

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Evaluation 2024-25 (As per NEP-2020) **
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the Academic year 2025-26)

VII-SEMESTER SCHEME OF TEACHING & EVALUATION 2024-25											
S. N.	Course Type	Course Code	Course Title	Teaching Hours/week			Examination				Credits
				Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Discipline Specific Elective	MEUGTD_		3	-	-		40	60	100	3
2	Discipline Specific Elective	MEUGTD_		3	-	-		40	60	100	3
3	Professional Elective	MEUGTP_		3	-	-		40	60	100	3
4	Professional Elective	MEUGTP_		3	-	-		40	60	100	3
5	Generic Elective	MEUGTG1	Professional Ethics	1				100	-	100	1
6	MOOCs			3	-	-		40	60	100	3
7	Project	MEUGPV1	Minor Project	-	-	8		100	200	300	4
Total				16	-	8	-	400	500	900	20
* Not for ME students											
Credit Definition: ➤ 1-hour lecture (L) per week per semester = 1 Credit ➤ 1-hour tutorial (T) per week per semester = 1 Credit ➤ 2-hour Practical/Drawing(P) per week per semester = 1 Credit			➤ Four credit courses are to be designed for 50 hours of Teaching-Learning process. ➤ Three credit courses are to be designed for 40 hours of Teaching-Learning process. ➤ Two credit courses are to be designed for 30 hours of Teaching-Learning process. ➤ One credit courses are to be designed for 15 hours of Teaching-Learning process Note: The above is applicable only to THEORY courses								

CIA: Two internal Class Tests, each of 15 Marks. Assignment: 10 Marks

SEA: Semester End Assessment – 60 marks

Professional/Discipline Specific Elective subjects

GROUP A: Discipline Specific Electives (D)

- MEUGTD1 - Fundamentals of Tribology
- MEUGTD2 - Refrigeration and Air-Conditioning
- MEUGTD3 - Energy Conversion and waste heat recovery
- MEUGTD4 - Power Plant Engineering
- MEUGTD5 - Solar Energy: Fundamental and Applications
- MEUGTD6 - Theory of Vibrations

GROUP B – Professional Elective (P)

- MEUGTP1 - Industrial Sustainability
- MEUGTP2 - Maintenance Engineering & Management
- MEUGTP3 - Advances in Welding and Joining Techniques
- MEUGTP4 - Machine Learning in Mechanical and Materials Engineering
- MEUGTP5 – Marketing Management for Engineers

MOOCs through Swayam Online

- MEUGTO1 - Heat Exchangers: Fundamentals and Design Analysis
- MEUGTO2 - Operations and Supply Chain Management
- MEUGTO3 - E-Business
- MEUGTO4 - Experimental Modal Analysis
- MEUGTO5 - Dynamic Behaviour of Materials
- MEUGTO6 - Fundamentals of additive manufacturing technologies
- MEUGTO7 - Materials Processing (Casting, Forming & Welding)

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(Effective from the Academic year 2025-26)

VIII-SEMESTER SCHEME OF TEACHING & EVALUATION 2024-25											
S. N.	Course Type	Course Code	Course Title	Teaching Hours/week			Examination				Credits
				Theory lectures	Tutorial	Practical/Drawi	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Project	MEUHPV1	Major Project	-	-	30		200	300	500	12
Total				-	-	30		200	300	500	12
* Not for ME students											
Credit Definition: ➤1-hour lecture (L) per week per semester = 1 Credit ➤1-hour tutorial (T) per week per semester = 1 Credit ➤2-hour Practical/Drawing(P) per week per semester = 1 Credit			➤ Four credit courses are to be designed for 50 hours of Teaching-Learning process. ➤ Three credit courses are to be designed for 40 hours of Teaching-Learning process. ➤ Two credit courses are to be designed for 30 hours of Teaching-Learning process. ➤ One credit courses are to be designed for 15 hours of Teaching-Learning process Note: The above is applicable only to THEORY courses								

CIA: Two internal Class Tests, each of 15 Marks. Assignment: 10 Marks

SEA: Semester End Assessment – 60 marks



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTD1	Fundamentals of Tribology	3	0	0	40	60	3

Course objectives:

1. Provide fundamental knowledge of tribology and its interdisciplinary significance.
2. Analyze surface contact, friction, and wear mechanisms in engineering applications.
3. Explore lubrication principles and their role in reducing friction and wear.
4. Introduce surface engineering techniques for enhancing material performance

UNIT – I	Introduction
	Introduction to tribology, history of tribology, inter-disciplinary approach, economic benefits.
UNIT – II	Surface contact
	Introduction to surface, surface roughness and its measurement, conformal and non-conformal contact geometry, types, and stresses in non-conformal contact.
UNIT – III	Friction
	Causes of friction, adhesion theory, abrasive theory, junction growth theory, laws of rolling friction, friction instability, friction of non-metallic materials
UNIT– IV	Wear
	Introduction, Wear mechanisms, adhesive wear, abrasive wear, corrosive wear, fretting wear, wear analysis, delamination theory of wear, wear debris analysis, wear testing methods.
UNIT -V	Bearings and Lubrication & Surface engineering
	Boundary lubrication, basic equations for fluid film lubrication, hydrodynamic journal bearing, liquid lubricants: properties and measurement, additives. Surface engineering: Introduction, surface treatments, surface coatings, methods, and procedure.

TEXTBOOKS:

- 1.Engineering Tribology – Prasanta Sahoo – Prentice Hall of India Pvt. Ltd., New Delhi,2005.
2. Fundamentals of Tribology, B. B. Ahuja, S. K. Basu, S. N. Sengupta, PHI Learning ,2005
- 3.Tribology: Friction and Wear of Engineering Materials, Ian Hutchings, Philip Shipway, Butterworth-Heinemann Ltd, 2020
4. Friction, Wear, Lubrication: A Textbook in Tribology, Kenneth C. Ludema, Oyelayo O. Ajayi, CRC Press, 2021

REFERENCE BOOKS:

1. Bharat Bhushan, Introduction to Tribology, Wiley, 2020
- 2.A. Cameron, C. M. Mc. Ettles, Basic Lubrication Theory, Ellis Horwood Ltd, Publisher, 2024
3. Practical Heat Recovery – Boyen J.L. (John Wiley, New York, USA1976)

WEB RESOURCES:

<https://nptel.ac.in/courses/112102015>
<https://archive.nptel.ac.in/course.html>



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Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Understand and apply tribological principles to analyze friction, wear, and lubrication in mechanical systems.	U
CO2	Evaluate surface contact characteristics and their influence on tribological performance.	A
CO3	Analyze and compare different wear mechanisms to predict material degradation and improve component lifespan.	An
CO4	Apply lubrication techniques to minimize friction and enhance system efficiency.	A
CO5	Utilize surface engineering methods to improve the durability and reliability of engineering components.	U

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	2	1					1					1	1		
CO2	2	1	1				1					1	1		
CO3	2	1					1					1	1		1
CO4	2	1	1				1					1	1		1
CO5	2	1	1				1					1	1		



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTD2	REFRIGERATION & AIR CONDITIONING	3	0	0	40	60	3

Course objectives:

1. Learning the fundamental principles and different methods of refrigeration and air-conditioning.
2. Study of various refrigeration cycles and evaluate performance using P-h charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

UNIT – I	Introduction to refrigeration system
	Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).
UNIT – II	Vapor Compression Refrigeration System
	Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of multistage system.
UNIT – III	Vapor Absorption Refrigeration Systems, Refrigerants & Non-conventional refrigeration systems
	Simple cycle. Actual cycle of ammonia water and lithium-bromide water systems, Electrolux system. Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone layer depletion and global warming considerations of refrigerants. Production of low temperature - cascade system, Joule Thomson effect & liquefaction of gases, liquefaction of hydrogen & helium, application of cryogenics. Nonconventional refrigeration system -thermo-electric refrigeration, vortextube, steam jet refrigeration system.
UNIT– IV	Refrigeration System Components
	water- and air-cooled condensers, evaporative condensers, expansion devices - capillary tube, expansion valve - thermostatic expansion valve, float valve and solenoid valve evaporators, natural convection coils, flooded evaporators direct



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	expansion coils. Reciprocating compressors - single stage and multistage compressors, optimum pressure ratio, effect of inter-cooling, volumetric efficiency, isothermal and adiabatic efficiency, Rotodynamic compressors -screw and vane type compressors, principle of operation, hermetic, semi-hermetic and open type refrigeration compressors.
UNIT -V	Principles of Air Conditioning
	Psychrometry and psychrometric chart, human comfort, effective temperature comfort chart. Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). Air Washers, Cooling towers & humidifying efficiency.

TEXTBOOKS:

1. Refrigeration and Air Conditioning C. P. Arora – TMH, 2021.
2. Refrigeration and Air Conditioning – P.L. Ballaney – Khanna Publishers, 2025
3. A course in refrigeration and air conditioning -SC Arora & Domkundwar- Dhanpatrai, 2023
4. Refrigeration and air conditioning- Stoecker W.F. & Jones J.W.- Mc Graw Hill, 2014

REFERENCE BOOKS:

1. Principles of refrigeration-Dossat-Pearson Education, 2002
2. Refrigeration and air conditioning- Manohar Prasad- New Age, 2021
3. Refrigeration and air conditioning - Ahmadul Amen – PHI, 2006

WEB RESOURCES:

<https://nptel.ac.in/courses/112105128>

<https://nptel.ac.in/courses/112105129>

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Describe the concept of refrigeration.	U
CO2	Explain air refrigeration cycle and its application in air craft.	An
CO3	Explain vapour compression refrigeration system	An
CO4	Explain vapour absorption refrigeration system	U
CO5	Present the properties, applications and environmental issues of different refrigerants.	An
CO6	Discuss basic concepts of air conditioning, psychrometric properties and processes.	An



CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	2					1							1		1
CO2	2	1				1							2		1
CO3	2	1	1			1							2		1
CO4	2					1							1		1
CO5	2	1	1			1	2						1		1
CO6	2	1	1			1							2		1



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTD3	Energy Conversion and Waste Heat Recovery	3	0	0	40	60	3

Course objectives:

1. To understand the basic knowledge of waste heat recovery
2. To understand the basic concept of co-generation system
3. To learn the thermal analysis and area requirement of heat exchangers
4. To get familiar with different type of waste heat to useful energy conversion technology
5. To understand different types of energy storage and distribution

UNIT – I	Introduction
	Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
UNIT – II	Common Power Cycle
	Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
UNIT – III	Application of industrial waste heat
	Gas-to-liquid and liquid-to liquid heat recovery systems, Recuperators and regenerators, heat pipes, waste heat boilers, fluidized bed heat recovery, shell and tube heat exchangers
UNIT– IV	Direct conversion technologies
	Thermoelectric Generators, Thermionic conversion, ThermoPV, MHD
UNIT -V	Energy Storage Techniques
	Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells, Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage

TEXTBOOKS:

1. Direct Energy Conversion : W.R.Corriss, 1964, 1st Edition
2. Aspects of Energy Conversion : I.M.Blair and B.O.Jones, 1975, 1st Edition
3. Principles of Energy Conversion : A.W.Culp (McGrawHill International), 1979
4. Energy conversion principles : Rakoshdas Begamudre, New Age International, 2007
5. Fuel Economy Handbook, NIFES, 1981

REFERENCE BOOKS:

1. Industrial Furnaces (Vol I & II) and M.H. Mawhinney, (John Wiley Publications)
2. Refractories – F.H. Norton,(John Wiley Publication.)
3. Refractories and their Uses – Kenneth Shaw, (Applied Science Publishers Ltd.)
4. Refractory Material G.B. Rotherberg , (Noyes data Corp. N.I)
5. The storage and handling of Petroleum liquid (John R. Hughes, Charles Griffin & Co. Ltd.)
6. Fuels and fuel Technology Wilfred Francis, (Pergamon press)
7. Domestic and commercial oil Burners Charles H. Burkhadt (McGraw Hill Publication)
8. The efficient use of steam – Oliver Lyle, (HMSO London)
8. Boilers – Types, Characteristics and functions – Carl D. Shields (Mcgraw Hill book)
10. The Efficient use of steam generation – General editor – P.M.Goodall
11. Principles of Refrigeration R.J. Dossat (Wiley Estern Limited.)
12. Stoichiometry – Bhatt, Vora (Tata Mc.Graw Hill)
13. Practical Heat Recovery – Boyen J.L. (John Wiley, New York, USA1976)



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WEB RESOURCES:

<https://archive.nptel.ac.in/courses/112/105/112105221/>

https://onlinecourses.nptel.ac.in/noc20_mm20/preview

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Describe Waste heat recovery systems.	U
CO2	Discuss the basic concepts of cogeneration systems	U
CO3	Analysis of heat exchangers and evaluation of thermal stratification in storage tanks	An
CO4	Examine the knowledge of waste to energy conversion technology	A
CO5	Describe about different types of energy storage and distribution	U

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	2	2	1				2						2	1	1
CO2	2	1					1						2	1	1
CO3	3	2	2										3	1	1
CO4	2	2	1				2						2	1	1
CO5	2	2					1						2	1	1



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SUB CODE	COURSE NAME	HOURS PER WEEK			IA	ESE	TOTAL	CREDITS
MEUGTD4	Power Plant Engineering	L	T	P	40	60	100	3
		3	0	0				

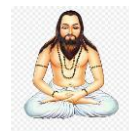
Course Objectives

1. To introduce the general sources of power, power demand scenarios in India and globally, and the classification and layout of various power plants.
2. To explain the working principles of steam power plants including the Rankine cycle, its modifications, and auxiliary components.
3. To provide knowledge of gas turbine power plants, their configurations, and combined cycle operations.
4. To understand the basics of nuclear power generation, types of reactors, and safety mechanisms.
5. To develop an understanding of power plant economics, load characteristics, cost analysis, and environmental concerns.

UNIT- I	Introduction: Power Plant
	General Sources of power, power requirement of India and world, types of power stations- steam, nuclear, diesel and hydro - brief layout and arrangement of elements and complements, sitting of different power stations.
UNIT-II	Steam Power Plant
	Steam power plants, basic Rankine cycle and its modifications, selection of working medium, working of different circuits, fuel and ash handling, heat Balance in steam cycles, heat rates. Air pre-heater, feed water heaters, superheater, deaerators, feed water treatment, Important instrumentation and piping of gas and water loop, governing of steam turbine, brief introduction to super critical boiler
UNIT- III	Gas Turbine Power Plants
	Introduction, classification, components of gas turbine power plants, working of closed and open cycle gas turbine, combined cycle power plants.
UNIT- IV	Nuclear Power Plant
	Evolution of nuclear energy from atoms by fission and fusion. Chain reactions, fission materials, arrangements of various elements in a nuclear power station, types of reactors: gas cooled, boiling water, liquid metal cooled and fast reactor, Reactor control, Reactor shielding and safety methods, India's nuclear program.
UNIT-V	Power Plant Economics
	Connected load, maximum demand, demand factor, average load, load factor, load curves and load duration curve, effect of variable load on plant design and operation, capital and operating cost of different power plants. Environmental issues, pollution control technologies.



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Textbooks:

1. P.K. Nag, *Power Plant Engineering*, McGraw-Hill Education, 2014, 4th Edition.
2. R.K. Rajput, *Power Plant Engineering*, Laxmi Publications, 2007, 5th Edition.

Reference Books:

1. M.M. El-Wakil, *Power Plant Technology*, McGraw-Hill Education.
2. Frederick T. Morse, *Power Plant Engineering*, Prentice Hall.
3. Arora and Domkundwar, *A Course in Power Plant Engineering*, Dhanpat Rai & Co.
4. S.C. Arora and S. Domkundwar, *Thermal Power Engineering*, Dhanpat Rai & Co.

Web Recourses:

1. <https://archive.nptel.ac.in/courses/112/107/112107291/>
2. <https://nptel.ac.in/courses/112103421>

Course Outcomes: After completion of the course, the students will be able to:

COs	Statement	Highest BTL
CO1	Classify power plants and describe their basic layout and site selection criteria.	Applying
CO2	Analyse steam cycles and explain key components such as feedwater heaters and superheaters.	Analysing
CO3	Differentiate between open and closed cycle gas turbines and describe the working of combined cycle systems.	Analysing
CO4	Explain the process of nuclear fission, reactor types, and safety and shielding methods.	Understanding
CO5	Evaluate power plant performance using load curves and analyse capital and operational costs, along with environmental impacts.	Evaluating

Outcome-Based Education Mapping: CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
CO4	3	3	-	2	-	2	2	-	-	-	-	-	3	3	2
CO5	3	3	2	-	-	2	3	-	-	-	2	-	3	3	2

1 = Low correlation, 2 = Moderate correlation, 3 = High correlation, Blank = No direct correlation



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTD5	Solar Energy: Fundamental and Applications	3	0	0	40	60	3

Course objectives:

- To understand the basic knowledge of solar radiation
- To understand working principles of solar thermal conversion technologies
- To impart knowledge about various solar thermal in domestic and industrial Applications
- To understand the concept of direct conversion from solar radiation into electrical energy and developments of photovoltaic technologies
- To impart knowledge about the status of solar energy market, economic and policies in India

UNIT – I	Introduction
	Introduction to solar energy: overview of global and Indian energy scenario, need of solar energy, propagation of solar radiation from the sun to earth; solar radiation geometry: sun earth geometry, extra-terrestrial and terrestrial radiation, solar energy measuring instruments; solar radiation estimation; on horizontal surface – solar radiation on inclined plane surface.
UNIT – II	Solar Thermal Collectors
	Liquid flat plate collector, flat plate air heaters, evacuated tube collector, thermal analysis of liquid flat plate and evacuated tube collector, solar PVT collectors compound parabolic concentrator - cylindrical parabolic, concentrator - linear Fresnel lens collector, paraboloid dish collector, central tower receiver.
UNIT – III	Solar Thermal Applications
	Solar water heater, Solar air heater, solar passive space heating and cooling systems solar cooker, solar dryer, solar distillation, solar pond, solar refrigeration and air conditioning system, solar thermal power plant - solar industrial process heating systems.
UNIT– IV	Solar Photovoltaic Energy Conversion
	Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells. various generations of solar cell- classification, PV standalone system components, Standalone PV-system design. Components of grid-connected PV system, solar power plant design and performance analysis.
UNIT -V	Solar Energy: Indian markets, Economics and Policies
	Current status of solar energy technologies and markets - The economics of solar energy - Barriers to the development and deployment of solar energy technologies - Government initiatives to promote solar energy - Major achievements in solar sector- Future prospects for solar energy

TEXTBOOKS:

1. Garg H.P., Prakash J., Solar Energy – Fundamentals and Applications, Tata McGraw Hill, 2017, 1st Edition
2. Sukhatme S.P. and Nayak J.K., Solar Energy – Principles of Thermal Collection and, Storage, Tata McGraw Hill, 2010.
3. Khan B.H., Non-Conventional Energy Resources, 3rd ed., McGraw Hill, 2017



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REFERENCE BOOKS:

1. Napoleon Enteria and Aliakbar Akbarzadeh, Solar Energy Sciences and Engineering Applications, CRC press, 2014.
2. Robert Foster, Majid Ghassemi and Alma Cota, Solar Energy: renewable Energy and the Environment, CRC press, 2010.
3. G.D. Rai, Non-Conventional Energy Resources

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Know the solar energy potential and solar radiation concepts	U
CO2	Understand the solar thermal energy conversion techniques and approach	U
CO3	Analyze the principles and applications of solar thermal systems,	An
CO4	Design a Solar Thermal / PV system for any requirement	A
CO5	Evaluate the current status, economics, barriers, government initiatives, achievements, and future prospects	U

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	2	2	1				1						1	1	1
CO2	2	3	2			1	1						3	2	3
CO3	3	3	3	3	2	1	2						3	2	3
CO4	2	1	1	2	2	2	3		2		2		1	2	1
CO5	2	1			1	1	2	1		3	3		1	1	1



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTD6	Theory of Vibrations	2	1	0	40	60	3

Course objectives:

- Introduce the fundamental concepts of vibration, including its causes, effects, and classifications, and develop mathematical models for various vibrating systems.
- Enable students to analyze the free and forced vibration response of single-degree-of-freedom (SDF) systems under various damping and excitation conditions.
- Equip students with the ability to formulate equations of motion and determine the free and forced vibration characteristics of two-degree-of-freedom (2-DOF) systems, including the concept of vibration absorption.
- Develop an understanding of multi-degree-of-freedom (MDOF) systems, enabling students to formulate equations of motion, analyze natural modes, and apply modal analysis techniques for both free and forced vibration responses.
- Provide an introduction to the vibration analysis of continuous systems, specifically focusing on the transverse vibration of strings, longitudinal vibration of bars, and transverse vibration of beams.

UNIT – I	Introduction:
	Causes and effects of vibration, Classification of vibrating system, Discrete and continuous systems, degrees of freedom, Identification of variables and Parameters, Linear and nonlinear systems, linearization of nonlinear systems, Physical models, Schematic models and Mathematical models. SDF systems: Formulation of equation of motion: Newton –Euler method, De Alembert's method, Energy method; Free Vibration: Undamped Free vibration response, Damped Free vibration response, Case studies on formulation and response calculation.
UNIT – II	Forced vibration response:
	Response to harmonic excitations, solution of differential equation of motion, Vector approach, Complex frequency response, Magnification factor Resonance, Rotating/reciprocating unbalances, Force Transmissibility, Motion Transmissibility, Vibration measuring instruments, Case studies on forced vibration.
UNIT – III	Two degree of freedom systems:
	Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method,; Free vibration response, Eigen values and Eigen vectors, Normal modes and mode superposition, Coordinate coupling, decoupling of equations of motion, Natural coordinates, Response to initial conditions, free vibration response case studies, Forced vibration response, undamped vibration absorbers, Case studies on undamped vibration absorbers.
UNIT– IV	Multi degree of freedom systems:
	Introduction , Formulation of equations of motion, Free vibration response, Natural modes and mode shapes, Orthogonality of model vectors, normalization of model vectors, Decoupling of modes, model analysis, mode superposition technique, Free vibration response through model analysis, Forced vibration analysis through model analysis, Model damping
UNIT -V	Continuous systems
	Introduction to continuous systems, Vibrations of String, bars and beams.

TEXTBOOKS:



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- S.S.Rao, "Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
- W.T. Thompson, Theory of Vibration,. CBS Publishers

REFERENCE BOOKS:

1. Clarence W. de Silva , Vibration: Fundamentals and Practice, CRC Press LLC, 2000
2. L.Meirovitch, "Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Classify different types of vibrating systems, identify their degrees of freedom, and formulate mathematical models for single-degree-of-freedom systems.	Understand
CO2	Analyze and determine the undamped and damped free vibration response, as well as the forced vibration response to harmonic excitations for single-degree-of-freedom systems, including the calculation of magnification factor and transmissibility.	Analyze
CO3	Formulate equations of motion for two-degree-of-freedom systems using various methods (e.g., equilibrium, Lagrangian), determine natural frequencies and mode shapes and analyze the effectiveness of undamped vibration absorbers.	Apply
CO4	Apply modal analysis techniques to multi-degree-of-freedom systems to determine natural frequencies and mode shapes, and predict their free and forced vibration responses.	Apply
CO5	Understand the fundamental principles of vibration in continuous systems and analyze the vibration characteristics of strings, bars, and beams.	Understand

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	3	3	1	-	1	-	-	-	-	-	-	1	2	1	-
CO2	3	3	2	1	2	-	-	-	-	1	-	1	3	2	-
CO3	3	3	2	1	2	-	-	-	-	1	-	1	3	2	-
CO4	3	3	2	1	2	-	-	-	-	1	-	1	3	2	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	2	1	-



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTP1	Industrial Sustainability	3	-	-	40	60	3

Course objectives:

1. Understand the basic fundamental principles & theories towards attaining Industrial Sustainability (IS).
2. Understand the concept, principles & approaches towards industrial sustainable development.
3. Explore the universal policies towards industrial sustainable development up to 2030 and their target, focus initiatives for industrial sustainable development.
4. Apply measurement and indicators of industrial sustainable development.
5. Understand & analyse the current contemporary issues associated industrial sustainable development.

UNIT – I	Industrial sustainability:
	Concept, Meaning, and Objectives, Goals, Importance & basic pillars of sustainability. Industrial Sustainability (IS)-History, evolution, principles, various strategies, tactics and necessary operations. The various theories-systems theory, popular theory, and ideal scientific models of IS.
UNIT – II	Industrial Sustainable development & Approaches:
	Concept, meanings, scope, and definitions of sustainable development–principles of industrial sustainable development, The pillars of industrial sustainable development and allied approaches: status quo approach, community capacity building approach, industrial sector approach, integrated systems approach, human development approach, and green account approach.
UNIT – III	Contributions towards industrial sustainable development:
	Nature, objectives and global goal & agenda of industrial sustainable development, government policies and their implications for sustainable development in India by 2030. Contribution of international organizations and NGOs and current and future government initiatives for industrial sustainable development.
UNIT– IV	Measurement and indicators of industrial sustainable development:
	Measurement tools for industrial sustainable development: Gross National Happiness (GBH), Human Development Index (HDI), Ecological Footprint (EF) and The Happy Planet Index (HPI), Indicators of industrial sustainable development-indicators for education, health, economy, gender equality, zero hunger.
UNIT -V	Challenges with industrial sustainable development:
	Diversity and Social exclusion: Concept and implications, human development of the socio-cultural and other ethnic groups of the society; Contemporary Issues of Sustainable Development–Bottom of the pyramid approach; Understanding the importance of social capital, social mobilization, social security, and population stabilization.

TEXT-BOOKS:

- Blewitt, John (2014). Understanding Sustainable Development. Routledge. ISBN 978-0-415-70782-4.
- Varun Chhachhar (2023), Sustainable Development in India, Vol.1, Khanna Publisher, ISBN- 8196200730.
- Filho, WL; Wall, T; Salvia, AL; Dinis, MAP and Mifsud, M (2023). The central role of climate action in achieving the United Nations' Sustainable Development Goals". Sci Rep. 13 (1).

REFERENCE BOOKS:

- Lekhi, RK(2013),The Economics of development and Planning, Kalyani Publishers
- Mukherji, Rahul(Eds).(2007), India'sEconomicTransition:ThePolitics of Reforms, Oxford University Press.

WEB RESOURCES:



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<https://www.ceew.in/research/industrial-sustainability>

<https://www.mckinsey.com/capabilities/sustainability/our-insights/reimagining-industrial-operations>

<https://suspot.org/industrial-sustainability/>

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Describe the basic fundamental principles & theories of Industrial Sustainability (IS)..	U
CO2	Describe the principles & approaches towards industrial sustainable development.	U
CO3	Discuss the knowledge of sustainable development goals 2030 and their target, ranking, governments' initiatives for industrial sustainable development.	U
CO4	Examining the performance of indicators associated with industrial sustainable development.	A
CO5	Describe & discuss the current contemporary issues associated industrial sustainable development.	U

CO-PO – Affinity Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1					1		2			1	2	3			
CO2					2	2	3			1	2	3			
CO3	1	1			2	2	2		1	1	3	3			
CO4			1		2	1	3			1	2	3			
CO5							3			1	2	2			

1= Slightly	2= Medium	3= Strong	- = No Relationship
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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTP2	Maintenance Engineering & Management	3	-	-	40	60	3

Course objectives:

1. Understand the basic fundamental principles & theories of maintenance Engg. & its planning.
2. Understand the various types of maintenance systems to void the future plant shot down.
3. Sense the various repair and replacement strategies and polices.
4. Understand the methods of prioritizing maintenance.
5. Realize the contemporary methods of decisions related to maintenance inspection.

UNIT – I	Maintenance Engineering & Planning:
	Definition, Objectives, Goals of Maintenance Engineering, Importance and benefits of sound maintenance Engineering, Maintenance Engineering and Planning-Principles and practices of maintenance planning, Basic-Objectives and principles of maintenance planning. Factors influencing plant availability, Maintenance control, Maintenance Strategies, Organization for Maintenance, Maintenance organization, Maintenance economics.
UNIT – II	Maintenance Management Systems:
	Maintenance categories-Comparative merits of each category-Preventive maintenance, maintenance schedules, Fixed time maintenance, Condition based Maintenance, Design out maintenance, Total Productive Maintenance, repair cycle-Principles and methods of lubrication-TPM, Condition Monitoring-Cost comparison with and without CM-On-load testing and off-load testing.
UNIT – III	Repair and Replacement:
	Meaning and difference, optimal overhaul / Repair / Replace maintenance policy for equipment subject to breakdown, Repair methods for equipments-Equipment records –Job order systems -Use of computers in maintenance. Replacement Decisions: Deterministic and stochastic replacement situations, failure and preventive replacement, Optimal Interval between preventive replacement of equipment subject to breakdown, group replacement
UNIT– IV	NUCREC Method of prioritizing maintenance:
	NUCREC Method of prioritizing maintenance work-Spare Parts Management: Classification of spares, traditional approach to spares inventory, MUSIC-3D Approach to spares inventory, optimum number of spares to satisfy given service level, simulation techniques.
UNIT -V	Maintenance inspection decisions:
	Optimal Inspection frequency (for maximization of profit and minimization of downtime). Shut down planning using CPM & PERT.

TEXT-BOOKS:

- Srivastava S.K., Industrial Maintenance Management, - S. Chand and Co., 1981
- Bhattacharya S.N., Installation, Servicing and Maintenance, S. Chand and Co., 1995
- Higgins L.R., Maintenance Engineering, McGraw Hill, 5th Edition, 1988.
- Armstrong, Condition Monitoring, BSIRSA, 1988.
- Davies, Condition Monitoring, Chapman &Hall, 1996.

REFERENCE BOOKS:

- White E.N., Maintenance Planning, I Documentation, Gower Press, 1979.
- Garg M.R., Industrial Maintenance, S. Chand & Co., 1986.

WEB RESOURCES:

<https://fiixsoftware.com/glossary/maintenance-engineer/>

<https://www.accessengineeringlibrary.com/content/book/9780071826617>

<https://www.amazon.in/Maintenance-Engineering-Sushil-Kumar-Srivastava/dp/8121926440/>



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Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Describe the basic fundamental principles & theories of maintenance Engg. & its planning.	U
CO2	Describe the various types of maintenance systems to void the future plant shot down.	U
CO3	Discuss the various repair and replacement strategies and polices.	U
CO4	Apply the methods of prioritizing maintenance.	A
CO5	Implement the contemporary methods of decisions related to maintenance inspection.	U

CO-PO – Affinity Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-			1		2			1	2	3			
CO2	1	-			2	2	3			1	2	3			
CO3	2	2			2	2	2		1	1	3	3			
CO4	2	2	1		2	1	3			1	2	3			
CO5	2	2	1				3			1	2	2			

1= Slightly	2= Medium	3= Strong	- = No Relationship
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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTP3	Advances in Welding and Joining Techniques	3	-	-	40	60	3

Course objectives:

1. Understand the concepts and theoretical aspects of welding technology.
2. Determination of weld parameters associated with different welding process.
3. Identification of the melted region along with the HAZ region of a welded metal or alloy.
4. Classifying different joint designs adopted in welding technique.
5. Identification of the cause of welding defects and its mitigation.

UNIT – I	Introduction
	Introduction to welding, application, classification and process selection criterion. Health & safety in welding. Welding Arc: Physics of welding arc, arc initiation, voltage distribution, arc characteristics, arc efficiency, arc temperatures and arc blow. Mechanism and types of metal transfer. Welding Power Sources: Types of welding power sources, operation characteristics and specifications.
UNIT – II	Advances in Welding Processes
	Shielded Metal Arc Welding (SMAW), Gas metal arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW), Plasma Arc Welding (PAW), Submerged Arc Welding (SAW), Electro Gas and Electro Slag Welding, Resistance Welding, Friction Welding, Brazing and Soldering, Laser Beam Welding (LBW), Electron Beam Welding, Ultrasonic Welding, Explosive Welding, Friction Stir Welding (FSW), Under Water Welding.
UNIT – III	Heat Flow and Welding Metallurgy
	Weld thermal cycle, Temperature distribution, and Heat Affected Zone (HAZ), Heating, Cooling and Solidification rates. Fundamentals of Physical Metallurgy, Principle of Solidification of weld metal, Reactions in weld pool – Gas metal reaction, Slag metal reaction, factors affecting changes in microstructure and mechanical properties of HAZ, Micro and macro structures in weld metal and HAZ.
UNIT – IV	Weldability
	Effects of alloying elements on weldability, Carbon equivalent, Welding of plain carbon steel, stainless steel, cast iron and aluminium alloys, Welding of dissimilar materials.
UNIT - V	Weld Design
	Types of welds and joints, Welding symbols, Weld defects and remedies, Residual stresses and distortion, Inspection and testing of welds: Introduction to Non-destructive techniques, Destructive techniques- Macro and Micro hardness test, Wear tests and types, Corrosion test, Tensile test, Bend test, SEM, EDS and XRD.

Text Books/References:

1. DeGarmo's, Materials and Processes in Manufacturing, John Wiley and Sons, 2020, 13th Edition.
2. Parmar, R.S., Welding Engineering and Technology, Khanna Publishers, 2022, 3rd Edition



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3. Little, R. L., Welding and Welding Technology, McGraw Hill education, 2017
4. Bohnart, E.R., Welding Principles and Practices, McGraw Hill education.
5. Hull, Non Destructive Testing, ELBS Edition, 1991.

Course Outcome and their mapping with Program Outcomes:

After completion of the course, the students will be able to:

COs	Course Outcomes	Bloom's Taxonomy
CO1	To understand the concepts and theoretical aspects of welding technology.	Understand
CO2	To determine the weld parameters associated with different welding process.	Evaluate
CO3	To identify the melted region along with the HAZ region of a welded metal or alloy.	Apply
CO4	To classify different joint designs adopted in welding technique	Understand
CO5	To identify the cause of welding defects and its mitigation	Apply

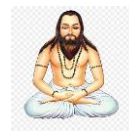
COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1							3	2	-
CO2	3	3	2	2	2	1							3	2	-
CO3	3	3	3	3	2	1							3	2	-
CO4	3	3	3	3	2	1							3	2	-
CO5	3	3	2	2	2	1							3	2	-
Total	15	15	12	12	10	5							15	10	-
Avg.	3	3	2.4	2.4	2	1							3	2	-

Course Outcomes and their mapping with Programme Outcomes:

Weightage: 1-Sightly; 2-Moderately; 3-Strongly



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTP4	Machine Learning in Mechanical and Materials Engineering	3	-	-	40	60	3

Course objectives:

1. Understand the basic concepts and techniques of Machine Learning.
2. Understand the basics of variety of machine learning algorithms.
3. Identify and solve the problem using a suitable machine learning technique.

UNIT – I	Introduction
	Machine Learning, Supervised learning, Unsupervised learning
UNIT – II	Linear Regression
	Model representation, Cost function formulation, gradient descent for linear regression, Linear Regression with Multiple Variables: Model representation, Cost function formulation, gradient descent for multiple variables, features and polynomial regression, Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost Function, Simplified Cost Function and Gradient Descent, Multiclass Classification Regularization: Over fitting, Regularized linear and logistic regression
UNIT – III	Neural Network Representation
	Physiology of Human Brain, Models of Neuron, Network Architecture, Artificial Intelligence & Neural Network Single Layer Perceptrons: Least mean square algorithm, learning curves learning rate annealing techniques, Perceptron, Perceptron Convergence Theorem. MultiLayer Feed forward Neural Networks: Multi-Layer Perceptrons, Back Propagation Algorithm, Generalization, Cross Validation.
UNIT – IV	Implementation of Artificial Neural Networks to Mechanical engineering problems
	Introducing machine learning tools to design solutions for various problems related to Mechanical engineering.
UNIT – V	Implementation of Artificial Neural Networks to Materials engineering problems
	Introducing machine learning tools to design solutions for various problems related to Materials Science engineering.

Text Books/References:

1. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2017.
2. Alpaydin, E. “Introduction to machine learning”, MIT press, 2014.
3. Marsland, S. “Machine learning: an algorithmic perspective”, CRC press, 2015.
4. Christopher M Bishop, “Pattern recognition and machine learning”, Springer New York, 2016.
5. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification” Second edition John Wiley, 2001.



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Course Outcome and their mapping with Program Outcomes:

After completion of the course, the students will be able to:

COs	Course Outcomes	Bloom's Taxonomy
CO1	To understand the fundamental basics and challenges of machine learning	Understand
CO2	To understand a wide variety of learning algorithms	Understand
CO3	To formulate and evaluate models generated from data	Apply
CO4	To design and implement Artificial Neural Networks for real world problems related to Mechanical and Materials engineering	Apply

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1					2	3	2	-
CO2	3	3	2	3	3	1	1					2	3	2	-
CO3	3	3	3	3	3	2	2					2	2	2	-
CO4	3	3	3	3	3	2	2					2	2	2	-
Total	12	12	10	11	11	6	6					8	10	8	-
Avg.	3	3	2.5	2.75	2.75	1.5	1.5					2	2.5	2	-

Course Outcomes and their mapping with Programme Outcomes:

Weightage: 1-Sightly; 2-Moderately; 3-Strongly



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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUGTP5	Marketing Management for Engineers	3	0	0	40	60	3

Course objectives:

- To understand the core concepts of marketing management and how they apply to engineering and technology-driven industries.
- To explore the role of engineers in marketing strategy and decision-making.
- To develop a comprehensive understanding of product development, branding, pricing, distribution, and promotion in engineering-focused markets

UNIT – I	Introduction to Marketing Management
	Definition and scope of marketing management. The evolution of marketing concepts - from product orientation to relationship marketing. Marketing mix: The 4Ps (Product, Price, Place, Promotion). The role of engineering in marketing. Market segmentation, targeting, and positioning. Marketing strategies for technology-driven markets.
UNIT – II	Product and Brand Management in Engineering
	Product life cycle (PLC) and its application to engineering products. New product development process (NPD) in engineering industries. Product differentiation and innovation. Brand management and positioning for engineering products. The role of engineering in product design and differentiation.
UNIT – III	Pricing Strategies in Engineering Markets
	Factors influencing pricing decisions in engineering sectors. Cost-based vs. value-based pricing models. Competitive pricing in technology markets. Pricing strategies for new products and innovations. Pricing for global markets and international engineering products. Discounting, bundling, and skimming in technology markets.
UNIT– IV	Distribution and Supply Chain Management
	The role of distribution channels in engineering markets. Types of distribution systems - direct, indirect, digital. Supply chain management and its importance for marketing engineering products. Logistics in marketing: Managing inventory and lead times. E-commerce and digital marketing channels for technology products. Partnering with suppliers and resellers in engineering markets.
UNIT - V	Promotion and Communication Strategies for Engineering Products
	Integrated marketing communications (IMC) and its application in engineering industries. Advertising and digital marketing strategies for tech products. Trade promotions, events, and exhibitions in the engineering sector. Public relations, media relations, and brand visibility in engineering industries. Social media and influencer marketing for engineering products. Customer relationship management (CRM) and retention strategies

TEXTBOOKS:

1. *Marketing Management* by Philip Kotler and Kevin Lane Keller (15th edition) 2016
2. *Marketing Management – Indian Context – Global Perspective* by V. S. Ramaswamy and S. Namakumari, Sixth Edition, SAGE Publications, India 2018



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REFERENCE BOOKS:

1. *Marketing Management* - Millenium Edition by Philip Kotler 2002
2. *Marketing Research* by Tull, S. and Hawkins, Prentice Hall of India-1997.
3. *Principles of Marketing* by Kotler and Armstrong G., Prentice Hall of India, 2000.
4. *Marketing* by Skinner, J., All India Publishers and Distributes Ltd. 1998.
5. *Industrial marketing management* by Govindarajan, Vikas Publishing Pvt. Ltd, 2003

Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Understand the fundamentals of marketing management in the context of engineering and technology industries	U
CO2	Apply product management and brand strategy to engineering products	A
CO3	Evaluate and implement pricing strategies in engineering and technology-driven markets	An
CO4	Design and optimize distribution and supply chain strategies for engineering products	An
CO5	Develop and execute integrated promotional and communication strategies for engineering products	A

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1			3	1								1			
CO2		1	3	3		2	1		2	2	2	2			
CO3	1	1	1	3	2	2	2	1		2	2	3			
CO4			2	2		2	1			3	3	3			
CO5	1	1	3	2		1	1			1	2	3			



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CODE	COURSE NAME	HOURS PER WEEK			CIA	CREDIT
		L	T	P		
MEUGTG1	Professional Ethics	3	-	-	100	1

Course objectives:

1. Understand the ethics and its necessity globally.
2. Understand the professional ethics and its constitutional necessity.
3. Understand the essential theories of professional ethics.
4. Understand the necessity of ethics in professional decision making.
5. Understand the necessity of development of ethical culture in various professions.

UNIT – I	Introduction to ethics:
	Definitions, understanding the need for ethics, its characteristics, principles of ethics, ethical values, myths and ambiguity, ethical codes & conducts.
UNIT – II	Professional ethics:
	Industrial vs. professional ethics, necessity of professional ethics in modern industry, professional ethics-principles, committee & constitution.
UNIT – III	Theories of professional ethics:
	Theories of ethics, absolutism verses relativism, teleological approach, the deontological approach, Kohlberg.
UNIT– IV	Ethical decision making in organizations:
	Ethics in professional decision making, ethical reasoning, resolution process; professional ethics dilemmas in different industries i.e., finance, marketing HRM and international business.
UNIT -V	Ethical culture in professions:
	Current trends and growth status so far in ethical culture development in various professions, Role of Indian scriptures in developing ethical culture in various professions.

TEXT-BOOKS:

- Chakraborty, S.K.: Foundations of managerial work contributions from indian thought, Himalaya Publishing House, Delhi 1998.
- Chakraborty, S.K.: Ethics in management: vedantic perspectives, Oxford University Press, Delhi 1995.
- Boatright, John R: Ethics and the conduct of business, Pearson Education, New Delhi 2005.

REFERENCE BOOKS:

- Kumar, S. and N.K.Uberoi: Managing secularism in the new millenium, Excel Books 2000.
- Griffiths, B: The Marriage of east and west, Colling , London 1985.
- Trevion and Nelson: Managing business ethics, John Wiley and Sons, 1995.
- Bhaskar R.K : Man management: A value based management perspectives, Sri Satya Sai Students and Staff Welfare Society, 2011

WEB RESOURCES:

- <https://open.library.okstate.edu/foundationsofeducationaltechnology/part/chapter-11-instructional-design/>
- <https://usic.uok.edu.in/Files/66ec1908-5fe0-4cbe-86cf-cd7cfcd0534/Custom/Professional%20ethics.pdf>
- <https://www.iaa.govt.nz/for-advisers/adviser-tools/ethics-toolkit/professional-ethics-and-codes-of-conduct/>



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Course Outcomes and their Mapping with Program Outcomes:

After completion of the course, the students will be able to		
COs	Statement	Highest BTL
CO1	Apply the ethics in own living and professionalism.	A
CO2	Describe the professional ethics codes and committee for operating business.	U
CO3	Apply the essential theories of professional ethics practically in own profession.	A
CO4	Apply the ethics in each decision making.	A
CO5	Discuss about to retain the ethical culture in own/other business.	U

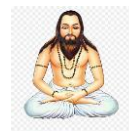
CO-PO – Affinity Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1	2	3			1	3			
CO2							2	3			1	3			
CO3						1	2	3			3	3			
CO4			1			1	3	3			1	3			
CO5								3			1	3			

1= Slightly	2= Medium	3= Strong	- = No Relationship
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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO1	Heat Exchangers: Fundamentals And Design Analysis	Prof. Prasanta Kumar Das, Prof. Indranil Ghosh	IIT Kharagpur	3

• **ABOUT THE COURSE:**

Heat exchangers are extensively used in diverse industries covering power generation, refrigeration and air conditioning, cryogenics, oil refineries and chemical processes, automobiles and other transport devices. The performance of a heat exchanger is very important for the conservation of energy, assurance of product quality, process viability and environmental protection. The present course aims at developing a familiarity with various types of heat exchangers, their construction and applications. Conventional methods of heat exchanger analysis; brief design methodology of typical heat exchangers and synthesis of heat exchanger network. It is planned to develop an appreciation and basic expertise in heat exchanger through description, mathematical analysis and numerical examples.

- **INTENDED AUDIENCE** : Mechanical Engineering, Chemical Engineering, Energy Engineering, Cryogenics Engineering, Aerospace Engineering etc.
- **PREREQUISITES** : Thermodynamics, Fluid Mechanics and Heat Transfer (at a very basic level).
- **INDUSTRY SUPPORT** : All the companies generating coal based and nuclear based power (NTPC, different state electricity boards, CPRI, BARC, and NPCL etc.). Companies dealing with the design and fabrication of heat exchangers, auto mobile industries, process industries, oil refineries. Companies dealing with waste heat recovery and renewable. Some specific companies could be BHEL, ALSTOM, HP, HPCL, IOCL, THERMAX, BPCL, GAIL, Reliance, TATA Chemicals etc.

Course layout

- Week 1:** Background, Application, Classification, Common terminologies.
- Week 2:** Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing and rating. F-LMTD and -NTU method.
- Week 3:** Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types.
- Week 4:** Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer, Fin tube heat exchanger
- Week 5:** Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design, application. Multistream PFHE.
- Week 6:** Multistream PFHE continued. Direct contact heat exchangers, types, application, simple analysis.
- Week 7:** Regenerators, types of regenerators, construction, application. Theory of Regenerator, -NTU and - method.



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- Week 8:** Heat pipes, construction, working principle, application, analysis. Special heat pipes.
- Week 9:** Microscale Heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations
- Week 10:** Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.
- Week 11:** Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.
- Week 12:** Heat Exchanger testing, steady state and dynamic methods.

Books and references

1. Fundamentals of Heat Exchanger Design by R. K. Shah, Dusan P. Sekulic, John Wiley & Sons, 11-Aug-2003.
2. Heat Exchanger Design Handbook by Kuppan Thulukkanam, Taylor & Francis, 23-Feb-2000.
3. Heat Exchangers: Selection, Rating, and Thermal Design, Third Edition by Sadik Kakac, Hongtan Liu, CRC-Press, 01-Feb-1998.
4. Cryogenic Heat Transfer, Second Edition by Randall F. Barron, Gregory F. Nellis, CRC Press, May 23, 2016.



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO2	Operations And Supply Chain Management	Prof. G. Srinivasan	IIT Madras	3

• **ABOUT THE COURSE:**

This course introduces the viewer to the basics of Operations and Supply Chain Management. The concepts in Operations Management are restricted to the planning and operational decisions within an organization while the supply chain concepts are for a network of organizations. The main emphasis of the course is on the basic concepts and on quantitative modeling of the various decision problems.

- **INTENDED AUDIENCE** : Any Interested Learner

Course layout

Week 1: Forecasting

Week 2: Facility layout and location.

Week 3: Capacity and aggregate planning

Week 4: Inventory management

Week 5: Scheduling models and applications

Week 6: Introduction to supply chain.

Week 7: Value of information and supply chain integration.

Week 8: Outsourcing

Week 9: Transportation decision

Week 10: Distribution and logistics in supply chains

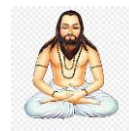
Week 11: Information technology in supply chain.

Books and references

1. Operations Management by Evans and Collier.
2. Operations Management by Heizer and Render.
3. Supply Chain Management by Janat Shah.
4. Supply Chain Management by Chopra and Meindl.



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO3	E-business	Prof. Mamata Jenamani	IIT Kharagpur	3

• **ABOUT THE COURSE:**

The Internet has changed the way companies carry out their businesses. The primary objective of this course is to introduce concepts, tools and approaches to electronic business to the post- graduate and undergraduate students. Further, the subject will help the students to develop skills to manage businesses in the digital world. The course will cover following aspects of E-Business Systems.

- Part 1: Foundations of E-Business systems
- Part 2: Infrastructure
- Part 3: Functional Areas
- Part 4: Decision Support for E-Business Systems

The course provides a balance approach including concepts from technology and management.

- **INTENDED AUDIENCE:** Engineering (IT/Production/Industrial Engg) & Management
- **PRE-REQUISITES** : Nil
- **INDUSTRY SUPPORT** : All the companies

Course layout

Week 1: Introduction to E-Business

Week 2: Making Functional Areas E-Business Enabled : Value chain and supply chain, inter and intra organizational business processes, ERP

Week 3: Making Functional Areas E-Business Enabled : E-Procurement

Week 4: Making Functional Areas E-Business Enabled : E-marketing, E-Selling, E-Supply Chain Management

Week 5: Technologies for E-Business: Internet and Web based system

Week 6: Technologies for E-Business: Security and payment systems

Week 7: Technologies for E-Business: Supply chain integration technologies (EDI, RFID, Sensors, IoT, GPS, GIS)



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Week 8: Technologies for E-Business: Supply chain integration technologies (Web services and cloud)

Week 9: Decision Support in E-Business: Web analytics

Week 10: Decision Support in E-Business: Customer behavior modeling

Week 11: Decision Support in E-Business: Auctions

Week 12: Decision Support in E-Business: Recommender systems

Books and references

1. Management Information Systems: Managing the Digital Firm, Laudon and Laudon, Pearson
2. Scaling for E-Business, Menasce & Almeida, PHI
3. eBusiness & eCommerce – Managing the Digital Value Chain, Meier & Stormer, Springer
4. eBook is available in springerlink.com
5. Some reference books, Internet Resources, and Research Papers



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO4	Experimental Modal Analysis	Prof. Subodh V. Modak	IIT Delhi	3

- **ABOUT THE COURSE:**

This course is about the fundamentals and basic concepts of Experimental Modal Analysis (EMA) and its applications. EMA, also known as Modal Testing, is a technique for experimentally determining the natural frequencies, mode shapes, and damping factors of a physical system or structure. One primary application of EMA is for the avoidance of resonant operation and troubleshooting vibration and noise problems. Another important application is in validating and updating structural dynamic FE models. EMA also enables deriving an experimental mathematical model of a physical system, which can be used for response simulation, force identification, structural modification, and structural control. The course will start from the theoretical basis of EMA, followed by signal processing for modal analysis. Then it will cover how the frequency and impulse response functions (FRFs and IRFs) can be measured by exciting the structure and measuring the input force and output response and how the modal parameters can be estimated from these measured FRFs and IRFs. In the end, the course will briefly cover Phase resonance testing, Operational Modal Analysis, and applications of EMA.

- **INTENDED AUDIENCE:**

BE/B. Tech/ME/M. Tech/MS/PhD students of Mechanical, Aerospace, Automotive, Civil, and Naval architecture disciplines
Practicing engineers and professionals

- **PREREQUISITES:** Basic mechanics

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- **INDUSTRY SUPPORT:** Automotive, aerospace, machine tool, and marine industries; Modal testing is widely used in many other industries, and they also may be interested.

Course layout

Week 1: Introduction, need and applications of EMA, lumped parameter models, Analytical modal analysis of SDOF undamped and damped systems; Free and forced response, FRF

Week 2: Analytical modal analysis of undamped and damped MDOF systems; eigenvalue problem (EVP), free response, Forced response, FRF matrix, modal space, modal response

Week 3: IRF, Convolution integral, FRF characteristics, FRF types, FRF Plots, stiffness and mass lines; modal contributions; antiresonances

Week 4: Signal processing for experimental modal analysis, Fourier series, Fourier transform, Discrete Fourier Series, Discrete Fourier transform



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Week 5: Time sampling; aliasing, sampling theorem, quantization, windowing; window functions, random signals, correlation, spectral density, white noise

Week 6: FRF measurement with an impact hammer, FRF estimation, Impact hammer, response measurement, accelerometer, mounting and selection, LDV

Week 7: Auto and cross spectrums, H1- H2 estimates, spectrum averaging, coherence function, FRF measurement simulation, boundary conditions, calibration

Week 8: FRF measurement with shaker, electromagnetic shaker, shaker-structure interaction, force transducer, impedance head; FRF measurement simulation, pseudo-random, periodic random, burst random, chirp excitation

Week 9: Modal parameter estimation using SDOF curve fitting, Peak-picking method, Circle fit method, Line fit, residuals

Week 10: Modal parameter estimation using MDOF curve fitting, RFP, Global method, Complex exponential method, Stabilization diagram, SVD, Eigensystem realization algorithm

Week 11: Phase resonance testing, Operational modal analysis

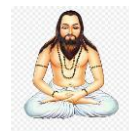
Week 12: EMA applications, local structural modification, Response simulation, Force identification, Coupled structural analysis, MAC correlation, FE Model validation and updating

Books and references

- 1) Ewins, D.J., Modal Testing: Theory, Practice and Application, 2000, Research studies press, England
- 2) Modak, S.V., Analytical and Experimental Modal Analysis, 2023, CRC Press, Taylor & Francis Group (Under publication)



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO5	Dynamic Behaviour of Materials	Prof. Prasenjit Khanikar	IIT Guwahati	3

• **ABOUT THE COURSE:**

Study of materials behavior in extreme environments and development of new materials for such environments has become a vital research area for materials scientists and engineers in the 21st century. Mechanical properties of materials under dynamic loading are considered as an important area of research and development in defense, automotive and aerospace industries. Under dynamic loading conditions, the inertial effects come to play an important role in the deformation behavior of the material. Many materials exhibit strain rate sensitivity at higher strain rates, i.e., flow stress dependence on strain rates. In addition, the failure mechanisms under high strain rate loading conditions are generally different than those occur in low strain rate. Furthermore, the deformation and failure mechanisms are controlled by the microstructure of the materials. This course will be important to mechanical, materials and civil engineers to understand materials behavior for ballistic applications, explosive forming or welding applications, automotive and aerospace applications.

INTENDED AUDIENCE: Mechanical Engineers, Civil Engineers, Materials Engineers

PREREQUISITES: Solid Mechanics and basic Materials Science course

Course layout

Week 1: Introduction: dynamic deformation and failure

Week 2: Introduction to waves: elastic waves; types of elastic waves; reflection, refraction and interaction of waves

Week 3: Plastic waves and shock waves: Plastic waves of uniaxial stress, uniaxial strain and combined stress; Taylor's experiments; shock waves

Week 4: Shock wave induced phase transformation; Explosive-material interaction and detonation

Week 5: Experimental techniques for dynamic deformation: intermediate strain rate tests; split Hopkinson pressure bar; expanding ring test; gun systems

Week 6: Review of mechanical behavior of materials (especially metals): Elastic and plastic deformation of metals; dislocation mechanics;



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- Week 7: Plastic deformation of metals at high strain rates: Empirical constitutive equations; relationship between dislocation velocity and applied stress; physically based constitutive equations
- Week 8: Plastic deformation in shock waves: Strengthening due to shock wave propagation; dislocation generation; point defect generation and deformation twinning
- Week 9: Strain localization/shear bands: Constitutive models; metallurgical aspects
- Week 10: Dynamic Fracture: Fundamentals of fracture mechanics; limiting crack speed, crack branching and dynamic fracture toughness; spalling and fragmentation
- Week 11: Dynamic deformation of materials other than metals: Polymers; ceramics; composites
- Week 12: Applications: Armor applications; explosive welding and forming

Books and references

Textbook:

1. Marc A. Meyers, Dynamic Behavior of Materials, John Wiley & Sons, New York, 1994

References:

1. L.B. Freund, Dynamic Fracture Mechanics, Cambridge, 1990
2. Y. Bai B. Dodd, Adiabatic Shear Localization, Pergamon, Oxford, UK, 1992
3. G.E. Dieter, Mechanical Metallurgy, Mc Graw Hill, 1986
4. J.W. Swegle, D.E. Grady, in Shock Waves in Condensed Matter- 1985,
5. J. L. Wise and L.C. Chhabildas, in *Shock Waves in Condensed Matter-1985, Proceedings of the Fourth APS Topical Conference on Shock Waves in Condensed Matter, Spokane, WA, July 22-25, 1985*, edited by Y. M. Gupta (Plenum, New York, 1986), p. 441.



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO6	Fundamentals of additive manufacturing technologies	Prof. Sajan Kapil	IIT Guwahati	3

- **ABOUT THE COURSE:**

The progress of additive manufacturing processes is ever increasing with the development of the digital platform in the manufacturing sector, which is essential for the growth of modern technologies. This course is primarily designed for fundamental understanding of different additive manufacturing technologies for realizing the metallic and non-metallic objects. The syllabus is oriented to cover from basic understanding to practical applications of this technology to develop the products. Therefore, the academic people, as well as the industrial practitioner both, will be benefitted from this course. The special emphasis is given to link computer interface with the digital manufacturing process and their demonstration using commercially available software. The modules cover almost all the direction of additive manufacturing technologies, and it is blended with fundamental development to the recent technologies. The audience will be able to develop a fundamental understanding of different perspectives and recent development in this field through the lectures, skill development through demonstration, and reinforce their knowledge by solving assignments. This course is presented in a lucid and simplified way to make it enjoyable to the beginners.

- **INTENDED AUDIENCE:** Bachelor/Master/PhD students having background in Mechanical Engineering/Production Engineering/Manufacturing Technology
- **PRE-REQUISITES:** There are no pre-requisites in educational qualification.
- **INDUSTRY SUPPORT:** No industry support is required

Course layout

Week 1 :Introduction to Additive Manufacturing

Week 2 :Computer Aided Process Planning for Additive Manufacturing

Week 3 :Computer Aided Process Planning for Additive Manufacturing

Week 4 :Liquid Additive Manufacturing

Week 5 :Liquid Additive Manufacturing

Week 6 :Sheet Additive Manufacturing



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Week 7 :Wire Additive Manufacturing

Week 8 :Wire Additive Manufacturing

Week 9 :Wire Additive Manufacturing

Week 10 :Powder Additive Manufacturing

Week 11 :Powder Additive Manufacturing

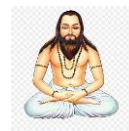
Week 12 :Powder Additive Manufacturing

Books and references

1. Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
2. Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
3. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
4. Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.



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Massive Open Online Course (MOOC)

CODE	COURSE NAME	Course Instructor	Affiliation	CREDIT
MEUGTO7	Materials Processing (Casting, Forming & Welding)	Prof. Swarup Bag	IIT Guwahati	3

• **ABOUT THE COURSE:**

The progress of material processing is ever challenging with the development of new materials and their application in modern technologies. Materials processing effectively transforms the raw materials into useful products and largely decides the thermal, electrical, mechanical and other characteristic properties. The specific properties of materials, useful coating, thin film deposition, and integration of fibers mainly bring the functional properties of modern optical, electronic, and biomedical devices. Material processing technologies are mainly explained by heat transfer and material flow, diffusion, phase transformation and solidification that bridge the gap between manufacturing science and engineering. The syllabus is oriented to the conventional and advancement of the material processing technologies. The modules cover almost all the direction of material processing technologies and it is blended with fundamental development to the recent technologies. Audience will be able to develop fundamental understanding on different perspective and recent development in this field through the lectures and reinforce their knowledge by solving assignments. This course is presented in a lucid and simplified way to make it enjoyable to the beginners.

• **INTENDED AUDIENCE:**

Second year onwards undergraduate students, post-graduate students having a background in Mechanical/Material Science/Metallurgical Engineering/ Production Engineering/Manufacturing Technology. The faculty of different institutes can attend this course as a part of FDP.

Course layout

Week 1: Introduction to Materials processing - 1

- Materials and microstructure evolutions
- Basics of heat conduction and fluid flow - I
- Basics of heat conduction and fluid flow – II; Numerical problems

Week 2: Introduction to Materials processing – 2

- Solidification processing - I



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- Solidification processing – II; Numerical problems

Week 3: Overview of casting, welding and forming processes

- Casting and Welding; Numerical problems
- Material forming; Numerical problems

Week 4: Melt processes – Casting - 1

- Processing of metals, polymers and ceramics; Case studies
- Shape casting, extrusion and injection molding; Case studies

Week 5: Melt processes – Casting - 2

- Blow molding and fused deposition modeling; Case studies
- Sand casting, lost foam & cooled molds; Case studies

Week 6: Melt processes – Fusion welding

- Arc, laser and electron beam welding; Case studies
- Advanced welding processes; Case studies
- Metallic wire additive manufacturing; Case studies

Week 7: Solid processes – Bulk deformation

- Mechanical responses of metals and polymers; Numerical problems
- Hot working and cold working; Case studies
- Hot rolling of steel; Case studies

Week 8: Solid state deformation

- Solid state welding; Case studies
- Ball Milling and friction Consolidation; Case studies

Week 9: Powder processing

- Powder compaction; Case studies
- Powder additive manufacturing; Case studies
- Powder treatment; Case studies

Week 10: Non-conventional processing



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- Colloidal processing and coating; Case studies
- Dispersions and additive processes; Case studies

Week 11: Steel processing

- Steel making and single crystal production; Case studies
- Steel fluid flow analysis
- Steel solidification

Week 12: Processing of electronics, magnetic and optic materials

- Electronics material processing; Case studies
- Magnetic material processing; Case studies
- Optic material processing; Case studies

Books and references

1. Lorraine F. Francis, Materials Processing, Academic Press, 2016
2. John E. Neely and Thomas J. Bertone: Practical Metallurgy and Materials of Industry, 6th Ed, Prentice Hall, 2002.
3. D S Porter, K E Esterling and M Y Sherif, Phase Transformation in Metals and Alloys, 3rd Ed., CRC Press, 2016.
4. Sindo Kou, Welding Metallurgy, Wiley Interscience, 2nd Ed., 2003.
5. John D Verhoeven, Fundamentals of Physical Metallurgy, John Wiley & Sons, 1975
6. Vladimir B. Ginzburg, Steel-Rolling Technology: Theory and Practice, 1st Ed, CRC Press, 1989
7. W. Kurtz and D.J. Fischer, Fundamentals of Solidification, 3rd Ed., Trans Tech Publications, 1992
8. John Campbell, Castings, Butterworth Heinemann, 1st Ed., 1998.
9. D R Poirier and E J Poirier, Heat Transfer Fundamentals for Metal casting, TMS, 2nd Ed., 1993.
10. Chris Nielsen and Paulo Martins, Metal Forming, 1st Ed, Academic Press, 2021.