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

New Syllabus Outline Structure

For

5th SEMESTER (B.Tech in Mechanical Engineering)

Effective from Academic Year 2025-2026

DEPARTMENT OF MECHANICAL ENGINEERING

Index

5th SEMESTER

SL NO	Category	Paper Code	Paper Name	L	T	P	Total Contact Hrs	Credits
Theory Papers								
1	PCC	PCCME501	Heat Transfer & Thermal Machines	3	1	0	4	4
2	PCC	PCCME502	Machine Element & System Design	3	1	0	4	4
3	PCC	PCCME503	Manufacturing Process- II	3	0	0	3	3
4	PCC	PCCME504	Mechatronics, Robotics & Control	2	0	0	2	2
5	PEC	PECME501	Professional Elective - I	3	0	0	3	3
6	HSMC	ESPME501	Essential Studies for Professionals (ME) - V	2	0	0	2	0.5
Practical / Sessional Papers								
7	PCC	PCCME591	Mechanical Engg Lab IIIC (Applied Thermodynamics & Heat Transfer)	0	0	2	2	1
8	PCC	PCCME592	Mechanical Engg Lab IB (Machine Drawing)	0	0	2	2	1
9	PCC	PCCME593	Mechanical Engg Lab IC (Kinematics & Dynamics of Machines)	0	0	2	2	1
10	PCC	PCCME594	Mechatronics, Robotics & Control Lab	0	0	2	2	1
11	PRJ	PRJME581	Project-III	0	0	2	2	1
12	HSMC	SDP581	Skill Development for Professionals - V	0	0	2	2	0.5
13	HSMC	HSMME582	Seminar & Communication 2	0	0	2	2	1
TOTAL							**32**	**23**
For B.Tech Honours Degree								
15	MOOCs	MOOCS	MOOCs Certificate Courses (NPTEL/SWAYAM)	-	-	-	-	-
For B.Tech with Minor Degree in Robotics								
16	MD	MINOR501R	Microprocessors & Embedded Systems	3	0	2	5	4
For B.Tech with Minor Degree in Sustainable Energy Engineering								
17	MD	MINOR501S	Energy storage systems for renewables	1	1	2	3	3
For B.Tech with Minor Degree in Artificial intelligence and Machine learning								
18	Minor	MINOR501A	Deep Learning and Neural Network	3	0	2	5	4
Mandatory Courses								
19	MC	IFC	Industry and Foreign Certification (IFC)	0	0	0	0	0

20	MC	MAR581	Mandatory Additional Requirements (MAR)	0	0	0	0	0

List of Professional Electives for Elective-I

A. Mechanical Vibration
B. Advanced Welding Technology
C. Micro and Nano Manufacturing
D. Power Plant Engineering
E. Die, Mould and Tool Engineering
F. Computational Fluid Dynamics

University of Engineering and Management

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

Subject Name: Heat Transfer & Thermal Machines **Credit: 4**

Subject Code: PCCME501 **Lecture Hours: 48**

Pre-requisite: Engineering Thermodynamics, IC Engine and Gas Turbine

Relevant Links: STUDY MATERIAL NPTEL

COURSE OBJECTIVES:

The purpose of learning this course is to:

1. Build a solid foundation in heat transfer, exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

CO1: Recognize and understand the mechanisms underlying conduction, convection, and radiation heat transfer.
CO2: Apply mathematical models of heat transfer to solve practical problems, including heat conduction through solids, convective heat transfer in fluids, and radiative heat exchange between surfaces.
CO3: Analyze complex heat transfer problems to identify relevant parameters and boundary conditions for providing solutions in practical engineering scenarios.

CO4: Evaluate the effectiveness and efficiency of different heat transfer mechanisms in various applications and create innovative solutions to enhance heat transfer phenomenon in engineering systems.

Module number	Topic	Sub-topics	Book name and chapter	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	**Introduction**	Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation. Fourier transform and separation of variables techniques.	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 1.	**International Standard:** https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://www.iitbbs.ac.in/mtech-thermal-science-and-engineering.php **Industry Mapping: MATLAB**	6	1. Determination of the thermal conductivity and specific heat of given objects. 2. Solve 1d numerical problems of heat transfer with MATLAB.
2	**Conduction Heat Transfer**	Steady 1D solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry; Concept of conduction and film resistances; Critical insulation thickness; Lumped system approximation and Biot number; Heat transfer through pin fins; 2D conduction solutions for steady and unsteady heat transfer. Transient heat conduction in 1D;	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 3. Domkundwar Arora Domkundwar , A Course in Heat & Mass Transfer, Chapter- 2, Chapter- 4, Chapter- 5, Chapter-6	**International Standard:** https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf https://che.iith.ac.in/assets/acad/btechcourses.pdf https://www.iitbbs.ac.in/mtech-thermal-science-and-engineering.php	6	1. Determination of thermal conductivity of an insulating powder/or an insulating plate. 2. Heat conduction analysis of a solid cylinder using ANSYS

		conduction with moving boundary.		Industry Mapping: MATLAB, ANSYS		
3	**Convection Heat Transfer**	Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection; Turbulent flow in pipes; Flow over bank of tubes; heat transfer for impinging jets.	D.S. Kumar, Heat & Mass Transfer, Chapter 11 & Chapter 12	**International Standard:** Https://Ocw.Mit.Edu/Courses/2-051-Introduction-To-Heat-Transfer-Fall-2015/Pages/Syllabus/ **AICTE-Prescribed Syllabus:** Https://Www.Aicte-India.Org/Downloads/Model_Syllabi_For_Ug_%20mech_%20engg.Pdf Https://Www.Iitmandi.Ac.In/Pdf/Senate_Courses/Me303.Pdf Https://Www.Iitbbs.Ac.In/Mtech-Thermal-Science-And-Engineering.Php **Industry Mapping: ANSYS**	8	1. Simulating Thermal Pipe Flows using ANSYS 2. Simulating heat transfer over a flat plate using ANSYS 3. Determination of the convective heat transfer coefficient for flow over a heated plate. 4. Determine the overall heat transfer coefficient at the surface of a given metal pipe by the forced convection method. 5. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.
4	**Radiation Heat Transfer**	Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 12 & Chapter 13.	*International Standard: https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/* *AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*	8	1. Determination of the emissivity of a given sample. 2. Modelling Radiative heat transfer using ANSYS

		surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield.		https://www.iitmandi.ac.in/pdf/senate_courses/ME303.pdf *Industry Mapping: MATLAB, ANSYS*		3. Calculates view factors and radiative heat transfers between two surfaces using MATLAB
5	**Heat Exchanger Design**	Function, classification and configuration of heat exchangers; overall heat transfer coefficient; concept of fouling factor; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers.	Yunus A. Cengel & Afsin J. Ghajar, "Heat & Mass Transfer", Chapter 11.	***International Standard:*** ***https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/*** ***AICTE-prescribed syllabus:*** *https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf* https://www.iitmandi.ac.in/pdf/senate_courses/ME303.pdf ***Industry Mapping: MATLAB***	3	1. Calculate the outlet temperature for a heat exchanger with ε -NTU method using MATLAB 2. Study of a shell and tube heat exchanger and determination of LMTD.
6	**Boiling and Condensation heat transfer**	Pool boiling; Saturated pool boiling curve; Flow boiling; Rohsenow's nucleate boiling correlation; critical heat flux correlation; minimum heat flux and film boiling correlations. Film and drop wise condensation dew point.	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, Chapter 10.	***International Standard:*** ***https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/*** ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** https://www.iitk.ac.in/me/ME341 ***Industry Mapping: MATLAB***	3	1. Calculate the outlet temperature of a condenser with ε -NTU method using Matlab
7	**Introduction to mass transfer**	Analogy between heat and mass transfer; Mass diffusion; mass diffusion without and	Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass	***International Standard:*** ***https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/***	3	1. Esimate the rate of diffusion of a gas by implementing Fick's

		with homogeneous chemical reactions; boundary and initial conditions; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer.	Transfer, Chapter 14.	***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** https://iitr.ac.in/Departments/Mechanical%20and%20Industrial%20Engineering%20Department/static/Academics/Syllabus/BTech_Mech.pdf ***Industry Mapping: MATLAB***		law of diffusion in Matlab

TEXT BOOK:

1. Yunus A. Cengel & Afsin J. Ghajar, Heat & Mass Transfer, McGraw Hill Education (India) Private Limited, 2014.
2. Domkundwar Arora Domkundwar , A Course in Heat & Mass Transfer, Dhanpat Rai & Co, 2017
3. D.S. Kumar, Heat & Mass Transfer, S.K. Kataria & Sons, 2015

REFERENCE BOOKS:

4. J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.
5. F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.
6. Massoud Kaviany, "Principles of Heat Transfer," John Wiley, 2002.
7. Bejan, "Heat Transfer," John Wiley, 1993
8. P.S. Ghoshdastidar, Heat Transfer, Oxford University Press, 2012

ONLINE RESOURCES: MIT OPEN COURSEWARE

University of Engineering and Management

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

Subject Name: Machine Element & System Design **Credit: 4**
Subject Code: PCCME502 **Lecture Hours: 48**
Pre-requisite: Engineering Mechanics, Mechanics of Deformable solid,

Relevant Links: **STUDY MATERIALS**

Module No.	Topic	Sub-topics	Text Books and Chapters	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Introduction**	Anatomy of machines; Functional dissection machines into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Engineering materials; Design considerations – Limits, fits and standardization; Friction and lubrication.	Design of Machine Elements, V.B.Bhandari - Chapter 2 A Textbook of Machine Design, Khurmi & Gupta – Chapter 3	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ ***Industry Mapping:*** AutoCAD https://www.autodesk.in/products/autocad/	6	Making 2D drawings for some simple machine elements

2	**Failure Theories**	Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.	Design of Machine Elements, V.B.Bhandari - Chapter 4, 5	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechatronics.stanford.edu/mechanical-systems-design ***Industry Mapping:*** ANSYS https://www.ansys.com/en-in/academic/students	10	Applying theories of failures in finite element analysis using ANSYS Mechanical
3	**Force analysis of machine elements**	Force analysis of machine elements and machine systems; Application to power screws, couplings and brakes.	Design of Machine Elements, V.B.Bhandari - Chapter 6,9 A Textbook of Machine Design, Khurmi & Gupta– Chapter 25	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechatronics.stanford.edu/mechanical-systems-design ***Industry Mapping:*** ANSYS https://www.ansys.com/en-in/academic/students	8	Force and strength analysis of power screws, couplings etc. using ANSYS Mechanical
4	**Design of Machine Elements**	*Springs* – Helical compression, tension, torsional and leaf springs; *Fasteners* – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; *Shafts* – shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; *Transmission elements* –	Design of Machine Elements, V.B.Bhandari - Chapter 8, 9, 10, 13, 15, 16, 17, 21	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/pages/readings/ https://biomechatronics.stanford.edu/mechanical-systems-design	18	1. 3D Modelling of machine elements using Solidworks/Creo with the calculated dimensions 2. Checking the safety of

		transmission ratio and efficiency of spur, helical, bevel and worm gears; clutches; belt and chain drives; Flywheels.		***Industry Mapping:*** CREO, Solidworks, ANSYS https://www.ptc.com/en/products/creo https://www.solidworks.com/product/solidworks-3d-cad https://www.ansys.com/en-in/academic/students		the elements by importing the 3D models to ANSYS Mechanical and carrying out Finite Element Analysis
5	**Vibrations of Machine Elements**	Single degree-of-freedom systems; Natural frequency and critical damping; Forced vibration; Resonance; Balancing of reciprocating and rotating masses; Torsional vibration and critical speeds of shafts.	Theory of Machines, S. S. Rattan – Chapter 18	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/2-003sc-engineering-dynamics-fall-2011/pages/mechanical-vibration/ ***Industry Mapping:*** ADAMS	6	Analyse vibrating mechanical systems using ADAMS

Course Outcomes:

After completing this course, students

1. can understand the design specifications, component behaviour subjected to static & dynamic loads and identify the concepts of principal stresses, the failure criteria.
2. can understand the design of shaft, coupling & transmission elements like gear, chain, belt pulley drives.
3. can analyse the pressure distribution and design of power screw, springs, bearings, brakes, clutches and engine parts.
4. can analyse vibration of different mechanical systems

Learning Resources:

Text Books

1. V. B. Bhandari, Design of Machine Elements by, McGraw Hill Publishing Co. Ltd.
2. R. L. Norton, Mechanical Design– An Integrated Approach, Prentice Hall
3. S. S. Rattan, Theory of Machines, McGraw Hills

Reference Books

1. J.E. Shigley and C.R. Mischke, Mechanical Engineering Design, 5th Edition, McGraw Hill International, 1989.
2. D. Deutschman, W.J. Michels and C.E. Wilson, Machine Design Theory and Practice, Macmillan, 1992.
4. R.C. Juvinal, Fundamentals of Machine Component Design, John Wiley, 1994.
5. M.F. Spottes, Design of Machine elements, Prentice-Hall India, 1994.
6. R. L. Norton, Mechanical Design– An Integrated Approach, Prentice Hall, 1998.
7. P. Kannaiah, Machine Design, 2nd Edition, Scitech Publications.

Online Learning Materials:

1. Coursera: https://www.coursera.org/learn/machine-design1
2. NPTEL: https://archive.nptel.ac.in/courses/112/105/112105124/

University of Engineering and Management

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

Subject Name: Manufacturing Process II **Credit: 3** **Lecture Hours: 38**
Subject Code: PCCME503
Pre-Requisites: Manufacturing Processes I

Relevant Links: Study Material

Course Objectives:

To impart knowledge to make students able to demonstrate the conventional and unconventional tooling needed for manufacturing and assembly of different components. Also, students will be able to understand the principles of working with NC, CNC machine tools, and rapid prototyping.

Course Contents:

Module No.	Topic & Sub-topics	Textbook & Chapters	Mapping with Industry and International Academia	Contact Hrs.	Corresponding Lab Assignment
1	**Machine tool** Turning, Drilling, Milling, Grinding, and other finishing processes; Single and multi-point cutting tools; Cutting tool materials; Cutting fluids; Material removal rates, surface finish, accuracy, integrity, and machinability	P.N. Rao, Manufacturing technology Volume II Metal Cutting and Machine Tools, Chater- 2, 3 Manufacturing Processes for Engineering Materials- 6th	**International Academia:** https://ocw.mit.edu/courses/2-670-mechanical-engineering-tools-january-iap-2004/pages/syllabus/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf	8	Utilize CAD software such as SolidWorks or CATIA to create a 3D model of the workpiece, including detailed features and dimensions. Import the 3D model into CAM software like Mastercam or Fusion 360 CAM to generate toolpaths for each machining operation. Conduct experiments or simulations to compare the effects of different cutting tools, materials, and machining parameters on material

		edition- S Kalpakjian & S R Schmid- Chapter 8	**Industry Mapping:** MATLAB, ANSYS, Python		removal rates, surface finish, accuracy, integrity, and machinability. 3. Study of 3D Machining using virtual labs. https://fab-coep.vlabs.ac.in/exp/3d-machining/theory.html
2	**Unconventional Manufacturing Processes:** Abrasive Jet Machining, Water Jet Machining; Ultrasonic Machining; Electrical Discharge Machining, Wire EDM; Electro-Chemical Machining; Laser Beam Machining, Plasma Arc Machining, Electron Beam Machining; Micro and nanomanufacturing.	1. P.N. Rao, Manufacturing technology Volume II Metal Cutting and Machine Tools, Chater- 11 2. Serope Kalpakjian & Steven R. Schmid Manufacturing Engineering and Technology Chapter 27	**International Academia:** https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2004/pages/lecture-notes/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf **Industry Mapping:** Minitab, Ansys	9	Select a specific application or component suitable for micro or nanomanufacturing, considering factors such as size, complexity, and material properties. Utilize CAD software such as SolidWorks or CATIA to design the micro or nanocomponent, ensuring precise dimensions and features. Study the effect of process parameters in electrochemical grinding. https://mm-coep.vlabs.ac.in/exp/electrochemical-grinding/theory.html
3	**CNC Machine Tools** Structure and working principle of CNC lathe, milling machine, Examples and use of CNC machines, Machining Centre (Vertical and Horizontal),	P.N. Rao, Manufacturing technology Volume II Metal Cutting and Machine Tools, Chater- 17 P.N. Rao, CAD/CAM	**International Academia:** https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2003/resources/labs13/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Mod	6	Introduce industry-standard CAD/CAM software such as Mastercam or Fusion 360 CAM for CNC programming. Demonstrate the process of designing and programming a simple part for machining on a CNC lathe or milling machine using the selected software.

	Components and Their Functions in NC/CNC Machines MCU, DPU, and CLU, Feed drives using stepper/ servo motors and recirculating ball screw-nut system, Automatic Tool Changers- Tool Turret and Tool Magazine, Automatic pallet Changer.	Principles and Application, Chapter 9, 10, 11, 12	el_Curriculum/Final_Mechanical%20Engg.pdf **Industry Mapping:** Fusion 360, Solidworks, NX 8, MasterCAM		Introduce simulation software such as Siemens NX or Autodesk HSMWorks for virtual modeling and analysis of CNC machine components and functions. Explore the operation and optimization of automatic tool changers (ATC) such as tool turrets and tool magazines through virtual simulations. Study of Computer Controlled Cutting of wooden object. https://fab-coep.vlabs.ac.in/exp/computer-controlled-cutting/theory.html
4	**Basic systems of NC and CNC machines** Coordinate system, Control–open loop and closed loop, Dimensioning– absolute and incremental, Point–to–point and contour motion, Linear and circular Interpolation. **Part Programming for CNC machines** Manual Part Programming using ISO G and M Codes in CNC lathe and milling machine for simple jobs, Canned cycle. Computer Aided Part Programming using MACRO statements in APT for simple jobs in CNC lathes and milling machines.	P.N. Rao, Manufacturing technology Volume II Metal Cutting and Machine Tools, Chater- 17 P.N. Rao, CAD/CAM Principles and Application, Chapter 13, 14, 15	**International Academia:** https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2003/resources/labs13/ **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf **Industry Mapping:** Fanuc CNC simulator, SIEMENS Sinutrain Software	7	

5	**Additive Manufacturing Processes:** Extrusion; vat polymerization, powder bed fusion; material jetting, binder jetting; direct energy deposition (DED) and lamination processes.	1. Serope Kalpakjian & Steven R. Schmid, Manufacturing Engineering and Technology Chapter 20 2. Principles of Modern Manufacturing, Mikell P Groover, Part VIII, Chapter 29	**International Academia:** https://professional.mit.edu/course-catalog/additive-manufacturing-3d-printing-factory-floor **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf **Industry Mapping:** Solidworks, CURA, ThinkerCAD	6	1. Utilize CAD software such as SolidWorks or Autodesk Fusion 360 to design the component, ensuring adherence to additive manufacturing design guidelines. 2. Simulation of Pre-processing in Additive manufacturing. https://3dp-dei.vlabs.ac.in/exp/simulation-additive-manufacturing/index.html Simulation of Powder Binding / Jetting Process. https://3dp-dei.vlabs.ac.in/exp/simulation-powder-binding/theory.html

Course Outcomes:

1. Gain an understanding of conventional and unconventional machines and associated tools utilized in the manufacturing of diverse components.
2. Comprehend the design and assembly principles of molds and dies within manufacturing processes.
3. Develop proficiency in CNC machine tools operation and programming techniques.
4. Acquire knowledge of additive manufacturing processes and their applications in modern manufacturing.

Learning Resources:

Text Book

1. P.N. Rao, Manufacturing technology Volume II Metal Cutting and Machine Tools, McGraw Hill, 4th edition
2. S. Kalpakjian and S.R. Schmid, Manufacturing Processes for Engineering Materials, 5th Edition, Pearson India, 2014.
3. M.P. Grover, Fundamentals of Modern Manufacturing, 3rd Edition, Wiley.

Reference Book

4. A. Ghosh & A.K. Mullick, Manufacturing Science, EW Press.

5. Y. Koren, Computer Control of Manufacturing Systems, McGraw Hill, 1986.
6. M.P. Groover, Automation, Production Systems and CIM, Prentice Hall.
7. A. Ghosh, Rapid Prototyping, EW Press.
8. P.N. Rao, CAD/CAM Principles and Application, McGraw Hill, 2009.

Online Learning Resources:

1. https://ocw.mit.edu/courses/2-008-design-and-manufacturing-ii-spring-2004/pages/labs/
2. https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. https://onlinecourses.nptel.ac.in/noc21_me04/preview
4. https://www.coursera.org/specializations/autodesk-cad-cam-manufacturing
5. https://www.coursera.org/specializations/cad-design-digital-manufacturing

University of Engineering and Management

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

Subject Name: Mechatronics, Robotics & Control **Credit: 2**

Subject Code: PCCME504 **Lecture Hours: 24**

Pre-requisite: Kinematics of Machines, Mathematics

Relevant Links: **STUDY MATERIAL** **NPTEL**

COURSE OBJECTIVES:

1. Model and analyze mechatronic systems for an engineering application.
2. Identify sensors, transducers and actuators to monitor and control a process or product.
3. Develop PLC programs for an engineering application.
4. Evaluate the performance of mechatronic systems.

COURSE OUTCOMES:

CO1: Students will have developed an ability to recognize and analyze electro-mechanical systems in daily lives.
CO2: Students can understand the role of sensors, actuators, and controls in mechatronic systems.
CO3: They will be able to understand the basic theory of robot kinematics.
CO4: They will be familiar with control theory and controller design.
CO5: Students will appreciate and perform measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Module number	Topic	Sub-topics	Textbook & Chapter No.	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	**Introduction**	Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapter 1]	***International Standard:*** (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***	2	1. List various mechanical systems used in practical life, which can be replaced by more efficient electro-mechanical systems and explain how the transformation can be incorporated.
2	**Sensors**	Transduction principles; Sensitivity, accuracy, range, resolution, noise sources; Sensors for common engineering measurements – proximity, force, velocity, temperature, etc.; Signal processing and conditioning; Selection of sensors.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapter 2]	***International Standard:*** (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***	4	1. Conduct a review of literature on the development of proximity sensors.
3	**Actuators**	Pneumatic and hydraulic actuators; Electric motors including DC, AC, BLDC, servo and	W. Bolton, "Mechatronics," Addison Wesley	***International Standard***: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/)	4	**1.** Model and simulate a piezoelectric system using MATLAB Simulink.

		stepper motors; Solenoids and relays; Active materials – piezoelectric and shape memory alloys.	Longman, 2010. [Chapters 2, 7, 9]	***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***		
4	**Machine Controls**	Microprocessors and their architecture; Memory and peripheral interfacing; Programming; Microcontrollers; Programmable Logic Controllers; PLC principle and operation; Analog and digital input/output modules; Memory module; Timers, internal relays, counters and data handling; Industrial automation systems; Basic PLC programming; Industry kits (Arduino, Raspberry Pi, etc.).	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapters 10, 14]	***International Standard***: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***	4	1. Write a MATLAB script to control the blinking of an LED connected to a microcontroller (e.g., Arduino). Use MATLAB's Arduino support package to send commands to the microcontroller to turn the LED on and off at specific intervals.
5	**Robotics**	Robot configurations: serial and parallel; Denavit–Hartenberg	J. J. Craig, Introduction to Robotics Mechanics and	***International Standard***: (https://ocw.mit.edu/courses/2-12-introduction-to-r	4	1. Create a Simulink model to generate smooth trajectories for a robot

		parameters; Manipulators kinematics; Rotation matrix, Homogenous transformation matrix; Direct and inverse. Kinematics for robot position and orientation; Workspace estimation and path planning; Robot vision; Motion tracking; Robot programming and control; Industrial robots - Pick and place robots, sorting, assembly, welding, inspection, etc.	Control, Addison Wesley, 1999. [Chapters 1, 2, 3, 4]	obotics-fall-2005/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***		manipulator to follow. Experiment with different trajectory generation techniques such as linear interpolation, cubic spline interpolation, or polynomial interpolation.
6	**Control Theory and Systems**	Basic control concepts; Feedback; Open and closed loop control; Concept of block diagrams; P, PI and PID controllers; Tuning the gain of controllers; System models, transfer functions, system response, frequency response; Root Locus method and Bode plots.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010. [Chapters 21, 22]	***International Standard***: (https://ocw.mit.edu/courses/2-017j-design-of-electromechanical-robotic-systems-fall-2009/resources/mit2_017jf09_ch11) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***	4	2. Design a simple control system (e.g., PID controller) and analyze its frequency response using Bode plots. Plot the open-loop and closed-loop transfer functions and analyze the system's stability and performance characteristics using MATLAB.

7	**Computational Tools**	Demonstration and projects using simulation software (e.g., Matlab) for control systems and robotics.	J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999. [Chapters 1, 2, 3, 4]	***International Standard***: (https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf) ***Industry Mapping: MATLAB***	2	1. Model a hydraulic actuator system using Simscape Fluids. Include components such as a hydraulic pump, hydraulic cylinder, valves, and fluid lines to simulate the actuator's movement driven by hydraulic pressure. Investigate how changes in fluid properties, valve settings, or load conditions affect the actuator's performance.

TEXT BOOK:

1. W. Bolton, "Mechatronics," Addison Wesley Longman, 2010.
2. J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999.

University of Engineering and Management

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

Subject Name: Advanced welding Technology **Credit: 3**
Lecture Hours: 36
Subject Code: PECME501B

COURSE OBJECTIVES:

- To make the students learn basic set-up configurations of precision welding equipment and their applications.
- To develop the skills needed to weld ferrous and non-ferrous metals.
- Illuminate the concepts of continuity, mechanism, physics, and design elements in welding process
- Comprehend the characteristics of weldable materials and welding technologies
- Demonstrate the importance of modelling and simulation of welding process
- Develop intellectual skills for correlating the microstructural evolution with the defects and properties of weldments

RELEVANT LINK: Course Material NPTEL

Module No.	Topic & Sub-topics	TextBook & Chapter	Mapping with Industry and International Academia	Contact Hrs.	Corresponding Lab Assignment
1	Overview of welding processes and their classification, types of joints, edge preparation, weld symbols, weld nomenclature, bead geometry, power	O P Khanna Welding Technology, Chapter 4, 5, 6, 8	**International Academia:** https://ocw.aprende.org/courses/materials-science-and-engineering/3-37-welding-and-joining-processes-fall-2002/index.htm	12	1. Simulate precision welding processes using the selected software, considering factors such as welding

	density, heat sources – Gaussian distribution of heat flux, welding techniques – linear and orbital. Arc characteristics. Voltage-current characteristics. Types of welding manipulators and their applications. **Arc Welding-** SAW, TIG, MIG Different types of equipment, Power sources, Choice of Polarity, Arc characteristics, Modes of Metal Transfer, Welding Positions, Electrode selection. **Resistance Welding processes-** Spot, Butt, Seam, Projection. **Solid State Welding processes-** Forge, Friction, Friction Stir, Diffusion, and Roll welding. **Critical and Precision Welding processes-** USW, PAW, LBW, EBW, hybrid welding. Underwater Welding- Wet Welding and Dry Welding: Hyperberic and Cavity. Welding of Plastics- Hot Gas Welding, Hot Tool		**AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical Engg.pdf **Industry Mapping:** MATLAB**,** ANSYS, Python		parameters, material properties, and joint geometry. Optimize welding parameters such as voltage, current, wire feed rate, travel speed, and shielding gas composition to achieve desired weld quality, including bead geometry, penetration, and distortion. 2. Introduce virtual reality (VR) welding simulation technology, including its benefits for training and skill development in welding.

	Welding, Hot Press Welding, Friction Welding, Ultrasonic Welding. Case studies and applications – industrial, automotive and aerospace.				
2	Thermal modeling and simulation of welding processes – governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties, micro/macrostructures of weldments and heat-affected zone. Prediction of weld defects such a crack, segregation, lack of fusion. Modeling and simulation of pulsed arc processes. Solidification behaviour of fusion weld: structural zones, epitaxial growth, weld pool shape and columnar grain structures.	R.S. Parmer "Welding Engineering and Technology" Chapter 2	**International Academia:** **IIT Syllabus:** https://www.iitg.ac.in/mech/documents/94/ME675.pdf **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical Engg.pdf **Industry Mapping:** MATLAB**,** ANSYS, Python	10	1. Provide an overview of industry-relevant software tools for thermal simulation of welding processes, such as ANSYS Welding Simulation or Simufact Welding. 2. Predict mechanical properties, micro/macrostructures of weldments, and heat-affected zone using thermal simulation outputs, such as temperature gradients and cooling rates.

3	Welding Metallurgy, HAZ, Effect of different process parameters on the characteristics of weldment. Weldability of Plain Carbon Steel, Stainless Steel, Cast Iron, Aluminium copper, nickel and titanium alloys. Microstructures of weldment. Impact of micro/ macro-structures and segregation on mechanical properties. Pre – and post-treatment. Effects of heat flow on residual stresses and distortion. Weldability tests. Welding defects – causes and remedies. Methods of testing weldments – mechanical, pressure and leak testing. Inspection methods – visual, penetrant, magnetic, ultrasonic, x-ray and gamma radiography. Use of imaging techniques for online monitoring.	R.S. Parmer "Welding Engineering and Technology" Chapter 8, 9, 10	**International Academia:** **IIT Syllabus:** https://www.iitg.ac.in/mech/documents/94/ME675.pdf **AICTE-prescribed syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical Engg.pdf **Industry Mapping:** MATLAB**,** ANSYS, Python	8	1. Analyze the weldability of plain carbon steel, stainless steel, cast iron, aluminum, copper, nickel, and titanium alloys using simulation results and metallurgical data. 2. Conduct simulations or virtual inspections of weldments using software tools to identify potential defects and evaluate inspection methods.
4	Welding Fixtures, Welding Automation and Robotic Welding, welding sensors	O P Khanna Welding Technology, Chapter 34, 45, 46	**International Academia:** **IIT Syllabus:** https://www.iitg.ac.in/mech/documents/94/ME675.pdf **AICTE-prescribed**	6	1. Provide an overview of software tools commonly used for robotic welding cell design and

	and data acquisition; welding process modeling and optimization;		**syllabus:** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical Engg.pdf **Industry Mapping:** MATLAB**,** ANSYS, Python		optimization, such as RoboDK or Process Simulate. 2. Demonstrate the setup and simulation of robotic welding cells, including robot programming, workpiece positioning, and welding process parameters.

COURSE OUTCOMES:

CO1: Understand principles and characteristics of different critical and precision welding processes, joint configurations, and heat source characteristics

CO2: Apply the knowledge of power sources, formulate governing equations and boundary conditions to simulate the thermal phenomenon in the course of a welding process

CO3: Assess the weldability of different materials, including plain carbon steel, stainless steel, cast iron, and aluminium alloys, based on their metallurgical properties and behaviour during welding.

CO4: Identify common welding defects, understand their causes and remedies, and select appropriate inspection and testing methods for welded joints.

Textbooks/References:

Textbook(s):

1. Dr. R.S. Parmer "Welding Engineering and Technology" Khanna Publishers.
2. O P Khanna “A Text Book of Welding Technology”

Reference(s):

3. American Welding Society, Welding Handbook - Welding Processes Part 2, Vol. 3, AWS, 2004.
4. ASM International Handbook Committee, Welding, Brazing and Soldering, ASM handbook, Vol 6, 1993.
5. Y. N. Zhou, Microjoining and Nanojoining, Woodhead publishing, 2008.
6. L. Liu, Welding and Joining of Magnesium Alloys, Woodhead Publishing, 2010.
7. J. Norrish, Advanced welding Processes, Woodhead publishing, 2006.
8. L. E Lindgren, Computational welding mechanics, Woodhead Publishing Limited 2007.
9. J. A. Goldak, Computational welding mechanics, Springer, 2005
10. H. S. Bawa "Manufacturing Technology-I" Tata Me Graw Hill Publishers New Delhi, 2007.
11. S. V. Nadkami, Modem Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd.
12. CORNU.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers,1994.
13. LANCASTER.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
14. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
15. P.L. Jain “Principles of foundry Technology" Tata Mc Graw Hill Publishers.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc20_me65/preview
2. https://onlinecourses.nptel.ac.in/noc21_me99/preview

University of Engineering and Management

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

Subject Name: Power Plant Engineering
Subject Code: PECME501D **Credit: 3** **Lecture Hours: 36**
Pre-requisite: Engineering Thermodynamics

Relevant Links: NPTEL Study Material

COURSE OBJECTIVES:

The purpose of learning this course is to provide an overview of power plants and the associated energy conversion issues

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to

1. To understand the principles of operation for steam and gas thermal power plants.
2. To understand the principles of operation for hydro power plants and nuclear power plants.
3. To understand the principles of operation for solar, wind and geothermal energy power plants.
4. To understand the economics of power generation and the environmental aspect of power generation.

Module number	Topic	Sub-topics	Textbook and chapter	Mapping with Industry and International Academia	Lecture Hours	Corresponding Assignment
1	**Introduction**	Power plants – types and classification based on energy sources. Fundamentals of thermodynamics, chemistry, and	Nag P.K., Power Plant Engineering, 3rd ed., chapter 1.	***International Standard:*** https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/	5	1. Using Matlab, develop a code to calculate the gross power generation for a

		transport applied to energy systems.		https://www.uprm.edu/inme/wp-content/uploads/sites/96/2019/03/INME-4027-Power-Plant-Engineering.pdf ***AICTE-prescribed syllabus:*** *https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf* ***Industry Mapping: MATLAB***		given power plant, provided the fuel and air flow rate.
2	Coal based Thermal Power Plants	Basic Rankine cycle and its modifications; Rankine cycle efficiency; Cogeneration; Layout of modern coal power plant; Super critical boilers, FBC boilers; Turbines, condensers, steam and heating rates; Subsystems of thermal power plants; Fuel and ash handling; Draught system; Feed water treatment; Binary cycles and cogeneration systems.	Nag P.K., Power Plant Engineering, 3rd ed. Chapter 2 and chapter 3.	***International Standard:*** https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/bookstore/viewsyllabus/2207/81395 ***AICTE-prescribed syllabus:*** ***https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** ***Industry Mapping: MATLAB***	6	1. Using Matlab, develop a code to calculate efficiency and power output of a steam power plant operated on reheat regenerative Rankine cycle with closed cycle feedwater heater. Plot the changes in power output and efficiency for parametric variation of regenerator effectiveness.
3	Gas Turbine	Brayton cycle analysis and	Nag P.K., Power Plant	***International Standard:***	5	**1.** Using Matlab, develop

	and Combined Cycle Power Plants	optimization; Components of gas turbine power plants; Combined cycle power plants; Synthetic fuels; Integrated coal gasification combined cycle.	Engineering, 3rd ed., chapter 11.	https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/bookstore/viewsyllabus/2207/81395 ***AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** ***Industry Mapping: MATLAB***		a code to calculate efficiency and power output of a gas turbine power plant which is having a 90% efficiency of the compressor and turbine.
4	Nuclear Power Plants	Basics of nuclear energy conversion; Reactor heat generation; Thermal design principles; Layout and subsystems of nuclear power plants; Boiling Water Reactor (BWR); Pressurized Water Reactor (PWR); CANDU Reactor; Pressurized Heavy Water Reactor (PHWR); Fast Breeder Reactors (FBR); Gas cooled and liquid metal cooled reactors; Safety measures for nuclear power plants.	Nag P.K., Power Plant Engineering, 3rd ed., chapter 9.	***International Standard:*** https://ocw.mit.edu/courses/22-312-engineering-of-nuclear-reactors-fall-2015/pages/syllabus/ ***AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** ***Industry Mapping: MATLAB***	5	1. Develop a steady-state control program for a nuclear reactor using Matlab/ SIMULINK.
5	Hydroelectric Power Plants	Classification; Typical layout and components. Hydroelectric power; Pumped storage.	Nag P.K., Power Plant Engineering,	***International Standard:*** https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-e	5	1. Develop a generalized model to simulate a

			3rd ed., chapter 10.	nergy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/bookstore/viewsyllabus/2207/81395 ***AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** ***Industry Mapping: MATLAB***		hydro power plant using MATLAB/SIMULINK
6	Renewable Power Systems	Principles of wind, tidal, solar photo-voltaic, solar thermal, geothermal, biogas and fuel cell power systems. Ocean power: thermal and wave. Ocean power: tidal and current.	Nag P.K., Power Plant Engineering, 3rd ed., chapter 14.	***International Standard:*** https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ https://webapp4.asu.edu/bookstore/viewsyllabus/2207/81395 ***AICTE-prescribed syllabus: https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_%20Mech_%20Engg.pdf*** ***Industry Mapping: MATLAB***	5	1. Using MATLAB, develop a code to calculate the efficiency of a wind power plant.
7	Energy Economics and Environment	Economic and environmental issues; Power tariffs; Load distribution parameters; Load curve; Capital and operating cost of different power plants; Pollution control technologies including waste disposal	Domkundwar and Domkundwar, Power plant engineering, eighth ed., Dhanpat Rai and Co, 2016. Chapter 35, 39.	***International Standard:*** https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/pages/syllabus/ ***AICTE-prescribed syllabus:*** *https://www.aicte-india.org/downloads/MODEL_SYLLABI_FO*	5	1. Using MATLAB/SIMULINK, perform the load flow analysis of a series of thermal powered plants

		options for coal and nuclear plants.		*R_UG_%20Mech_%20Engg.pdf* ***Industry Mapping: MATLAB***		and minimize the power tariff.

TEXT BOOK:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. Domkundwar and Domkundwar, Power plant engineering, eighth ed., Dhanpat Rai and Co, 2016.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ONLINE RESOURCES:

Solar energy basics fundamentals **Solar energy system design** **Renewable energy technology**

University of Engineering and Management

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

Subject Name: Essential Studies for Professionals-V
Subject Code: ESP(ME)501 **Credit: 0.5** **Lecture Hours:48**
Study Material

Module number	Topic	Sub-topics	Mapping with International/National/ State Level Exams	Lecture Hours	Corresponding Assignment
1	**Engineering Mechanics**	Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collision.	***National Exams:*** ***1. GATE: (https://gate2024.iisc.ac.in/wp-content/uploads/2023/07/me.pdf)*** ***2. UPSC Engineering Service Examination: (https://upsc.gov.in/sites/default/files/Notif-ESEP-23-engl-140922-Final.pdf), Page- 22,23*** ***3. UPSC Civil Service Examination: (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), Page- 127- 129*** ***4. SSC Junior Engineer: (https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/N***	16	1. Explain the concept of a free-body diagram. How does it aid in analyzing the equilibrium of a system? 2. Define trusses and frames in the context of structural engineering. Discuss the fundamental differences between them. 3. A bridge structure consists of multiple trusses connected together. Explain the advantages and disadvantages of using the method of joints compared to the method of sections for analyzing the forces in the members of such a complex frame. When might one method be preferred over the other? 4. Discuss the concept of static determinacy in trusses and frames. How does the number of supports and internal connections affect the determinacy of a structure? Provide an example of a statically determinate truss and a statically indeterminate frame. 5. What is virtual work, and how does it relate to the principle of virtual displacement?

			OTICE_JE_2023_26072023.pdf) 5. ***RRB JE,Technician, & Miscellaneous Category Posts:*** ***(https://wcr.indianrailways.gov.in/uploads/files/1658493303114-english%20GDCE%2002_2022.pdf)***		6. Discuss the limitations of using virtual work for solving real-world engineering problems. Are there any situations where virtual work might not be a suitable approach? Explain your reasoning. 7. A cannon fires a projectile at an angle towards a target. Describe the different stages of the projectile's motion after it leaves the cannon's barrel. Explain how the initial launch angle and velocity affect the trajectory and range of the projectile using the concepts of horizontal and vertical components of motion. 8. Discuss the different types of collisions (elastic, inelastic, and perfectly inelastic) and how they are characterized based on the conservation of momentum and kinetic energy. 9. A tennis ball is served during a match. Explain the concept of impulse and how it relates to the change in momentum of the ball during the serve. Is there a transfer of momentum involved between the racket and the ball? Explain. (10 points) 10. A car is negotiating a turn on a racetrack. Describe the different types of motion the car undergoes during the turn (translation, rotation, or both). How do the concepts of angular velocity and angular acceleration relate to the car's turning behavior?
2	**Casting, Forming and Joining Processes**	**Metal Casting:** Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes;	***National Exams:*** 1. ***GATE:*** ***(https://gate2024.iisc.ac.in/wp-content/uploads/2023/07/me.pdf)*** 2. ***UPSC Engineering Service Examination:*** ***(https://upsc.gov.in/sites/default/files/Notif-ESEP-23-engl-140922-Fi***	32	1. Design of product by solid work which will manufacture by casting. 2. derive an equation for the solidification time for the droplet in vacuum (an analog of Chvornikov's rule). 3. Using Solidworks optimize the gating and riser system design for a complex automotive engine block casting to minimize defects such as shrinkage porosity and ensure uniform solidification throughout the component

		Forming: load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. **Joining:** Principles of welding, brazing, soldering and adhesive bonding **Thermodynamics:** Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations **Engineering Materials:** Structure and properties of engineering materials,	*nal.pdf), Page- 22,23* 3. ***UPSC Civil Service Examination:*** *(https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), Page- 127- 129* 4. ***SSC Junior Engineer:*** *(https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/NOTICE_JE_2023_26072023.pdf)* 5. ***RRB JE,Technician, & Miscellaneous Category Posts:*** *(https://wcr.indianrailways.gov.in/uploads/files/1658493303114-english%20GDCE%2002_2022.pdf)*		4. Utilizing AutoForm simulate and optimize the progressive die stamping process for a high-strength steel automotive chassis component, considering factors such as material flow, springback, and die wear, to achieve improved part quality and production efficiency. 5. simulate and optimize the roll forming process for manufacturing complex structural profiles, such as those used in the construction industry, while ensuring precise dimensional accuracy, uniform material flow, and minimizing springback effects 1. Calculate Boundary Work using Matlab 2. Using Matlab, do the first law analysis of a compressor and a turbine. 3. Create a Matlab code to calculate enthalpy and entropy of a pure substance at a given temperature and pressure. 4. Using Matlab, do the second law analysis of a compressor and a turbine. 5. Using Matlab, calculate the entropy destroyed in a compressor and a turbine. 6. Using Matlab, do the exergy analysis of a compressor.

		phase diagrams, heat treatment, stress-strain diagrams for engineering materials			

Text Books:

Textbook: Acing the GATE: Mechanical Engineering by Ajay Kumar Tamrakar, Dinesh Kumar HarurSampath, Publisher Wiley

Chapter 1, 8, 10, 11, 12, and 13.

1. G.K publishers GATE Mechanical Engineering,
2. McGraw Hill GATE 2017 Mechanical Engineering,
3. Wiley GATE 2017 Mechanical Engineering

University of Engineering and Management

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

Subject Name: Mechanical Engg Lab IIIC (Applied Thermodynamics & Heat Transfer)

Subject Code: PCCME591 **Credit: 1**

Pre-Requisites: Engineering Thermodynamics, IC Engine & Gas Turbine

Objectives:

(i) To understand the principles and performance characteristics of thermal devices.
(ii) To measure different thermal properties related to heat transfer equipment.

Contents (List of Experiments):

Topic	Mapping with Industry and International Academia	Corresponding Lab Assignment
1. Determination of dryness fraction of steam by combined separating and throttling calorimeter. 2. Study and performance test of a single acting reciprocating air compressor. 3. Determination of the thermal conductivity and specific heat of given objects. 4. Determination of the convective heat transfer coefficient for flow over a heated plate. 5. Determine the overall heat transfer coefficient at the surface of a given metal pipe by the forced convection method. 6. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf https://che.iith.ac.in/assets/acad/btechcourses.pdf https://www.iitbbs.ac.in/mtech-thermal-science-and-engineering.php	1. Modelling of two stage reciprocating compressor using MATLAB 2. Design and Optimization of Air Compressor Intake Valve Body Casing using ANSYS 3. Thermal conductivity and specific heat analysis using ANSYS 4. 1D finite difference heat transfer analysis using MATLAB

7. Determination of thermal conductivity of an insulating powder/or an insulating plate. 8. Determination of the emissivity of a given sample. 9. Study of a shell and tube heat exchanger and determination of LMTD.	***International Standards:*** https://ocw.mit.edu/courses/2-051-introduction-to-heat-transfer-fall-2015/pages/syllabus/ Industry Mapping: MATLAB, ANSYS	5. Finding Convective Heat Transfer Coefficient using MATLAB 6. Shell-Tube Heat Exchanger Simulator using MATLAB

Course Outcomes:

CO1: Recognize different modes of heat transfer and their characteristics and interpret heat transfer phenomena observed in experiments.
CO2: Apply mathematical models of heat transfer to solve practical problems.
CO3: Analyze experimental data to determine thermal properties of materials and heat transfer coefficients.
CO4: Evaluate the effectiveness of different heat transfer mechanisms in various practical scenarios and create an innovative solution for enhancing heat transfer efficiency in engineering systems.

University of Engineering and Management

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

Subject Name: Mechanical Engineering Laboratory IB (Machine Drawing)
Subject Code: PCCME592 **Credit: 1**
Lecture Hours: 24

Module No.	Topics	Mapping with Industry and International Academia	Laboratory Hours
1	Schematic product symbols for standard components in mechanical systems, e.g. Welding symbols, Pipe-joint symbols	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards*** : https://ocw.mit.edu/courses/4-500-introduction-to-design-computing-fall-2008/ https://explorecourses.stanford.edu/search?view=catalog&filter-coursestatus-Active=on&q=ME%20181:%20Deliverables:%20A%20Mechanical%20Engineering%20Design%20Practicum&academicYear=20152016 ***Industry Mapping:*** Autodesk AutoCAD https://www.autodesk.in/products/autocad/ PTC Creo https://www.ptc.com/en/products/creo SolidWorks https://www.solidworks.com/product/solidworks-3d-cad	4
2	Orthographic projections of machine elements, Different sectional views- full, auxiliary sections; Isometric projection of machine components;		4
3	Assembly and detailed drawings of various mechanical assemblies, e.g. i. Plummer block, ii. Tool head of a shaping machine, iii. Tailstock of a lathe, iv. Simple gear box, v. Flange coupling,		8
4	Welded bracket joined by stud bolt on to a structure, welded pipe joints indicating work parts before welding, etc.		2
5	Introduction to production and fabrication drawing.		2

6	Drawing different machine components in 3D CAD environment and extracting their orthographic and isometric projections.		4

Course Outcomes:

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

CO1. Create knowledge about the various practices with regard to the dimensioning, sectioning and development of views.
CO2. Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
CO3. Prepare part or assembly drawings as per the conventions.
CO4. Interpret of machine drawings that in turn help the students in the preparation of the production drawings.

Learning Resources

1. N. D. Bhatt , Machine Drawing, Charotar Publishing House
2. K. L. Narayana, P. Kannaiah, K. Venkata Reddy, Machine Drawing, New AGE International Publishers
3. R. K. Dhawan, A Textbook of Machine Drawing, S Chand & Company.

University of Engineering and Management

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

Subject Name: Mechanical Engg Lab IC (Kinematics & Dynamics of Machines)

Subject Code: PCCME593 **Credit: 1** **Lecture Hours: 24**

Pre-requisite: Engineering Mechanics (Statics), Engineering Mechanics (Dynamics)

Relevant Link: STUDY MATERIAL **NPTEL** **COURSERA (1 & 2)**

Course Objectives:

To understand the deformation behaviour of materials

To understand the kinematic and dynamic characteristics of mechanical devices

Course Contents (experiments/ problems/ studies are to perform):

Topic	Mapping with Industry and International Academia	Corresponding Lab Assignment
1. To study various types of gear and gear trains. 2. Determination of velocity ratios of simple, compound, epicyclic and differential gear trains and to evaluate torque and energy required 3. Studying kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms	***AICTE prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_Mechanical%20Engg.pdf ***International Standards:*** https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/resources/chapter4/ ***Industry Mapping:*** SOLIDWORKS Motion Simulation	1. Visual study of some basic mechanism 2. Kinematic study of some simple mechanics using manual calculations and validating the results with SOLIDWORKS Motion Simulation 3. Kinematic study of different types of cam-follower pairs using manual calculations and

4. Studying kinematics of typical mechanisms like pantograph, some straight-line motion mechanisms, wiper, drafter, etc. 5. Motion studies of different cams & followers. Draw displacement diagram, velocity diagram & acceleration diagram of cam follower. 6. Single degree of freedom Spring-mass- damper system: determination of natural frequency and damping coefficient 7. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies 8. Studying machine vibration using sensor 9. Solving simple balancing problems experimentally	https://help.solidworks.com/2021/english/SolidWorks/motionstudies/c_motion_analysis.htm Physical inspection of cam-follower mechanisms in machines Hexagon ADAMS Simulation Dynamic analysis of single and multi DOF systems using Hexagon ADAMS Simulation https://hexagon.com/products/product-groups/computer-aided-engineering-software/adams Physical inspection of different types of gears in motion in machines SOLIDWORKS Motion Simulation https://help.solidworks.com/2021/english/SolidWorks/motionstudies/c_motion_analysis.htm Demonstration of static and dynamic balancing in the laboratory (in a smaller version of an industrial machine)	validating the results with ADAMS Simulation 4. Kinematic study of different types of gears using SOLIDWORKS Motion Simulation 5. Balancing of an unbalanced rotating mass system using manual calculation and applying in actual setup. 6. Calculating the gyroscopic couple manually and validate with experimental results 7. Calculating dynamic parameters of vibrating systems using manual calculations and validating the results with ADAMS Simulation

Course Outcomes:

After completing this course,

1. The students can design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning.
2. They can understand the kinematics and rigid- body dynamics of kinematically driven machine components
3. They can understand the kinematics of gear trains and cam systems to generate specified output motion
4. They can understand the application of balancing, flywheel and gyroscope and concept of vibration.

Learning Resources:

1. Theory of machine by S S Ratan, McGraw Hill Education India Private Limited
2. A. Ghosh and A.K. Mallick, Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

3. T. Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors, 2005.
4. A. Shariff, Theory of Machines, Dhanpat Rai Publication, New Delhi, 2000.
5. W.L. Cleghorn, Mechanisms of Machines, Oxford University Press, 2005.
6. R.L. Norton, Kinematics and Dynamics of Machinery, 1st Edition, McGraw Hill India, 2010.

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

Subject Name: Mechatronics, Robotics & Control lab **Credit: 1** **Lecture Hours: 24**

Subject Code: PCCME594

Pre-requisite: Kinematics of Machines, Mathematics

COURSE OBJECTIVES:

1. To synergies the combination of mechanical, electronics, control engineering and computers.

2. To foster critical thinking and innovation by encouraging students to explore emerging technologies, research trends, and novel applications in mechatronics and robotics.

COURSE CONTENT:

Details of Experiments	Mapping
1. Modeling and Simulation of a Robotic Arm using MALTAB (Simulink/Simscape) 2. Study of a Robotic Arm 3. Experiment on LVDT for displacement measurement 4. Study of PLC 5. Study of a Microcontroller 6. Study of a Microprocessor (8086) 7. Cut-section of a solenoid valve 8. Experiment on Pneumatic servo system 9. Experiment on Hydraulic servo system 10. Verification of P, P+I, P+I+D control actions controller	***International Academia:*** **(**https://cs.stanford.edu/groups/manips/teaching/cs223a/) ***AICTE-prescribed syllabus:*** **(**https://www.aicte-india.org/sites/default/files/Model_Curriculum/Mechatronics/mechatronics.pdf) ***Industry Mapping***: MATLAB (Simulink/Simscape)

COURSE OUTCOMES:

CO1: Students will acquire proficiency in software tools commonly used in mechatronics and robotics, such as MATLAB (Simulink/Simscape).

CO2: Students will develop problem-solving skills by analyzing, designing, and implementing solutions to real-world engineering challenges encountered in mechatronics and robotics.

University of Engineering and Management

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

Subject Name: Project-III **Credit: 1**

Subject Code: PRJME581 **L-T-P: 0-0-2**

Pre-Requisites: Project I (CAD Based), Project II (Research Methodology)

Course Objective(s):

The purpose of learning of this course is to:

1. To demonstrate their technical skills, and put in practice their experiences and knowledge.
2. To identify suitable problem/research gap through literature review and solve the real-life problems faced by the society.
3. To design engineering solutions to complex problems utilizing a systems approach either through simulation, theoretical or experimentation work.
4. Analyze and evaluate the work comprehensively through presentation and develop a comprehensive project report.
6. Create a solution for the society and present his/her work in a conference or publish the work in a peer reviewed journal.

Course Content.

Sl. No.	Contents	Hours
1	Understanding the language of research – concept, construct, definition, variable research process, literature review	4
2	Problem identification & formulation of research gap	4
3	Development of project plan and formulate of the design of experiment.	4

4	Market Survey & Estimation of Budget for the project work	4
5	Modelling, simulation or Fabrication or the Project as per the requirement.	4
6	Optimization of the prototype or model for holistic development.	2
7	Publication of the work and dissemination through conference and journal publication.	2

Course Outcome:

CO1: Understand the problem/research gap through literature review for solving the real-life problems.

CO2: Apply the developed solution either through practical work or through simulation, theoretical or experimental work.

CO3: Analyze & evaluate the results and further optimize as per the project requirements.

CO4: Understand the importance of team work and create technical solution through delivery of the project goal.

Learning Resources:

1. Kothari, C.R, and Garg, G., (2019), Research Methodology - Methods and Techniques, 4th Edition, New Age International Publishers.
2. Catherine Dawson, (2019), Introduction to Research Methods by, 5th Edition, Robinson
3. Bordens, K. S. and Abbott, B. B. (2013) Research Design and Methods – A Process Approach. 9th Edition, McGraw-Hill.

University of Engineering and Management

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

Subject Name: Skill Development for Professionals-V **Credit: 0.5** **Lecture Hours:48**
Subject Code: SDP581

Module number	Topic	Sub- topics	Mapping with International/National/ State Level Exams	Lecture Hours	Corresponding Assignment
1	**Quantitative Aptitude**	**Textbook:** Quantitative Aptitude for Competitive Examination **Author:** R.S Agarwal **Publishing House:** S.Chand Advanced Level Permutation & Combination: Compound Interest, Simple Interest, Numbers, Alphabets, Linear arrangement, Circular arrangement, Repetition, Selection based Advanced Level Probability: Coins, Dices, Drawing of balls, Cards, Numbers, Miscellaneous, Advanced Level Percentage	***International Exams*** ***1. GRE (https://www.ets.org/pdfs/gre/gre-math-review.pdf)*** ***2. GMAT (https://downloads.mba.com/do wnloads/gmat-handbook.pdf)*** ***National Exams:*** ***1. UPSC Civil Services Exam*** (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 ***2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21***	12	1. Permutation & Combination a. How to arrange different numbers in different sequences. b. Questions based on Alphabet arrangements. c. Problems based on linear and circular arrangements. d. Problems based on garlands and Necklaces. e. Problems based on selection of things and persons. 2. Probability a. Problems based on different numbers of coin tossed. b. Problems based on rolling dices. c. Problems based on forming of committees based on selection. d. Problems based on drawing of cards
		Advanced Level Ratio and	***3. RBI Grade B***		

		Proportion Advanced Level Profit and Loss Advanced Level Percentage	*(https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23* ***4. IBPS Probationary officer(https://www.ibps.in/wp-content/uploads/Detailed-Advt.-CRP-PO-XII.pdf) , Pg 7.*** ***5. Combined Graduate Level conducted by SSC (https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/notice_CGLE_03042023.pdf) pg. 20-22*** ***6. Intelligence Bureau ACIO (https://www.pw.live/exams/wp-content/uploads/2023/11/IB-ACIO-Recruitment-2023-Notification-Emp-News.pdf)*** ***7. XAT (https://xat.org.in/xat-syllabus/)*** ***8. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/)*** ***9. CAT https://iimcat.ac.in/per/g01/pub/756/ASM/WebPortal/1/index.html?756@@1@@1*** ***State Level Exams:*** ***1.Civil Services Executive Exam (WBCS)***		3. Mensuration. a. Problems based on 2D and 3D shapes. b. Finding area based on mixed shapes. c. Finding the volume based on different shapes. d. Problems based on Prism Pyramid. ** All the assignments are in line of GS Paper I of UPSC CSE Mains Examination

			(https://wbpsc.gov.in/Download?param1=20230225142430_Syllabus.pdf&param2=advertisement, pg 1 ***2.* Miscellaneous Services Recruitment Examination (*file:///C:/Users/UEMK/Downloads/2707970_2019.pdf), pg 1***		
2	**Logical Reasoning**	**Textbook:** Verbal and Non Verbal reasoning **Author:** R.S Agarwal **Publishing House:** S.Chand 1) Clock 2) Miscellaneous questions on Puzzle and Sitting Arrangement Number Series	***National Exams:*** ***1. UPSC Civil Services Exam*** (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 ***2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf , pg 20-21)*** ***3. Combined Graduate Level conducted by SSC (https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/notice_CGLE_030420223.pdf) pg. 20-22*** ***4. Intelligence Bureau ACIO (https://www.pw.live/exams/wp-content/uploads/2023/11/IB-ACIO-Recruitment-2023-Notification-Emp-News.pdf*** ***State Level Exams:*** ***1.Civil Services Executive***	12	**Clocks** 1. **Basic Time Calculation**: ○ Provide questions asking students to calculate the time when the minute and hour hands of a clock form a specific angle (e.g., What time will it be when the hands form a 90-degree angle?). 2. **Angle Calculation**: ○ Ask students to determine the angle between the hour and minute hands at given times (e.g., What is the angle at 3:15?). 3. **Mirror Image**: ○ Provide times and ask students to find the mirror image of these times (e.g., What is the mirror image of 4:30?). 4. **Gaining and Losing Time**: ○ Pose problems involving clocks that gain or lose time (e.g., A clock gains 5 minutes every hour. If it shows 8:00 AM now, what will be the actual time after 6 hours?). 5. **Correct Time**: ○ Provide scenarios where a clock shows incorrect time, and ask students to find the correct time based on given conditions (e.g., A clock shows 2 PM when it is actually 1:45 PM. What will be the correct time after 4 hours?).

			Exam (WBCS) (https://wbpsc.gov.in/Download?param1=20230225142430_Syllabus.pdf&param2=advertisement, pg 1 ***2.*** **Miscellaneous Services Recruitment Examination** (***file:///C:/Users/UEMK/Downloads/2707970_2019.pdf), pg 1***		**Miscellaneous Puzzles and Sitting Arrangements** 1. **Linear Sitting Arrangement**: ○ Provide a scenario where people are sitting in a line and give clues about their positions. Ask students to determine the exact order (e.g., A is sitting three places to the left of B. C is at the end. Where is D sitting?). 2. **Circular Sitting Arrangement**: ○ Give a puzzle involving people sitting in a circle with certain conditions (e.g., A is sitting immediately to the right of B. C is opposite D. Find the seating arrangement). 3. **Complex Puzzles**: ○ Present multi-step logical puzzles where students need to use given clues to solve the problem (e.g., In a family of six members, there are two married couples. Identify the relationships based on given conditions). 4. **Floor Puzzle**: ○ Provide a scenario where people live on different floors of a building. Give clues about their living floors and ask students to determine who lives on which floor (e.g., A lives two floors above B, who lives on the 3rd floor. Who lives on the 5th floor?). 5. **Direction-Based Puzzles**: ○ Pose puzzles involving directions and distances (e.g., A starts from a point and walks 5 km north, then turns right and walks 3 km. Where is A now from the starting point?). **Number Series** 1. **Simple Number Series**: ○ Provide basic number series and ask

					students to find the next number in the series (e.g., 2, 4, 6, 8, ...). 2. **Pattern Identification**: o Give more complex number series and ask students to identify the pattern and find the next number (e.g., 1, 4, 9, 16, ...). 3. **Missing Numbers**: o Provide series with missing numbers and ask students to fill in the blanks (e.g., 2, _, 8, _, 18). 4. **Mixed Operations**: o Pose series that involve a mix of arithmetic operations (e.g., 2, 6, 12, 20, ...). 5. **Alphabet and Number Series**: o Combine letters and numbers in a series and ask students to find the next element (e.g., A1, B2, C3, ...). 6. **Complex Series**: Provide more challenging series that may involve multiple operations or steps (e.g., 1, 3, 7, 15, ...).
3	**Verbal English**	**Textbook:** Objective General English **Author:** R.S Agarwal **Publishing house:** S.Chand **1)** Sentence Improvement **2)** Fill the blanks with appropriate words/articles/preposit ion/ verbs/adverbs/conjunc tion. **3)** Rearrangement of Sentences(Advanced Level)	***International Exams*** ***1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37)*** ***National Exams:*** ***1. UPSC Civil Services Exam*** (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 ***2. UPSC Combined***	12	**Sentence Improvement** 1. **Grammar Correction**: o Provide sentences with grammatical errors and ask students to correct them (e.g., "She don't like apples" should be "She doesn't like apples"). 2. **Improving Clarity**: o Give sentences that are unclear or ambiguous and ask students to rewrite them for clarity (e.g., "The man saw the boy with the telescope" should be "The man used the telescope to see the boy").

		(Advance Level) **4)** Multiple Fillers (Double fillers and Triple Fillers) **5)** Reading Comprehension **6)** Notice Writing .	***Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21*** ***Combined Graduate Level conducted by SSC (https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/notice_CGLE_03042023.pdf) pg. 20-22*** ***4. Intelligence Bureau ACIO (https://www.pw.live/exams/wp-content/uploads/2023/11/IB-ACIO-Recruitment-2023-Notification-Emp-News.pdf)*** ***State Level Exams:*** ***1. Civil Services Executive Exam (WBCS) (https://wbpsc.gov.in/Download?param1=20230225142430_Syllabus.pdf&param2=advertisement, pg 1*** **Miscellaneous Services Recruitment Examination** (***file:///C:/Users/UEMK/Downloads/2707970_2019.pdf) pg 1***		3. **Word Choice**: Present sentences with inappropriate word choices and ask students to replace them with more suitable words (e.g., "He is very happy for his success" should be "He is very happy about his success"). **Fill in the Blanks with Appropriate Words/Articles/Prepositions/Verbs /Adverbs/Conjunctions** 1. **Single Blank Fillers**: oProvide sentences with a single blank and a list of options to choose from (e.g., "She is interested _painting" with options like in, on, at). 2. **Article Fillers**: oGive sentences with blanks for articles and ask students to fill them in (e.g., "He is _____best player on the team" should be "He is the best player on the team"). 3. **Preposition Fillers**: oProvide sentences with blanks for prepositions (e.g., "She is good ___ dancing" should be "She is good at dancing"). 4. **Verb Fillers**: oProvide sentences with blanks for verbs in different tenses (e.g., "He _(go) to school every day" should be "He goes to school every day"). 5. **Adverb Fillers**: oProvide sentences with blanks for adverbs (e.g., "She sings __(beautiful)"

					should be "She sings beautifully"). 6. **Conjunction Fillers**: o Provide sentences with blanks for conjunctions (e.g., "I want to go, __I can't" should be "I want to go, but I can't"). **Rearrangement of Sentences (Advanced Level)** 1. **Paragraph Jumble**: o Provide a set of sentences and ask students to rearrange them to form a coherent paragraph. 2. **Logical Sequencing**: o Give sentences that describe a process or event and ask students to arrange them in the correct order. 3. **Narrative Order**: Provide sentences that form part of a story and ask students to arrange them in the correct narrative sequence. **Multiple Fillers (Double Fillers and Triple Fillers)** 1. **Double Fillers**: o Provide sentences with two blanks and a list of options to fill both blanks (e.g., "She is ___and _____" with options like "smart, intelligent", "happy, excited"). 2. **Triple Fillers**: o Provide sentences with three blanks and ask students to fill them with appropriate words (e.g., "He is ___, ___, and ___" with options like "tall, dark, handsome"). **Reading Comprehension**

					1. **Passage Questions**: o Provide a passage and ask students to answer questions based on the content. 2. **Inference Questions**: o Ask students to make inferences based on the information provided in the passage. 3. **Summary Writing**: o Provide a passage and ask students to write a summary of it. 4. **Critical Analysis**: o Ask students to critically analyze the passage and provide their viewpoints or arguments. **Notice Writing** 1. **School Event Notice**: o Ask students to write a notice for a school event such as a sports day or a cultural program. 2. **Lost and Found Notice**: o Provide a scenario where an item is lost and ask students to write a notice for it. 3. **Meeting Notice**: o Ask students to write a notice for an upcoming meeting, including all necessary details such as date, time, venue, and agenda. 4. **Competition Notice**: Provide a scenario of an upcoming competition and ask students to write a notice inviting participants.
4	**Data Interpretation level-II**	**Textbook:** Quantitative Aptitude for Competitive Examination **Author:** R.S Agarwal	***International Exams*** ***1. GRE*** (***https://www.ets.org/gre/test-takers/general-***	12	1. Problems based on mixed diagrams. Problems based on time series.

		Publishing House: S.Chand	***test/prepare/content/quantitative-reasoning.html#accordion-eb7b696bc8-item-f763480e0e*** ***)***		
		Miscellaneous	***National Exams:*** ***1. UPSC Civil Services Exam*** (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl-010223.pdf), pg 25-26 ***2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21*** ***3. Combined Graduate Level conducted by SSC (https://ssc.nic.in/SSCFileServer/PortalManagement/UploadedFiles/notice_CGLE_03042023.pdf) pg. 20-22*** ***4. Intelligence Bureau ACIO (https://www.pw.live/exams/wp-content/uploads/2023/11/IB-ACIO-Recruitment-2023-Notification-Emp-News.pdf)*** ***State Level Exams:*** ***1. Civil Services Executive Exam (WBCS) (https://wbpsc.gov.in/Download?param1=20230225142430_Syllabus.pdf&param2=advertisement), pg 1***		

			2. **Miscellaneous Services Recruitment Examination (*file:///C:/Users/UEMK/Downloads/2707970_2019.pdf*) *pg 1***		

Subject Name: Seminar & Communication 2 **Credit: 1** **Lecture Hours: 24**

Subject Code: HSMME582

RELEVANT LINK:

LINKEDIN LEARNING

COURSE OBJECTIVE:

To impart knowledge on the correct use of the English language for technical and interpersonal communication.

COURSE OUTCOME:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

COURSE CONTENT:

Module number	Topic	Sub- topics	Mapping with International/National/ State Level Exams	Lecture Hours	Corresponding Assignment
1	**General vocabulary**	The concept of Word Formation; Root words from foreign languages and their use in English; Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives; Synonyms, antonyms, and standard abbreviations.	***International Exams*** 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) ***National Exams*** 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl- 010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23	12	Choose a topic or theme and list down 10 words associated with it. Find one synonym and one antonym for each word. Create a meaningful paragraph using the 10 chosen words. Recite the same with the correct verbal expressions in class. Generate a paragraph using the same set of words using ChatGPT and compare your original paragraph with the one framed by ChatGPT.

			4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)		
2	**Grammar & Verbal Reasoning**	Parts of speech; Active and Passive Voice; Direct and Indirect Speech; Reading Comprehension	***International Exams*** 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) ***National Exams*** 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl- 010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/)	12	Assignment sheet on verbal reasoning to be answered and submitted.

			5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)		
3	**Creative writing**	Precise and Essay Writing; Letter and Email Writing; Technical Report Writing	***International Exams*** 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) ***National Exams*** 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl- 010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT	12	1. One technical report on any topic relevant to the course is to be submitted. 2. Write an original short story and present the same in class.

			(2IIM-CAT-Exam-Syllabus-2024.pdf)		
4	**Oral Communication**	Creating a YouTube channel to create and upload original content; Group discussions; Debates; Seminars	***International Exams*** 1. GRE (https://www.ets.org/gre/test-takers/general-test/prepare/content/verbal-reasoning.html#accordion-9f58105fc6-item-88093eca37) 2. GMAT (https://downloads.mba.com/downloads/gmat-handbook.pdf) ***National Exams*** 1. UPSC Civil Services Exam (https://upsc.gov.in/sites/default/files/Notif-CSP-23-engl- 010223.pdf), pg 25-26 2. UPSC Combined Defence Services (https://upsc.gov.in/sites/default/files/Notif-CDS-I-Exam-2023-Engl-211222.pdf), pg 20-21 3. RBI Grade B (https://rbidocs.rbi.org.in/rdocs/Content/PDFs/DADVTGRB09052023FA65E4FB1C2CF473396B4FD7E5F69CDDE.PDF), pg 22-23 4. XAT (https://xat.org.in/xat-syllabus/) 5. GATE (https://gate2024.iisc.ac.in/papers-and-syllabus/) 6. CAT (2IIM-CAT-Exam-Syllabus-2024.pdf)	12	1. Choose a theme on which you must create original content and post the same on YouTube. 2. Present a seminar on a topic of your choice.

Text Book:

1. English Grammar & Composition. Wren & Martin, Revised by N.D.V. Prasada Rao, S. CHAND & COMPANY LTD.
2. AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097

Reference Books:

1. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
7. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Subject Name: Microprocessor and Embedded Systems **Credit: 4**

Subject Code: MINOR501R

Lecture Hours: (L: 3; T: 0; P: 2)

Pre-requisite: MINOR301R, MINOR401R

Relevant Links:

STUDY MATERIAL **NPTEL**

Course Objective: This course aims to teach the detailed functioning of microprocessors and the role of embedded systems in a robotic system.

Course Contents:

Module 1: Introduction to Embedded Systems and microcomputers: Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded System Models, Embedded System development cycle, Challenges for Embedded System Design, Evolution of computing systems and applications. Basic Computer architecture: Von-Neumann and Harvard Architecture. Basics on Computer organisations. Computing performance,

Throughput and Latency, Basic high-performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics.

Module 2: Microprocessor: 8086 Microprocessor and its Internal Architecture, Pin Configuration and their functions, Mode of Operation, Introduction to I/O and Memory.

Timing Diagrams, Introduction to Interrupts. Introduction to C language, Instruction format, C language programming format, Addressing mode, Instruction Sets, Programming 8086 microprocessor.

Module 3: Microprocessor Interfacing: Introduction to interfacing, Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller,

Programmable Key Board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing. Microcontroller: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, Programming model, addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller.

Module 4: Microcontroller Interfacing: Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor.

Module 5: Introduction to Advanced Embedded Processor and Software: ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C.

Module 6: Microprocessor and Embedded System Laboratories: Basic C language programming implementation on Microprocessor and Microcontroller. Interfacing Displays, Key boards and sensors with Microprocessors and Microcontrollers, Data Acquisition using Microprocessor and Microcontroller, Implementation of Controlling schemes for DC, Servo, Stepper motor using C programming in microprocessors and Microcontrollers.

Text Books/References:

1. K. V. Shibu, Introduction to Embedded Systems, McGRAW Hill Publications (2009).

2. Raj Kamal, Embedded Systems, TATA McGRAW Hill Publications (2003).

3. M. Morris Mano, Computer System Architecture, 3ed, Pearson Publication, (2007).

4. D. V. Hall, 8086 Microprocessors and Interfacings, TATA McGRAW Hill, (2005).

5. B. B. Brey, The Intel Microprocessors, Prentice Hall Publications, 8th ed, (2018).

6. M. A. Mazidi, R.D. Mckinlay and D. Casey, PIC Microcontrollers and Embedded Systems, Pearson Publications, (2008).

7. M. Predko, Programming and Customizing the PIC Microcontroller, McGRAW Hill Publications. 3ed, (2017).

8. R. Barnett, L. O'Cull and S. Cox, Embedded C Programming and Microchip PIC, Cengage Learning, (2003).

Alternative SWAYAM/NPTEL Course:

NPTEL Course Name: Embedded Systems, Instructor: Prof. Santanu Chaudhary, Host Institute: IIT Delhi

Course Outcomes:

After completion of course, students would be able:

1. To prepare block diagrams for any robotic control-hardware design,
2. To choose appropriate flow of embedded systems for a specific application.
3. To Write code for micro controller devices.
4. To use advanced embedded processor and software.

Subject Name: Energy storage systems for renewables **Credit: 3**

Subject Code: SEEME501

Lecture Hours: 40 [Lecture (10 hours), Practical (20hours) , Social(10 hours)]

Pre-requisite: Energy and its Resources SEEME401

Relevant Links:

STUDY MATERIAL **NPTEL**

COURSE OBJECTIVES:

Course Objective:
This course will offer

- An overview of the storage system suitable for offering reliable energy solutions.
- Energy storage types based on energy form
- Sustainable storage solutions for renewable energy systems will be identified based on reliability and affordability.
- Life cycle cost, energy and environmental analysis of conventional storage systems
- Study of the characteristics of conventional energy storage systems

COURSE OUTCOMES:

- **CO1**: Understanding about the different types of demand supply mismatches in a renewable system
- **CO2**: Understanding of basic operating principle of different storage systems
- **CO3**: Ability to analyze the life cycle energy cost of different energy storage system
- **CO4**: Knowledge of characteristics behavior of different storage systems

Course Content

A. Theoretical Learning

Lecture No.	Contents
1	**Demand-supply mismatch and role of energy storage:** Discussion on types and variation in different load demands such as residential load, office, agricultural load; Variation in renewable energy resources, Understanding the mismatch between load profile and generation profile; introduction to the mismatch time scale
2	**Overview of different energy storage options:** Introduction to the Ragone plot; Introduction of demand-supply mismatch time scale on Ragone plot; C-rating
3	**Mechanical Energy Storage-Compressed Air:** Basic thermodynamics; working principle; general consideration; power extraction system-diabatic, adiabatic and isothermal method
4	**Mechanical Energy Storage-Flywheel:** Introduction to the moment of inertia, angular momentum and kinetic energy of rotating object; working principle; components; characteristics; applications
5	**Mechanical Energy Storage-Pumped Hydro:** Introduction; working principle; components and complete system; open-loop and closed-loop pumped hydro storage; turbines types and applications
6	**Thermal Energy Storage:** Introduction to the fluid flow and heat transfer; latent and sensible heat storage; phase change materials (PCM) for thermal energy storage; different geometries for PCM based thermal storage
7	**Overview of Electrochemical Energy Storage:** Electrochemical cells and batteries; primary cell; secondary cell, Faradic and Non-faradic process, charging and discharging of electrochemical cells and polarity, efficiencies
8	**Open circuit voltage for electrochemical storage:** Standard pressure and temperature, standard electrode potential, concentration cell
9	**Current-voltage behaviour of electrochemical storage:** Types of electrode electrolyte interfaces, double layer capacitance, mechanism of electron transfer at the interface, oxidation and reduction and polarity, anode and cathode, cell polarisation behaviour-activation polarisation, ohmic polarisation, concentration polarisation
10	**Supercapacitor as energy storage:** Introduction, working principle, basic design, types, charging-discharging characteristics and efficiencies, applications

11	**Batteries storage:** Introduction to Primary battery, reserve batteries and secondary batteries, Lead-acid batteries-working principle, components and characteristics, Li-ion batteries- working principle, components and characteristics
12	**Hydrogen storage:** Introduction to water electrolysis, alkaline electrolyser, PEM electrolyser, current-voltage characteristics, materials for electrolyser, engineering configurations
13	**Hybrid energy storage:** Introduction to hybrid energy storage, C-rating of a storage system, Life of energy storage, studying the demand-supply mismatch and selection of storage system
14	**Flow batteries:** Working principle, Types of flow battery, components and configurations, current-voltage characteristics, efficiencies, lifetime
15	**Life cycle analysis:** Depth of discharge and state of charge, cycle life of a battery as a function of depth of discharge, full effective cycle, shelf life, life cycle cost analysis, environmental impact and recycling,

B. Practical Learning

The duration of each experiment is for 3 hours.

Experiment No.	Contents
1	Study the characteristics of a lead-acid battery, note down the parameters on charging and discharging cycles
2	Study the characteristics of a flywheel Reference link: https://vlab.amrita.edu/?sub=1&brch=74&sim=571&cnt=3
3	Study the behaviour of different electrodes for electrochemical energy storage
4	Study the thermal behaviour of different phase change material

C. Social Learning

Social experiment No.	Contents

1	Visit an office / industry / any other place (it may be there in your own institution) where battery based storage is installed. Observe the kind of batteries installed, their configuration, ratings of individual battery and that of combined storage, back-up that battery storage is performing.
2	Prepare a report on Lead-acid battery recycling. If possible, visit a factory premises where batteries are manufactured or recycled. Identify aspects of battery manufacturing and recycling that would environmental impact.
3	Prepare brief report on any one of the following energy storage (more than 100 kWh) mechanisms based on actual installations: pump storage / H_2 storage / battery storage

TEXT BOOK:

1. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1-84919-219-4), 2011
2. Robert A. Huggins, "Energy Storage", Springer Science (ISBN - 978 -1-4419-1023-3), 2010
3. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011

ONLINE RESOURCES: COURSERA (course 1) COURSERA (course 2)

Course Code	**:**	**MINOR501A**
Course Title	**:**	**Deep Learning and Neural Network**
Number of Credits	**:**	**4 (L: 3; T: 0; P: 2)**
Course Category	**:**	**AIML**
Pre-requisite	**:**	**Introduction to AI & Machine Learning**

Course Objective:

- To strengthen important Mathematical concepts required for Deep learning and neural network.
- To get a detailed insight of advanced algorithms of ML.

Course Contents: [Total Theory Duration: 42 Lectures]

Module 1: [Duration: 8 Lectures]
Information flow in a neural network, understanding basic structure and ANN.

Module 2: [Duration: 8 Lectures]
Training a Neural network, how to determine hidden layers, recurrent neural network.

Module 3: [Duration: 10 Lectures]
Convolutional neural networks, image classification and CNN.

Module 4: [Duration: 9 Lectures]
RNN and LSTMs. Applications of RNN in real world.

Module 5: [Duration: 7 Lectures]
Creating and deploying networks using tensor flow and keras.

Lab Work:

1. Introduction to Kaggle and how it can be used to enhance visibility.
2. Build general features to build a model for text analytics. 3. Build and deploy your own deep neural network on a website using tensor flow.

Text Books/References:

1. Rajiv Chopra, Deep Learning, Khanna Publishing House.
2. John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.
3. Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, Shroff Publisher /O'Reilly Publisher Media.
4. Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford. Corresponding Online Resources:
1. Fuzzy Logic and Neural Networks, https://onlinecourses.nptel.ac.in/noc21_ge07/preview Or
2. Fuzzy Logic, https://onlinecourses.nptel.ac.in/noc22_ee21/preview

Course Outcomes: After completion of course, students would be able:

1. To design and implement Artificial Neural networks.
2. To decide when to use which type of NN.

MANDATORY ADDITIONAL REQUIREMENT (MAR)

- Tech Fest/Fest/Teachers' Day/Fresher's Welcome
- Rural Reporting
- Tree Plantation
- Participation in Relief Camps (Collection of funds/materials for the Relief Camp)
- Animal Welfare Camp
- Participation in Debate/Group Discussion/Tech Quiz/Quiz
- Publication of Wall Magazine in institutional level (magazine/article/internet)
- Publication in Newspaper, Magazine and Blogs
- Research Publication
- Innovative Projects (other than course curriculum)
- Blood donation
- Participation in Sports/Games (College level /University level / District level / State level National/International Level)
- Cultural Programme (Dance, Drama, Elocution, Music etc.)
- Member of Professional Society /Student Chapter
- Relevant Industry Visit & Report
- Activities in different Clubs (Photography / dance/drama etc. Club)
- Participation in Yoga Camp
- Adventure Sports with Certification
- Training to under-privileged/differently able
- Community Service & Allied Activities
- Self-Entrepreneurship Programme (Organize Entrepreneurship Workshop /To take part in Entrepreneurship Workshop /Video Film-Making on Entrepreneurship /Submit Business Plan on any / To work for start-up/as entrepreneur)

Massive open online course MOOCs

https://docs.google.com/spreadsheets/d/e/2PACX-1vQxHuRpCPTN16ho3JJzQQED9JyO06qKTDdipAI8ui2MCSRY3FtQCuqFBozkYoV8vjNOZbhUjA259-SN/pubhtml