academia	Contact Hrs.	Corresponding Lab Assignment
1	**Introduction:** Need for quality, Definition of Quality, Evolution of quality, Product quality and Service quality, Dimensions of Quality, Definition of Total Quality Management, Quality Planning, Quality costs - Analysis, Techniques for Quality Costs, and Basic concepts of Total Quality Management. Quality Council, Quality Statements, Strategic quality planning, Barriers to TQM Implementation, Benefits of TQM, Contributions of Deming, Juran and Crosby.	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standard*** https://ocw.mit.edu/courses/15-760b-introduction-to-operations-management-spring-2004/ ***Industry Mapping:*** Minitab, SPSS, **MATLAB** (control charts, modelling), Python (libraries: NumPy, SciPy, Pandas, Scikit-Learn), **Microsoft Visio** (process mapping, flowcharts)	6	1. Using Minitab/SPSS/Python, perform a complete quality cost analysis with Pareto charts and statistical summaries. 2. Using Microsoft Visio, create a flowchart of the evolution of quality and a fishbone diagram for the dimensions of quality.

2	**TQM Principles:** Customer satisfaction- Customer Perception of Quality, Customer Complaints, Service Quality. Customer Retention; Employee involvement and motivation; Empowerment; Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCA cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standard*** https://ocw.mit.edu/courses/15-760b-introduction-to-operations-management-spring-2004/?utm_source=chatgpt.com ***Industry Mapping:*** Minitab, SPSS, **MATLAB** (control charts, modelling), Python (libraries: NumPy, SciPy, Pandas, Scikit-Learn), **Microsoft Visio** (process mapping, flowcharts)	6	1. Using SPSS/Python, conduct factor analysis on customer satisfaction data to identify key drivers of service quality. 2. Using MATLAB/Python, prepare a control chart and improvement analysis for a process before and after PDCA/5S implementation.
3	**TQM Tools and Techniques:** Benchmarking- Reasons to Benchmark, Benchmarking Process; Quality Function Deployment (QFD); Taguchi Quality Loss Function; Seven traditional tools of quality; New management tools; Process capability; Six sigma-concepts, methodology; TPM- concepts, improvement needs, performance measures; FMEA- Stages of FMEA.	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standard*** https://ocw.mit.edu/courses/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/ ***Industry Mapping:*** Minitab, SPSS, **MATLAB** (control charts, modelling), Python (libraries: NumPy, SciPy, Pandas, Scikit-Learn), **Microsoft Visio** (process mapping, flowcharts)	18	1. Using Minitab/MATLAB/Python, calculate DPMO, sigma level, process capability (Cp, Cpk), and prepare control charts for defect data. 2. Using Visio and Python/MATLAB, construct a QFD (House of Quality) and compute priority rankings using benchmarking data.

4	**Quality Systems:** Need for ISO 9000 and Other Quality Systems, ISO 9001:2015 Quality System- Elements, Documentation; Quality Auditing, QS 9000, ISO 14000- Concept, Requirements and Benefits; TQM implementation in manufacturing and service sectors	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standard*** *https://ocw.mit.edu/courses/15-760a-operations-management-spring-2002?utm_source=chatgpt.com* ***Industry Mapping:*** Minitab, SPSS, **MATLAB** (control charts, modelling), Python (libraries: NumPy, SciPy, Pandas, Scikit-Learn), **Microsoft Visio** (process mapping, flowcharts)	6	1. Using Microsoft Visio, create an ISO 9001:2015 compliant process map and identify gaps against relevant clauses. 2. Using SPSS/Minitab/Python, analyze internal audit non-conformity data with Pareto analysis and Chi-square testing.

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

5. Understand quality management philosophies, techniques, and frameworks
6. To understand different TQM principles
7. Apply tools and techniques of TQM in manufacturing and service sectors.
8. Understand the implications of quality management standards and systems

Learning Resources:

Text Book

1. D.H. Besterfield, C. Besterfield, G.H. Besterfield, M. Besterfield, H. Urdhwareshe and R. Urdhwareshe, Total Quality Management, Pearson Education,2018.
2. S. Ramasamy, Total Quality Management, McGraw Hill Publishing Co., New Delhi,2011.

Reference Book

3. A. Mitra, Fundamentals of Quality Control and Improvement, Wiley Student Edition,2008.
4. J.R. Evans and W.M. Lindsay, The Management and Control of Quality, Cengage Learning, 1999.
5. D.C. Montgomery, Introduction to Statistical Quality Control, John Wiley,2019.

6. M.P. Poonia, Total Quality Management, Khanna Book Publishing,2018.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	-	-	-	-	2
CO2	3	3	2	2	2	2	1	-	-	-	-	2
CO3	3	3	2	2	2	2	1	-	-	-	-	2
CO4	3	3	2	2	2	2	1	-	-	-	-	2

Subject Name: Maintenance Engineering **Credit: 3**

Subject Code: OECME801B **Lecture Hours: 36**

Pre-requisite: Manufacturing Processes

Course Objectives:

To provide knowledge on different aspects of repair and maintenance practiced in industry. To make students familiar with different repair and maintenance strategies used in industry.

Course Content:

Module No.	Description of Topic	Mapping with Industry and International Academia	Contact Hrs.	Corresponding Lab Assignment
1	**Introduction:** Definitions of repair and maintenance; Importance of maintenance; Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Maintainability, failure pattern, availability of equipment/ systems, design for maintainability.	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3, 4 Software: Minitab, MATLAB, AutoCAD / SolidWorks	5	Analyze failure data of a machine using Minitab to determine failure distribution, MTBF, and availability, and prepare a probability plot to identify the failure pattern (infant mortality, random, or wear-out).
2	**Total Productive Maintenance (TPM):** definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE).	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3	3	Develop a MATLAB script to calculate Overall Equipment Effectiveness (OEE) using production data, and generate bar charts showing Availability,

				Performance, and Quality trends before and after TPM implementation.
3	**Organizational structures for maintenance:** Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3	4	Use Minitab to perform ABC analysis on spare parts consumption data and generate a Pareto chart to classify critical, moderate, and low-value spare parts for maintenance inventory management.
4	**Economic Aspect of Maintenance:** Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools, planning, reports.	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3 MATLAB Reliability Toolbox	4	Write a MATLAB program to compute Life Cycle Cost (LCC) of a machine, including acquisition, operation, maintenance, and disposal costs, and plot the cost distribution using a pie or bar chart.
5	**Function and use of Maintenance Equipment, Instruments & Tools:** Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc.	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3 AutoCAD / SolidWorks for repair drawings	6	Create a detailed 2D/3D drawing of a maintenance tool or measuring instrument (e.g., torque wrench, bearing puller, dial gauge setup) showing dimensions, material notes, and assembly details.

6	**Lubrication:** Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals.	***AICTE prescribed syllabus:*** **International standard:** 1, 2	4	Model a lubrication system layout (manual or centralized) in AutoCAD/SolidWorks, including pump, distribution lines, lubrication points, and reservoir, with proper annotations and symbols.
7	**Repair & Maintenance Procedures:** Repair of cracks, threads, worn shafts, keyways, bush bearings, and damaged gear teeth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, electrical wiring, isolators and main switches, small induction motors; Steps for installation of a machine.	***AICTE prescribed syllabus:*** **International standard:** 1, 2, 3, 4	10	(MATLAB) Simulate shaft misalignment data and generate plots of allowable vs. measured misalignment. (AutoCAD/SolidWorks) Create a technical drawing showing correct shaft alignment procedure with coupling, shims, and reference points.

Course Outcomes:

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

1. Know different types of repair and maintenance procedures practised in the industry.
2. Understand different repair and maintenance strategies used in industry.
3. Understand the organizational structure of an industry for maintenance management
4. Understand the economy involved in this.

Learning Resources:

1. R.C. Mishra and K. Pathak, Maintenance Engineering and Management, PHI,2012.
2. S.K. Srivastava, Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi,1998.
3. K. Venkataraman, Maintenance Engineering and Management, PHI,2007.
4. K. Mobley, Maintenance Engineering Handbook, McGraw Hill, Eighth Edition,2014.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	1	-	-	-	1	2
CO2	3	2	2	2	2	2	1	-	-	-	1	2
CO3	3	2	2	2	2	2	1	-	-	-	1	2
CO4	3	2	2	2	2	2	1	-	-	-	1	2

Subject Name: Quality & Reliability Engineering **Credit: 3**

Subject Code: OECME801C **Lecture Hours: 36**

Pre-requisite: Manufacturing Processes

Module No.	Description of Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	Management of Product Quality Evolution of Quality Control; Changing Quality Concepts; Modern Concept of Total Quality Management; Contribution of Quality masters (Deming, Juran, Crosby, Ishikawa, Taguchi);	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/15-963-management-of-quality-winter-2005/ https://ocw.mit.edu/courses/15-066j-system-optimization-and-analysis-for-manufacturing-spring-2003/ **Minitab** – Statistical quality analysis, SPC, DOE,	3	Using Minitab, analyze historical defect data from a production process to compute defect proportions, plot a Pareto chart, and evaluate improvement opportunities based on Deming/Juran principles.
2	Creating Quality by Design Assessment of Customer's needs; Formulation of Design Specifications; Standardization; Costs of Quality; Quality Circles; 5-S concept;	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/ https://ocw.mit.edu/courses/15-501-introduction-to-operations-management-spring-2002/	4	Collect customer requirement data, create a House of Quality (QFD) in Excel, and use Python to calculate correlation weights and design priorities for a product's key features.

		SolidWorks (product quality design),		
3	Total Quality Management Concept of Total Quality, Difference between "Quality" Management and "Total Quality" Management, total quality maintenance, total quality in service sector; Role of Customer and People in Total Quality Management; Steps for Quality Improvement, Kaizen; Organizing for effective Quality Management;	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/ https://ocw.mit.edu/courses/15-066j-system-optimization-and-analysis-for-manufacturing-spring-2003/	4	Develop a MATLAB ML model (classification or regression) that predicts customer satisfaction levels based on service quality attributes, and propose Kaizen-driven improvements based on model insights.
4	Process Control Control Charts; Statistical Quality Control Tools; Statistical Process Control and Process Capability, Zero defect programme; Six – Sigma approach;	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/15-060-data-models-and-decisions-fall-2014/ https://ocw.mit.edu/courses/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/ **MATLAB** – Advanced modeling, SPC automation, excel, python	4	Write a MATLAB program that automatically generates X-bar/R control charts from process measurements, calculates process capability indices (Cp, Cpk), and flags out-of-control points.
5	Quality Management Systems	***AICTE prescribed syllabus:*** **International standard:**	4	Create an ISO 9001:2015 internal audit checklist in Excel, rate compliance

	ISO 9000 Series of Standard; ISO 14000 Series of Standards;	https://ocw.mit.edu/courses/1-040-project-management-spring-2004/ https://ocw.mit.edu/courses/1-011-project-evaluation-spring-2011/		scores for a selected department, and generate a compliance radar chart to visualize strengths and gaps.
6	Strategic tools and Techniques for TQM Need for Tools and Techniques in TQM; Commonly used Tools for TQM; Approaches and Deployment of Tools for Quality Planning – Quality Function Deployment (QFD), concurrent engineering; Tools for continuous Improvement – Deming's Plan – Do – Check – Act (PDCA) cycle, Poka – Yoke (Mistake – Proofing), Taguchi's Quality Loss Function.	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/16-660j-introduction-to-lean-six-sigma-methods-january-iap-2012/resources/continuous-process-improvement/?utm_source=chatgpt.com https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/ https://ocw.mit.edu/courses/2-810-ship-structural-analysis-distance-education-fall-2003/ Minitab	5	Using Minitab, design and analyze a Taguchi L9 orthogonal array to optimize a product or process parameter (noise vs control factors), and compute the Signal-to-Noise ratio for quality improvement.
7	Reliability Concept and definition of reliability; Reliability Parameters: Reliability as a function of time, failure rate as a function of time, constant failure rate, mean time to failure (MTTF), MTTF as a function of failure rate, mean time between failure (MTBF), mean	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/16-886-aircraft-systems-engineering-fall-2004/resources/lec9/ https://ocw.mit.edu/courses/15-060-data-models-and-decisions-fall-2014/ https://ocw.mit.edu/courses/16-885j-aircraft-	7	Perform reliability analysis of a mechanical component by fitting Weibull distribution to failure time data using ANSYS Reliability Engineering (or Python), and compute MTTF, MTBF, and reliability vs time curves.

	down time (MDT), maintainability & availability, increasing failure rate, bath-tub curve; Brief discussion on hazard models: constant hazard model, linearly increasing hazard model, nonlinear hazard model and weibull distribution, Advantages of weibull distribution; System reliability models: series system, parallel system, series-parallel system.	systems-engineering-fall-2005/ ANSYS Reliability Engineering		
8	Risk Assessment & Reliability in Design Causes of failures, Failure modes & Effects Analysis (FMEA), faulty tree analysis (FTA); Tribological failure and monitoring techniques; Design based on reliability, redundancy in design.	***AICTE prescribed syllabus:*** **International standard:** https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/ https://ocw.mit.edu/courses/16-886-aircraft-systems-engineering-fall-2004/resources/lec15/ https://ocw.mit.edu/courses/2-800-tribology-fall-2004/ https://ocw.mit.edu/courses/16-888-engineering-systems-analysis-for-design-fall-2021/ **SolidWorks Simulation** (fatigue, reliability)	5	Using SolidWorks Simulation, perform fatigue analysis on a mechanical part (e.g., bracket, shaft, linkage), identify high-risk failure locations, and propose design modifications based on reliability and safety factors.
Total			36	

COURSE OUTCOMES:

Upon completion of this course the student will be able to:

1. Attain the basic knowledge of quality and design.
2. Use control tools to analyze for improving the process quality.
3. Describe different quality standard, acquire basic knowledge of total quality management
4. Understand the concepts of reliability and maintainability

Recommended Books

Text Book

1. H. Lal, Total Quality Management – A Practical Approach — New Age International (P) Ltd. Publishers
2. S. K. Mondal –Total Quality Management Principles and Practice –Vikas Publishing House Pvt. Ltd.

Reference Book

3. A. V. Feigenbum– Total Quality Control, Mcgraw-Hill Book Company
4. Juran's Quality Control Handbook –McGraw Hill Book Company
5. Amitava Mitra, Fundamentals of quality Control and Improvement — PHI
6. Grant and Leavenworth-Statistical Quality Control, 7th Edition, Tata Mcgraw Hill
7. E. Balaguruswamy , Reliability Engineering – TMH
8. Bhadury and Basu- Terotechnology: Reliability Engineering and Maintenance Management, Asian Books Pvt. Ltd.
9. Paul Kales- Reliability of Technology, Engineering and Management- PHI

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	2	-	-	1	2
CO2	2	2	2	2	2	2	-	2	-	-	1	2
CO3	2	2	2	2	2	2	-	2	-	-	1	2
CO4	2	2	2	2	2	2	-	2	-	-	1	2

Subject Name: Machine Learning **Credit: 3**

Subject Code: OECME801D **Lecture Hours: 36**

Pre-requisite: Mathematics- IB, Mathematics- IIB, Mathematics- II.

Objectives:
To introduce the foundational concepts and techniques in Machine Learning, enabling a solid understanding of supervised, unsupervised, and probability-based learning methods, along with key graphical models used in modern ML algorithms.

Contents

Module No	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	**Introduction**	Learning– Types of Machine Learning– Supervised Learning– The Brain and the Neuron– Design a Learning System– Perspectives and Issues in Machine Learning– Concept Learning Task– Concept Learning as Search– Finding a Maximally Specific Hypothesis– Version Spaces and the Candidate Elimination Algorithm– Linear Discriminants– Perceptron–	**NPTEL** https://onlinecourses.nptel.ac.in/noc21_cs24/preview **Linkedin** https://www.linkedin.com/learning/machine-learning-foundations-statistics **Coursera** https://www.coursera.org/specializations/machine-learning-introduction	**8**	1. Implement a train–test split and build a basic classifier (e.g., KNN or Decision Tree) using scikit-learn, then evaluate accuracy. 2. Write the perceptron algorithm from scratch and plot how the decision boundary updates over training iterations. 3. Fit a linear regression model on synthetic data, plot the regression line, and compute error metrics (MSE/MAE).

		Linear Separability– Linear Regression.			
2	**Linear Models**	Multi-layer Perceptron– Going Forwards– Going Backwards: Back Propagation Error– Multilayer Perceptron in Practice– Examples of using the MLP– Overview– Deriving Back Propagation– Radial Basis Functions and Splines– Concepts– RBF Network– Curse of Dimensionality– Interpolations and Basis Functions– Support Vector Machines.	**NPTEL** https://onlinecourses.nptel.ac.in/noc21_cs24/preview **Linkedin** https://www.linkedin.com/learning/machine-learning-foundations-statistics **Coursera** https://www.coursera.org/specializations/machine-learning-introduction	**7**	1. Implement a Multilayer Perceptron from scratch (forward pass + backpropagation) and train it on a simple dataset like XOR. 2. Build an RBF network in Python using Gaussian basis functions and test its performance on a 2-class synthetic dataset. 3. Train an SVM classifier on a real dataset (e.g., Iris) and visualize the decision boundaries for different kernels.
3	**Tree and Probabilistic Models**	Learning with Trees– Decision Trees– Constructing Decision Trees– Classification and Regression Trees– Ensemble Learning– Boosting– Bagging– Different ways to Combine Classifiers– Probability and Learning– Data into Probabilities– Basic Statistics– Gaussian Mixture Models–	**NPTEL** https://onlinecourses.nptel.ac.in/noc21_cs24/preview **Linkedin** https://www.linkedin.com/learning/machine-learning-foundations-statistics **Coursera**	**7**	1. Implement a Decision Tree and Random Forest classifier from scratch and evaluate their performance on a real dataset (Iris or Wine) with visualized decision boundaries. 2. Perform K-means clustering on an unlabeled dataset (e.g., customer segmentation) and

		Nearest Neighbour Methods– Unsupervised Learning– K-means Algorithms– Vector Quantization– Self Organizing Feature Map.	https://www.coursera.org/specializations/machine-learning-introduction		compare results with Self-Organizing Feature Map (SOM) visualizations. 3. Build a Gaussian Mixture Model (GMM) for density estimation on a synthetic dataset and validate results using probability contours and nearest-neighbour comparisons.
4	**Dimensionality Reduction and Evolutionary Models**	Dimensionality Reduction– Linear Discriminant Analysis– Principal Component Analysis– Factor Analysis– Independent Component Analysis– Locally Linear Embedding– Isomap– Least Squares Optimization. Evolutionary Learning– Genetic algorithms– Genetic Offspring- Genetic Operators– Using Genetic Algorithms– Reinforcement Learning– Overview– Getting Lost Example– Markov Decision Process.	**NPTEL** https://onlinecourses.nptel.ac.in/noc21_cs24/preview **Linkedin** https://www.linkedin.com/learning/machine-learning-foundations-statistics **Coursera** https://www.coursera.org/specializations/machine-learning-introduction	**7**	1. Apply PCA, LDA, and ICA on a high-dimensional dataset (e.g., digits or gene expression data) and compare the reconstructed outputs and 2D visualizations. 2. Implement a basic Genetic Algorithm to optimize a nonlinear function and demonstrate the effect of different genetic operators (selection, crossover, mutation). 3. Build a simple Reinforcement Learning agent to solve a gridworld/maze (Getting Lost example) using Markov Decision Process principles and visualize its learned policy.

5	**Graphical Models**	Markov Chain Monte Carlo Methods– Sampling– Proposal Distribution– Markov Chain Monte Carlo– Graphical Models– Bayesian Networks– Markov Random Fields– Hidden Markov Models– Tracking Methods.	**NPTEL** https://onlinecourses.nptel.ac.in/noc21_cs24/preview **Linkedin** https://www.linkedin.com/learning/machine-learning-foundations-statistics **Coursera** https://www.coursera.org/specializations/machine-learning-introduction	**7**	1. Implement MCMC sampling (e.g., Metropolis–Hastings) on a 2D probability distribution and compare results with direct sampling. 2. Build a small Bayesian Network, perform inference using sampling, and visualize how evidence updates posterior probabilities. 3. Train a Hidden Markov Model for sequence tracking (e.g., POS tagging or gesture tracking) and demonstrate prediction on a real or synthetic sequence.

Text Books:

1. Jeeva Jose, Introduction of Machine Learning, Khanna Publishing House,2019.
2. S. Marsland, Machine Learning– An Algorithmic Perspective, 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. T.M. Mitchell, Machine Learning, First Edition, McGraw Hill Education,2013.

Reference Books:

1. P. Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press,2012.
2. J. Bell, Machine learning– Hands on for Developers and Technical Professionals, First Edition, Wiley,2014.

3. E. Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning Series), 3rd Edition, MIT Press, 2014.

Course Outcomes:

At the end of this course students will be able to

1. Distinguish between supervised, unsupervised and semi-supervised learning.
2. Apply the appropriate machine learning strategy for any given problem.
3. Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.
4. Design systems that use the appropriate graph models of machine learning. Modify existing machine learning algorithms to improve classification efficiency.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	2	-	-	1	2
CO2	2	2	2	2	2	2	-	2	-	-	1	2
CO3	2	2	2	2	2	2	-	2	-	-	1	2
CO4	2	2	2	2	2	2	-	2	-	-	1	2

Subject Name: Biomechanics & Biomaterials **Credit: 3**

Subject Code: OECME801E **Lecture Hours: 36**

Pre-requisite: Engineering Mechanics

Module No.	Description of Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	Musculoskeletal Anatomy: Basic Statics and Joint Mechanics (elbow, shoulder, spine, hip, knee, ankle)	**International Standard** https://ocw.mit.edu/courses/2-785-biomedical-mechanics-spring-2010/ https://ocw.mit.edu/courses/2-797j-mechanics-of-the-human-body-spring-2004/ https://ocw.mit.edu/courses/hst-010-human-anatomy-fall-2005/	6	Using MATLAB or a machine-learning model, estimate joint reaction forces at the elbow or knee by analyzing input motion data (angles, torques, muscle forces) and compare predicted forces with analytical static calculations.
2	Basic Dynamics to Human Motion: Review of linear and angular kinematics; Kinetic equations of motion; Work & energy methods; Momentum methods; Examples in biomechanics; Modern kinematic measurement techniques; Applications of human motion analysis. Structure, Function, and	**International Standard** https://ocw.mit.edu/courses/2-003sc-engineering-dynamics-fall-2011/?utm_source=chatgpt.com https://ocw.mit.edu/courses/2-301-dynamics-and-control-i-spring-2006/ https://ocw.mit.edu/courses/hst-021-muscle-	6	Build a MATLAB or ML-based kinematic model that predicts gait cycle phases from motion capture data (hip–knee–ankle angles), and classify walking vs running using a supervised learning algorithm (SVM/Random Forest).

	Adaptation of Major Tissues and Organs	cell-physiology-spring-2007/		
3	Fundamental Strength of Materials in Biological Tissues: Introduction to Viscoelasticity. Fundamentals of biomaterials science. Concept of biocompatibility. Classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance. Disinfection and sterilization of biomaterials.	**International Standard** https://ocw.mit.edu/courses/3-032-mechanical-behavior-of-materials-fall-2007/ https://ocw.mit.edu/courses/3-051j-introduction-to-biomaterials-spring-2006/ https://ocw.mit.edu/courses/hst-525j-biomaterials-and-sterilization-spring-2005/	6	Use MATLAB to fit a viscoelastic model (Maxwell/Kelvin–Voigt) to experimental stress-relaxation or creep data of a biological tissue, and compute elastic modulus, viscosity parameters, and model error.
4	Physico-chemical properties of biomaterials: mechanical (elasticity, yield stress, ductility, toughness, strength, fatigue, hardness, wear resistance), tribological (friction, wear, lubricity), morphology and texture, physical (electrical, optical, magnetic, thermal), chemical and biological properties.	**International Standard** https://ocw.mit.edu/courses/3-051j-introduction-to-biomaterials-spring-2006/ https://ocw.mit.edu/courses/2-800-tribology-fall-2004/ https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2010/	6	Develop an ML regression model (or MATLAB curve-fitting tool) to predict mechanical properties of biomaterials—such as elastic modulus or hardness—based on input features like composition, porosity, and processing parameters.
5	Elements in contact with the surface of a biomaterial: blood composition, plasma proteins, cells, tissues. Phenomena at the biointerfaces. Molecular and cellular processes with living environment, blood-	**International Standard** https://ocw.mit.edu/courses/20-462j-molecular-principles-of-biomaterials-spring-2006/	6	Train an ML classifier that predicts biocompatibility response (low/medium/high) using features such as surface

	materials interaction, short and long term reactions to the body.	https://ocw.mit.edu/courses/20-420j-principles-of-molecular-bioengineering-fall-2004/ https://ocw.mit.edu/courses/hst-176-functional-neuroanatomy-fall-2006/		roughness, hydrophobicity, protein adsorption levels, and cell adhesion test results.
6	Testing of biomaterials: in vitro, in vivo preclinical and in vivo clinical tests. Technologies of biomaterials processing, as implants and medical devices; improvement of materials biocompatibility by plasma processing.	**International Standard** https://ocw.mit.edu/courses/2-75-medical-device-design-fall-2010/ https://ocw.mit.edu/courses/20-363j-organogenesis-and-organ-engineering-spring-2006/ https://ocw.mit.edu/courses/3-051j-introduction-to-biomaterials-spring-2006/	6	Simulate in-vitro degradation of a biomaterial implant using MATLAB dynamic modeling, or build an ML model to predict degradation rate from experimental parameters (pH, temperature, porosity, material type).
Total			36	

Course outcomes:

Upon successful completion of this course, students will have the knowledge and skills to:

1. Basic Statics and Joint Mechanics, Basic Dynamics to Human Motion.
2. Fundamental Strength of Materials in Biological Tissues, Demonstrate a broad knowledge of different types of biomaterials.
3. Elements in contact with the surface of a biomaterial, interaction and reaction.
4. Testing, Technologies improvement of biomaterials processing.

References

1. Fundamentals of Biomechanics: D V Knudson, Springer.
2. Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, by Ozkaya and Nordin, Springer.
3. Biomechanics: Mechanical Properties of Living Tissues, by Fung, Springer
4. Basic Biomechanics of the Musculoskeletal System, by Nordin & Frankel, Barnes & Noble.

5. Biomaterials Science, An Intoduction to Materials in medicine, Eds. B. D. Ratner and A. S. Hoffman, Academic Press, New York.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	-	2	-	-	1	2
CO2	2	2	2	2	2	2	-	2	-	-	1	2
CO3	2	2	2	2	2	2	-	2	-	-	1	2
CO4	2	2	2	2	2	2	-	2	-	-	1	2

Subject Code: PRJME881	**Category:** Project
Subject Name: Project-VI	**Semester**: Eighth
L-T-P: **0-0-8**	**Credit: 4**
Pre-Requisites: All Subjects	

Course Contents:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design and formulation of the problem is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester. The students in a group of 4 to 6 works on a topic are to be approved by the head of the department under the guidance of a faculty member. The students prepare a comprehensive project report after completing the work to the satisfaction of the supervisor to be submitted at the end of the semester. The progress of the project is evaluated by a committee may be constituted by the Head of the Department. The project work is evaluated based on oral presentation and the project report may jointly by external and internal examiners constituted by the Head of the Department.

Course Outcomes:

1. Select a suitable problem/research gap through literature to solve the real life problems faced by the society
2. Find solution either through simulation or through practical work.
3. Present the results from the work comprehensively through presentation and develop a comprehensive report
4. Present his/her work in a conference or publish the work in a peer reviewed journal

TEXT BOOKS:

- C. R. Kothari, Research Methodology: Methods and Techniques, New Age International (P) Limited, Publisher

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	1	1	1	1	1	2
CO2	3	3	3	2	3	2	1	1	1	1	1	2
CO3	3	3	3	2	3	2	1	1	1	1	1	2
CO4	3	3	3	2	3	2	1	1	1	1	1	2

Solar Energy System Installations and Maintenance

Course Code	MINOR801S
Course Title	Solar Energy System Installations and Maintenance
Number of credits	03[Lecture(15hours):1,Practical(15hours):2,Social(15hours):1]
Course category	SEE
Pre-requisite	SEE-401

Course Objective:

This course will offer

- Understanding the site survey, feasibility study, site access, clearance and identifying component mounting location.
- Estimating the Solar PV plant capacity based on site active area and electricity bill consumption.
- Making Project SLD and Performance report using simulation software.
- Project scheduling, making BOM, material procurement and logistics at site.
- Understanding of installation tools, safety equipment, and risks involved.
- Project execution strategy and understanding best installation practices.
- Understanding civil work and types of module mounting structures.
- Understanding Earthing and Lightening protection system.
- Hands-On installation, testing & commissioning of a 1 kWp Off-Grid and 1 kWp On-Grid Solar PV plant.
- Understanding net metering, gross metering procedures and other important authority policies and approvals.
- Identify common factors that result in deviations from expected system performance.
- Understanding typical maintenance requirements for PV systems.
- Identify the safety requirements for operating and maintaining different types of PV systems.

Course Content

D. Theoretical Learning

Each lecture is assumed to be of one hour. In content column, if possible breakdown the content of 1 hour in sub-topics

Lecture No.	Contents
1	**Site survey and assessment:** Introduction to Solar Radiation, how to measure the solar radiation at site, Optimum orientation of Solar PV modules, Impact of environmental parameters on module performance, Visit and evaluate the site for installation, Points to check when selecting the installation location
2	**PV Capacity Estimation:** Understanding the electricity consumption of the customer, case study of user electricity bills and understanding various parameters essential for estimating the solar capacity, comparing the electricity consumption vs the area available at the site and propose the best capacity that can, In this case as both the inputs are not available, the BATTERY as storage medium
3	**System SLD and Performance Ratio using Simulation Software:** Read and Interpret the Single Line Diagram, Layout Diagrams Solar Panels Sizing, String combination, Inverter selection, Inverter rating, AJB rating, ACDB rating, How to make the SLD, System designing in Simulation software for calculating the plant performance ratio.

4	**Understanding PV Components and their Datasheets:** Identify the different components of a Solar PV system and its basic operation; Identify and understand the working of different types of Solar PV systems, Understand and acquire know-how of different Types, sizes and specifications of , Modules, Solar Inverters, Charge Controllers, Cables, Conduits, Junction Boxes, Solar Batteries and allied accessories, Read and Interpret the manufacturing data specification sheets
5	**Importance of Civil work and type of Solar Structures:** Understand and acquire know-how of different Types, sizes and specifications of foundations/footings, Select the right footing/foundation as per site location including suitability of roof condition or suitability of soil, What is a module mounting structure (MMS), why a mounting structure, What are the typical components of a MMS, design criteria
6	. **Understanding BoS:** The key balance of system components, selection criteria, installation process, Do's and Don'ts while installation. The balance of system equipment must be selected and installed correctly. If appropriate design procedures are not followed through, the system could have performance and reliability problems, premature faults and even failure.
7	**Plant and array Layout:** How to make a plant layout, Maintenance walkways, safety lifeline, access to solar panels, Shadow impact mitigation, Stringing – as per inverter specifications, temperature, Inter-row gap w.r.t. latitude of site, Landscape or portrait orientation
8	**AC and DC Cables and its sizing:** What is a conductor, Aluminium and Copper conductor difference, Power cable, Properties of cable insulation, Points to check before wiring, Types of wires, Different sizes of wires, Selection parameters of wires, Select the correct cable type, color, and gauge, Sizing of wires as per the plant design, Case study on cable sizing for different distances between Inverter and LT panel

9	**Understanding Distribution Boards and LT Panels** Identifying the grid LT panels at the site, What is a DCDB/AJB, what are the protections used in a AJB, types of AJB, Connection between Solar panel and AJB, Voltage and current rating of AJB, IP ratings of AJB and ACDB, ACDB types and protections, ACDB ratings and connection with LT panels
10	**Installation tools and Safety at Site** Introduction to measuring Instruments and types of tools, Marking Tools and hardware required for solar installation such as fasteners, nut bolts, lugs, etc, Plant Safety, inventory management and Assembly, Safe practices against harsh weather, Potential electrical hazards, Potential chemical hazards, Common steps to begin with a safe work practices, How a First aid kit for solar is different
11	**Project Execution Strategy:** The installer's responsibilities in SPV installation, System Design plan, Procurement plan, Site preparation plan, Material delivery plan, Installation plan, Civil work, Structure erection, Module mounting, Cable laying, Battery connection, Inverter mounting, meter connection and testing commissioning, Testing and commissioning plan, Operation and maintenance plan
12	**Net and Gross Metering concepts:** Comparison of Net metering and Gross metering, understanding the state policies for net metering, benefits and drawbacks of the net metering, procedure, charges and energy tariff. Eligibility criteria for net metering, various government approvals as per state energy regulation commission. Case study of an electricity bill before meter metering and after solar net meter
13	**Grid Synchronization** Protection at the AC side, AC side connection topology, Grid Integration, Integration challenges, Anti Islanding process, What is a micro grid system, Synchronization with DG

14	**Typical operation and maintenance(O&M) of a PV Plant** What is O&M, approaches or types of O&M, parts of O&M, challenges to O&M, factors that affect the cost of O&M, Health and safety during O&M, Performance indicators in O&M, Warranty Management & its objectives, What should be the general steps in O&M activity?, How you will come to know that O&M is needed & how you will initiate? How you will find the fault & trouble shoot it?
15	**PV Plant protections** Lightning, Surge, faults, earthing and protection, Lightning and Earthing EN standards, IEEE standards, What does a lightening arrestor do, Type of lightening arrestor, Surge arrestors, Earthing procedure and types of earthing, determining the number of earthing in a Solar PV plant.

E. Practical Learning

Each experiments can be of 1.5 to 3 hours. In contents please provide as detailed titled of the experiments as possible, also breakdown experiments in sub experiments to give clear indication on what are the concepts/observations students are expected to learn in each experiments.

Experiment No.	Contents
Note	Hands On Installation in group of 4-5students
1	Site assessment, Finalizing the shadow free area facing to the south direction, Foundation Marking using line, dori and measuring tape, Casting Civil Blocks (or using ready-made) with the mentioned grade and steel enforcement and Anchoring the fasteners for MMS
2	Module Mounting Structure installation for a 1 kWp Solar Plant, Safety at heights and work health
3	Solar Panel Installation for a 1 kWp Solar Plant, Testing of solar array, Earthing and wiring test

4	Making string connection as per the plant layout and cable laying to the DCDB/Inverter through conduits, Dismantling cable and crimping termination
5	Battery connection for Off grid system, Inverter and ACDB erection on the wall, terminating the AC Cables from Inverter to ACDB and ACDB to LT Panel, Testing of batteries and charge controller

F. Social Learning

This activity would be most crucial and needs careful design. This includes activities outside the classroom and outside the laboratory. Students must do something to apply their knowledge. This can also be exercise to apply the knowledge learned in classroom and laboratory and gather more information/data from society on a topic.

Social experiment No.	Contents
Note	These experiments are to be done as teamwork, entire batch can make one or two teams Teams may choose the installation of any other renewable energy technology-based system, like a hot water system, a biogas plant, a wind turbine, etc.
1	Make a project plan to install solar system in a school / college / NGO, estimate the cost and raise funds. Plan may include installation of solar power system, street light, water pump or any other requirement
2	Conduct the site survey and estimate the solar PV capacity using his electricity bills, Finalize the design and SLD, make the BOM list
3	Material procurement and transportation, Installation of the solar, commissioning of solar power plant

Tools required:

- Solar system components (panels, battery, structure, wires) for a given design
- Cement and concrete
- Measuring tape, installation tools (angle meter, screw driver, spanner, level meter, etc.)

Textbooks and other references

- PVsystemdesignSoftware
  - ✓ https://www.pvsyst.com/
  - ✓ https://www.homerenergy.com/homer/software
  - ✓ https://solargis.com/
- Solarradiationdataofanyplaceacrosstheworldhttps://globalsolaratlas.info/map
- KnowledgeCentre,MinistryofNew&RenewableEnergy-GovernmentofIndia https://mnre.gov.in/
- Chapter 03, S. P. Sukhatme and J. K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw Hill, 2008
- Chapter01,J.K.NayakandJ.A.Prajapati, HandbookOnEnergyConsciousBuildings,2006
- C.S.Solanki, Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, Prentice Hall of India, 2013
- PV Installation Professional Resource Guide–NABCEP

http://www.nabcep.org/wp-content/uploads/2016/10/NABCEP-PV-Resource-Guide-10-4-16-W.pdf

- Photovoltaics: Design and Installation Manual, Solar Energy International (SEI),USA https://www.solarenergy.org/

Course Code	:	MINOR881A
Course Title	:	Projects in AIML
Number of Credits	:	2 (L: 0; T: 0; P: 4)
Semester	:	8th Semester

Course Objectives

Apply AIML concepts to real-world problems.

1. Develop practical skills in designing, implementing, and evaluating AIML models.
2. Learn to work with various AIML frameworks, tools, and libraries.
3. Understand the importance of data preprocessing, feature engineering, and model evaluation.

Project-Based Learning

Students will work on individual or group projects, applying AIML concepts to real-world problems. Projects may include:

1. Image classification
2. Sentiment analysis
3. Recommendation systems
4. Time series forecasting
5. Chatbots

Assessment

1. Project evaluations
2. Code reviews
3. Written reports and presentations
4. Peer feedback and self-assessment

Course Outcomes: This course outline provides

1. A comprehensive overview of AIML projects, covering both theoretical foundations and practical applications.
2. Students will gain hands-on experience working on projects.
3. Students will develop skills in designing, implementing, and evaluating AIML models.

Course Code: MINOR881R
Course Title: Project in Robotics
Number of Credits: 2 (L: 0; T: 0; P: 4)
Course Category: Minor Degree

Course Objective

To assimilate the theoretical knowledge gained in lecture courses (ROB-1 to 4) and apply it to real-life practical applications, enabling skill development and improving employability in robotics-related industries.

Revised Course Contents

This course is a project-based course. The guidelines for conducting the course are as follows:

1. Students will be divided into small teams of two to four members within the first week, depending on total registrations.
2. Each team will have a coordinator/leader nominated by the course coordinators.
3. The project may be of the following types:
    - **Literature Search (LS):** Study an aspect of robotics such as kinematics, dynamics, controls, sensing, vision, etc.
    - **Algorithm Development (AD):** Develop and test algorithms using RoboAnalyzer, MATLAB/Octave, Python, or similar tools.
    - **Design/Synthesis (DS):** Propose a new system or robotic solution for a specific problem.
4. Teams must finalize their topic within the **first two weeks** of the course.
5. Students should spend around **4 hours per week** on project discussions, software/hardware work, literature study, programming, etc.
6. A short weekly interaction session will be used for guidance on literature survey, hardware sourcing, algorithm selection, motor selection, and case-study discussions.

Text Books / References

1. Chuhan, M., and Saha, S.K., 2010, *Robotics Competition Knowledge Based Education in Engineering*, Pothi.com.

2. Baun, M., and Chaffe, J., 2018, *Engineering and Building Robots for Competitions*, Amazon.com.

Online Resources:

1. http://www.ddrobocon.in/
2. http://courses.csail.mit.edu/iap/6.095/

Course Outcomes

After completing this course, students will be able to:

1. **Work effectively in multidisciplinary teams** and coordinate tasks to develop a robotics project.
2. **Apply theoretical concepts** from robotics courses to design, analyse, or implement a practical hardware/software solution.
3. **Use appropriate tools and technologies** (simulation, programming, sensors, actuators) for solving robotics-related problems.
4. **Create and deliver concise technical presentations**, demonstrating project outcomes and improving communication skills for academic and industrial settings.