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 2025-2026

DEPARTMENT OF MECHANICAL ENGINEERING

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8th sem Course Structure
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Syllabus for B. Tech Admission Batch 2022-2026

8th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	HSMC	HSMME801	Universal Human Values	2	0	0	2	2
2	OEC	OECME801	Open Elective-III	3	0	0	3	3
3	HSMC	ESP802	Essential Studies for Professionals - VIII	2	0	0	2	0.5
Practical / Sessional Papers								
4	PRJ	PRJME881	Project-VI (Prototype & Testing)	0	0	8	8	4
5	PRJ	PRJME882	Internship II	0	0	0	0	4
6	PRJ	PRJME883	Comprehensive viva	0	0	0	0	1
7	HSMC	SDP881	Skill Development for Professionals - VIII	0	0	2	2	0.5
			TOTAL				**19**	**15**
For B.Tech Honours Degree								
8	MOOCS	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Artificial Intelligence and Machine Learning								
9	MD	MINOR881A	Project in AIML	0	0	4	4	2
For B.Tech with Minor Degree in Robotics								
10	MD	MINOR881R	Project in Robotics II	0	0	4	4	2
For B.Tech with Minor Degree in Sustainable Energy Engineering								
11	MD	MINOR801S	Solar Energy System Installations and Maintenance	1	1	2	3	3
Mandatory Courses								
12	MC	IFC	Industry and Foreign Certification (IFC)	-	-	-	-	-
13	MC	MAR	Mandatory Additional Requirements (MAR)	-	-	-	-	-
14	MC	SAR	Skill Activity Report (SAR)	-	-	-	-	-

List of Open Electives for Elective-III

A. Total Quality Management
B. Maintenance Engineering
C. Quality & Reliability Engineering
D. Machine Learning
E. Biomechanics & Biomaterials

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8th Semester

Subject Code: OECME801A	**Category:** Open Elective Courses
Subject Name: Total Quality Management	**Semester:** Eighth
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: 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	Contact Hrs.
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.	6
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.	6
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.	18

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	6

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

1. Understand quality management philosophies, techniques, and frameworks
2. To understand different TQM principles
3. Apply tools and techniques of TQM in manufacturing and service sectors.
4. Understand the implications of quality management standards and systems

Learning Resources:

1. D.H. Besterfield, C. Besterfield, G.H. Besterfield, M. Besterfield, H. Urdhwareshe and R. Urdhwareshe, Total Quality Management, Pearson Education,2018.
2. A. Mitra, Fundamentals of Quality Control and Improvement, Wiley Student Edition,2008.
3. S. Ramasamy, Total Quality Management, McGraw Hill Publishing Co., New Delhi,2011.
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 Code: OECME801B	**Category:** Open Elective Courses
Subject Name: Maintenance Engineering	**Semester:** Eighth
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: 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	Contact Hrs.
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.	5
2	**Total Productive Maintenance (TPM):** definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE).	3
3	**Organizational structures for maintenance:** Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	4
4	**Economic Aspect of Maintenance:** Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools, planning, reports.	4

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.	6
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.	4
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.	10

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

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Subject Code: OECME801C	**Category:** Open Elective Courses
Subject Name: Quality & Reliability Engineering	**Semester:** Eighth
L-T-P: 3-0-0	**Credit:** 3
Pre-Requisites: No	

Module No.	Description of Topic	Contact Hrs.
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);	3
2	Creating Quality by Design Assessment of Customer's needs; Formulation of Design Specifications; Standardization; Costs of Quality; Quality Circles; 5-S concept;	4
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;	4
4	Process Control Control Charts; Statistical Quality Control Tools; Statistical Process Control and Process Capability, Zero defect programme; Six – Sigma approach;	4
5	Quality Management Systems	4

	ISO 9000 Series of Standard; ISO 14000 Series of Standards;	
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.	5
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 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 weilbull distribution, Advantages of weibull distribution; System reliability models: series system, parallel system, series-parallel system.	7
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.	5
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

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.
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 Code : OECME801D	**Category:** Open Elective Courses
Subject Name : Machine Learning	**Semester** : Eighth
L-T-P : **3-0-0**	**Credit: 3**
Pre-Requisites: Mathematics- IB, Mathematics- IIB, Mathematics- III	

Course Objective:

To introduce students to the basic concepts and techniques of Machine Learning.
To have a thorough understanding of the Supervised and Unsupervised learning techniques. To study the various probability-based learning techniques.
To understand graphical models of machine learning algorithms.

Course Content:

Module No.	Description of Topic	Contact Hrs.
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– Linear Separability– Linear Regression.	8
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.	7
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– Nearest Neighbour Methods– Unsupervised Learning– K-means Algorithms– Vector Quantization– Self Organizing FeatureMap.	7

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.	7
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.	7

Course Outcomes:

Upon completion of this course, the 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

Learning Resources:

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.
4. P. Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press,2012.
5. J. Bell, Machine learning– Hands on for Developers and Technical Professionals, First Edition, Wiley,2014.
6. E. Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning Series), 3rd Edition, MIT Press, 2014.

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: OECME801E	**Category:** Open Elective Courses
Subject Name: Biomechanics & Biomaterials	**Semester**: Eighth
L-T-P : **3-0-0**	**Credit: 3**
Pre-Requisites: No	

Module No.	Description of Topic	Contact Hrs.
1	Musculoskeletal Anatomy: Basic Statics and Joint Mechanics (elbow, shoulder, spine, hip, knee, ankle)	6
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 Adaptation of Major Tissues and Organs	6
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.	6
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.	6
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-materials interaction, short and long term reactions to the body.	6
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.	6
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

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Subject Code: HSMC802	**Category** : Mandatory& Industry ValueAdded Course
Subject Name: ESSENTIAL STUDIES FOR PROFESSIONAL VIII	**Semester** : 8th
L-T-P : 2-0-0 (Total Contact Hrs. 2)	**Credit:** 0.5
Pre-Requisites: Fundamental knowledge of humanities & social science subjects till class 10th standard and knowledge of Economics up to class11th standard.	

Course Objective:

1. To learn about basic of History to know about our past and to implement it in our daily life.
2. To learn about the Political System of Our Country.
3. To learn the concepts of Basics of Geography and Economics from which Students will acquire knowledge for Competitive exams.

Course Outcomes:

At the end of the course the students will be able to

1. To inculcate human values and ethical thinking among students.
2. To prepare the stage for facing different levels of civil service and other competitive examinations.
3. To prepare the ground for making them aware of the happenings, cultural historical and developmental aspects of the country as well as global affairs

Course Content:

Module No.	Description	Hours	BloomsLevel	PO(1..12) Mapping
1.	**Laws of Society:** Evolution of Indian Constitution, Part -II and Part - III.	10	L1 (Remember) L2 (Understand) L4 (Analyze)	PO6, PO7, PO8
2	**Our Freedom Struggle:** Indian National Congress, National Movement- 1905- 1947.	10	L1 (Remember) L2 (Understand)	PO6, PO7, PO8

3	**Know Our Country:** Physiography of India.	10	L1 (Remember) L2 (Understand)	PO6, PO7, PO8
4.	**Economics:** Capital and Money Market, Fiscal System of India.	15	L1 (Remember) L2 (Understand) L4 (Analyze)	PO6, PO7, PO8
5.	**India and World:** Monthly Current Affairs Magazine	2	L1 (Remember) L2 (Understand)	PO6, PO7, PO8
6.	**Universal Human Values:** Nature acceptance of Human Values, Competence in Professional Ethics, Strategies for transition towards value-based life and profession.	1	L1 (Remember) L2 (Understand)	PO6, PO7, PO8

Learning Resources:

- Indian Constitution- M. Laxmikant
- Indian Economy-Ramesh Singh
- History of Modern India- Bepan Chandra
- Geography of India- Majid Hussain
- Current Affairs Magazine of IEM-UEM

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Subject Code: HSMC882	**Category** : Mandatory& Industry ValueAdded Course
Subject Name: SKILL DEVELOPMENT FOR PROFESSIONALS	**Semester** : 8th
L-T-P : 2-0-0 (Total Contact Hrs. 2)	**Credit:** 0.5
Pre-Requisites: Fundamental knowledge of Mathematics, English language till class 10th standard and basic aptitude for Reasoning ability	

Course Objective:

1. To learn about basic of Mathematics to apply for Engineering problems as well as in daily life.
2. To learn about the Basics Grammatical English and Vocabulary.
3. To sharpen and develop the basic Aptitude skill.

Course Outcomes:

At the end of the course the students will be able to

1. Revision of entire Syllabus along with specific type of Mock Tests for the competitive exams like UPSC, IBPS, SBI PO/SO, SSC, RAIL, INSURANCE etc.
2. Learning Advance quantitative Aptitude Techniques on Algebra, Geometry, Menstruation, Trigonometry etc. which is very essential for appearing in different competitive Exams along with SSC.
3. Solving Puzzle based problems & learning different Analytical techniques.
4. Misc Practice sets on different Competitive Exams mains level papers.
5. Introduction to Critical reasoning.
6. Full Length Mock tests of different Competitive Exams (Prelims & Mains).

Course Content:

Module No.	Description	Hours	BloomsLevel	PO(1..12) Mapping
1.	Mock tests OF UPSC CSAT-II.	30	L2 (Understand) L3 (Apply)	PO1, PO2,

			L4 (Analyze)	PO10

Learning Resources:
Text Books:

1. Objective General English- S.P Bakshi
2. English Grmmar and Competition-S.C Gupta
3. Fast Track Objective Arithmetic- Rajesh Verma
4. Quantitative Aptitude– S.Chand

Reference Books:

1. Advance Maths- Rakesh Yadav
2. Verbal and Non-Verbal Reasoning- R.S Agarwal
3. A new approach to Reasoning- BS Sijwali
4. Quantitative Aptitude-R. S Agarwal

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.