SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA (A CENTRAL UNIVERSITY)
CBCS-NEW, STUDY & EVALUATION SCHEME
PROPOSED W.E.F. SESSION 2023-2024
B.Tech. IV Year (SEMESTER VII)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	ME207TPC13	Refrigeration & Air Conditioning	3	1	-	30	70	100	4
2.		Professional Elective	3	-	-	30	70	100	3
3.		Open Elective	3	-	-	30	70	100	3
4.	ME207MC04	Mandatory Course	-	-	-	100	-	100	-
5.	ME207THS04	Production Planning and Control	3	-	-	30	70	100	3
6.		Industry Course	1	-	-	100	-	100	1
		Total	**13**	**1**	**-**	**320**	**280**	**600**	**14**
PRACTICALS									
1.	ME207PPC01	Refrigeration & Air Conditioning Lab	-	-	2	30	20	50	1
2.	ME207PPE01	Engines and Combustion Lab	-	-	2	30	20	50	1
3.	ME207PRJ03	Minor Project	-	-	4	100	-	100	2
4.	ME207PRJ04	Seminar on Summer Training	-	-	2	100	-	100	1
		Total	**-**	**-**	**10**	**260**	**40**	**300**	**5**
GRAND TOTAL			**13**	**1**	**10**	**580**	**320**	**900**	**19**

Total Credits : **19**
Total Contact Hour : **24**
Total Marks : **900**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted. L-LECTURE, T-TUTORIAL, P-PRACTICAL, ESE –END SEMESTER EXAMINATION

Professional Electives		Industry Courses	
ME207TPE51	Engines and Combustion	ME207TIC11	Innovation & Design Thinking
ME207TPE52	Non-Destructive Testing	ME207TIC12	Maintenance Engineering and Management
ME207TPE53	Theory of Vibrations		

Open Electives	
EC207TOE02	CMOS Digital VLSI Design
CE207TOE02	Green Building and Sustainable Materials
CH207TOE02	Waste to Energy
IT207TOE01	Machine Learning
ME207TOE02	Principles of Management
CS207TOE01	GIS & Remote Sensing

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CBCS-NEW, STUDY & EVALUATION SCHEME

PROPOSED W.E.F. SESSION 2023-2024

B.Tech. IV Year (SEMESTER VIII)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	ME208TPC14	Power Plant Engineering	3	-	-	30	70	100	3
2.		Professional Elective	3	-	-	30	70	100	3
3.		Open Elective	3	-	-	30	70	100	3
4.	ME208THS05	Total Quality Management	3	-	-	30	70	100	3
5.	ME208TIC02	Industry Course	1	-	-	100	-	100	1
		Total	**13**	**-**	**-**	**220**	**280**	**500**	**13**
PRACTICALS									
1.	ME208PRJ05	Major Project	-	-	16	200	-	200	8
		Total	**-**	**-**	**16**	**200**	**-**	**200**	**8**
GRAND TOTAL			**13**	**-**	**16**	**420**	**280**	**700**	**21**

Total Credits : **21**
Total Contact Hour : **29**
Total Marks : **700**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted. L-LECTURE,T-TUTORIAL,P-PRACTICAL, ESE –END SEMESTER EXAMINATION

Professional Electives		Industry Courses	
ME208TPE61	Automotive Engineering	ME208TIC11	Metal Cutting
ME208TPE62	Solar Energy	ME208TIC12	Environment Friendly Power Generation from Coal
ME208TPE63	Introduction to Industry 4.0		

Open Electives	
EC207TOE03	Introduction to IoT
CE207TOE03	Infrastructure Planning and Management
CH207TOE03	Plant Engineering Economics and Management
IT208TOE01	Soft Computing
ME208TOE03	Supply Chain Management
CS208TOE01	Artificial Intelligence

Course: Refrigeration & Air Conditioning (RAC)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207TPC13	3	1	0	4	30	70	100	4

Course Objectives:

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

Syllabus Contents:

UNIT-I:

Refrigeration: 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: 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: 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 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, 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.

Course Outcomes:

After studying, the students are able to:

1. Illustrate the basic concepts of refrigeration and air conditioning system.
2. Analyze the performance of vapour compression cycle using p-h chart with respect to various refrigerants.
3. Explain the properties, applications and environmental issues of different refrigerants.
4. Evaluate the cooling/heating load based on properties of moist air for different air conditioning processes.
5. Identify the different components of basic refrigeration and air-conditioning equipment and discuss their uses.

Text/Reference Books:

1. Refrigeration and Air Conditioning C. P. Arora - TMH.
2. Refrigeration and Air Conditioning – P.L. Ballaney – Khanna Pub
3. A course in refrigeration and air conditioning -S C Arora & Domkundwar- Dhanpatrai
4. Principals of refrigeration-Dossat-Pearson education
5. Refrigeration and air conditioning- Manohar Prasad- New age.
6. Refrigeration and air conditioning - Ahmadul amen - PHI

CO-PO Mapping

COs	PROGRAM OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	3	1	1
CO2	2	2	1	-	-	-	-	-	-	-	-	1	2	2	1
CO3	3	1	-	-	-	1	3	-	-	-	-	1	3	1	1
CO4	2	2	1	-	-	1	-	-	-	-	-	1	1	1	1

CO5	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
Average	**2.4**	**1.5**	**1**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**1**	**2.4**	**1.2**	**1**

Course: Production Planning Control (PPC)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207THS04	3	0	0	3	30	70	100	3

Course Objectives:

1. Understand the objectives, functions as well as applications of PPC and its forecasting techniques for sustainable production.
2. Grasp the knowledge about applications MRP, charts as well as inventory control techniques.
3. Experience and solve the various routing, scheduling and facility location evaluation problems.
4. Understand different type of layouts and its design procedures and basic supply chain management and network.
5. Familiarize from the different maintenance strategies and practices to control production units.

Syllabus Contents:

UNIT-I:

Introduction: Introduction to various Types of Production System viz. Mass Production, Job Shop, Batch Production System, Continuous Production System, Concept of Production and Operation Management, Objective & functions of PPC.

Forecasting: Time Series method, moving average, weighted average, Trend, Seasonality, Regression Technique, and Delphi Method.

UNIT-II:

Aggregate Planning: Definition, Strategies, Pure and mixed strategies, methods. Master Production Schedule: objective and functions, Design of MPS, Bill of Materials. Material Requirement Planning: objectives, functions, MRP, MRP-II, limitations. Capacity Requirement Planning: Definition, Objectives, Process of CRP, Process Sheet, Rough Cut Capacity Planning, Loading, and Preparation of CRP chart.

UNIT-III:

Scheduling: Types, Single Machine Scheduling, Job shop Scheduling, Flow Scheduling; Sequencing: various priority rules; Line of Balancing: Rank and positional weight method, Kilbridgewestner method.

Facility location and facility location problems: Factors affecting plant locations, single facility locations problems and its methods.

UNIT-IV:

Types of layout- layouts design procedure such as CORELAP, CRAFT etc. Material handling system & their classification, principles, JIT&KANBAN, Depreciation& methods of depreciation. The objective, importance, decision phases.

UNIT-V:

Maintenance Management: Types of maintenance strategies, Breakdown and Preventive Maintenance, Predictive and Total Productive Maintenance, Condition monitoring, Individual and group replacement policies. Make or Buy Decision, concept of original equipment effectiveness.

Course Outcomes:

After studying, the students are able to:

1. Frame the objectives and functions of PPC and apply forecasting techniques for attaining the goals/objectives.
2. Grasp the knowledge about applications of MRP, charts as well as inventory control techniques.
3. Experience and solve the various routing, scheduling and facility location evaluation problems.
4. Describe the different type of layouts and its design procedures.
5. Implicate the different maintenance strategies and practices to control production units.

Text/Reference Books:

- Stephen, C. (2005), 1st edition, Pearson Publication.
- Buffa, S.N. (2008) Production operations management, PHI, Publication.
- Paneerselvem, O. (2009) TMH. 2, Publication. Production and operation management.
- Charry, S.N. TMH (2015) Publication. Production and operation management, TMH, Publication.
- Adem, E., (2018) Production and operation management, Edition. 3, Publication.
- Khanna, R.B. (2019) Production and Operations management, PHI, Publication.
- https://mrcet.com/downloads/digital_notes/ME/IV%20year/PPC_3122018.pdf.

CO-PO Mapping

COs	PROGRAM OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	-	3	-	-	-	3		3	-	3
CO2	3	3	3	-	1	-	3	-	-	-	3		3	-	3
CO3	3	3	3	-	1	-	3	-	-	-	3		3	-	3
CO4	3	3	3	-	-	-	3	-	-	-	3		3	-	3
CO5	3	3	3	-	2	-	3	-	-	-	3		3	-	3
Average	3	2.8	3	1	1.25	-	3	-	-	-	3	-	3	-	3

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207TPE51	3	-	-	3 hours	30	70	100	3

ENGINES AND COMBUSTION

Subject Code	Course Objectives
1	To understand air standard cycles and comparison with actual cycles,
2	To understand about the components & combustion phenomenon of SI and CI engines.
3	To understand cooling & lubrication systems in engines.
4	To understand performance parameters of IC engines.
5	To Evaluate the performance parameters of IC engines.

Syllabus Content:

UNIT-I:

Introduction of internal combustion engines: Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel, and Dual cycles. Two and four-stroke engines, SI and CI engines, Valve timing diagram, Fuel air cycle, factors affecting it, Actual cycle analysis, Actual Cycle.

UNIT-II:

SI Engines - Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, Combustion chamber design for SI engines, Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, Ignition system requirements, Magneto and battery ignition systems, Scavenging in 2 Stroke engines, Supercharging and its effect.

UNIT-III:

CI Engine - Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines.

Fuel injection in CI engines Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings.

UNIT-IV:

Engine Cooling - Different cooling systems, Radiators, and cooling fans.

Lubrication - Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation,

Fuels -Fuels for SI and CI engine, important qualities of SI and CI engine fuels, Rating of SI engine and CI engine

UNIT-V:

Testing and Performance of IC Engines : Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power –

Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

Subject Code	Course Outcomes	Bloom's Taxonomy Level
	After successful completion of the course, the students shall be able to:-	
CO1	Demonstrate the components & combustion phenomenon of SI and CI engines.	Understand
CO2	Understand cooling & lubrication systems in engines	Understand
CO3	Calculate performance parameters of IC engines.	Apply
CO4	Evaluate the performance parameters of IC engines.	Analyze

Text/Reference Books:

1. I. C. Engines by Mathur & Sharma, Dhanpatrai
3. I. C. Engines by V.Ganeshan, Tata McGraw Hill
4. I. C. Engines by R. Yadav, Central Pub., Allahabad
5. A Text Book of Internal combustion engines by R.K. Rajput, Laxmi Pub, Pvt., 2006

Course Outcomes and their mapping with Programme Outcomes:

COs	PROGRAM OUTCOMES (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III
CO1	**3**												**3**		
CO2	**3**												**3**		
CO3	**3**												**3**		
CO4	**3**	**1**											**3**		
CO5	**3**												**3**	**3**	
Average	**3**	**1**											**3**	**3**	

	NON – DESTRUCTIVE TESTING (ME207TPE52) **B.Tech. IV Year** **L T P C** **3 0 0 3**
UNIT - 1	**Introduction to NDT** Comparison between destructive testing and NDT, importance of NDT, scope of NDT, difficulties of NDT, Visual Inspection: Tools, applications and limitations, Fundamentals of visual testing, vision, lighting and material attributes, environmental factors, visual perception, direct and indirect methods, mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light source and special lighting, computer enhanced systems. Liquid Penetrant Inspection (LPI): Principles, properties required for a good penetrant and developers, Types of penetrants and developers, advantage and limitations of various methods of LPI, LPI techniques, test procedures, interpretation and evaluation of penetrant test indications, false indication, safety precautions required in LPI applications, advantages and limitations.
UNIT- 2	**Magnetic Particle Inspection** Magnetic Particle Inspection (MPI): Principles of MPI, basic physics of magnetism, Permeability, flux density, cohesive force, magnetizing force, retentivity, residual magnetism. Methods of magnetization, Magnetization techniques such as head shot technique, cold shot technique, central conduction testing, magnetization using products, using yokes, direct and indirect method of magnetization, Continuous testing of MPI, Residual testing of MPI, System sensitivity, Checking devices in MPI, Interpretation of MPI indications, Advantage and limitations of MPI
UNIT- 3	**Ultrasonic Testing** Principle, type of waves, frequency, velocity, wavelength, reflection, divergence, attenuation, mode conversion in ultrasonics, UT testing methods: Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, Ultrasonic Testing Techniques: Resonance testing, Through transmission technique, Pulse echo testing technique, Instruments used in UT, Transducer types, Reference blocks with artificially created defects, Calibration of equipment, Acoustical Holography- Principles, types, applications, advantage and limitations.
UNIT- 4	**Radiography Testing** Principle, electromagnetic radiation sources, X-ray sources, Production of X-rays, High energy X-ray source, Gama ray source, Properties of X-rays and gamma rays, Inspection techniques like SWSI, DWSI, DWDI, Panoramic exposure, Real time radiography, Films and screens used in radiography, Quality of radiographic film processing, interpretation, evaluation of test results, Safety aspects required in radiography, Applications, advantages and limitations of RT.
UNIT- 5	**Eddy Current Testing & Thermography** Principles, Physics aspects of ECT like conductivity, permeability, resistivity, inductance, inductive reactance, impedance, Filed factor and lift off effect, edge effect, end effect, Depth of penetration of ECT, relation between frequency and depth of penetration in ECT, Equipment and accessories, Various application of ECT, advantages and limitations of eddy current testing. Thermography: Principles, Contact and non-contact inspection methods, Heat sensitive paints and papers, thermally quenched phosphors, Liquid crystals, techniques for applying liquid crystals, Non-contact thermographic inspection: advantage and limitations, Infrared radiation and infrared detectors: Instrumentations and methods, application.

S.No.	Text Books	Publication
1	Baldev Raj, Practical Non-Destructive Testing, Narosa Publishing House	

S.No.	Reference Books	Publication
1	George E Dieter, Mechanical Metallurgy, McGraw Hill Book Company	
2	Hull B and John V. Non-Destructive Testing, McMillan	
3	Krautkramer Josef and Hebert Krautkramer, Ultrasonic Testing of Materials, Springer Verlag	

Subject Code	Course Objectives
A	To impart knowledge on various NDT methods
B	To describe appropriate techniques to detect the defects in components
C	To impart knowledge on quantification and calibration of equipment

Subject Code	Course Outcomes
	After successful completion of the course, the students shall be able to:-
CO1	*Explain the terminology used in destructive and non-destructive testing.* **(BTL-2)**
CO2	*Select appropriate testing methods and identify equipment required for the testing process.* **(BTL-3)**
CO3	*Perform a dye penetrant, magnetic particle and ultrasonic test to detect surface and internal defects.* **(BTL-3)**
CO4	*Build up knowledge in radiographic testing, eddy current inspection and thermography.* **(BTL-3)**
CO5	*Find the internal flaws in the material by NDT and take measures to eliminate them.* **(BTL-4)**

COs	PROGRAM OUTCOMES (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III
CO1	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-
CO2	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-
CO3	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-
CO4	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-
CO5	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-
	3	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	-	-

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207TPE53	3	0	0	3 hours	30	70	100	3

THEORY OF VIBRATIONS

Course Objectives:

1. Understand the fundamental concepts of vibration theory, including lumped mass, stiffness, and damping, and their representation using vector notation.
2. Analyze and solve vibration problems for single degree of freedom systems using energy methods, Newton's laws, and the general solution approach.
3. Apply mathematical techniques, such as Fourier analysis and convolution integral, to analyze transient vibrations and impulse responses.
4. Analyze multi-degree of freedom systems, including co-ordinate coupling, modal analysis, and the application of Lagrange's equation.
5. Gain familiarity with numerical methods, such as Rayleigh's method, for determining natural frequencies in vibration systems with complex boundary conditions.

Syllabus Content:

UNIT – I:

Element of vibration system: lumped mass, stiffness and damping, simple harmonic motion, vector representation. Single degree of freedom system: equation of motion by energy method & Newton law of motion, general solution, free and forced vibration.

UNIT – II:

Damped and undamped motion- Equation of motion for single and two degree of freedom equivalent damping, logarithmic decrement. Damping measurement, rotating and reciprocating unbalance, vibration absorber, Seismic instruments. Transient vibration: - impulse response, Convolution integral, Fourier analysis.

UNIT- III:

Multi degree freedom system: Equation of motion, co-ordinate coupling, undamped forced vibration, principal modes, generalized co-ordinates, semi definite system, orthogonality of modes, modal analysis, Lagrange’s equation.

UNIT – IV:

Natural frequency numerical solution: Rayleigh`s method

UNIT – V:

Continuous system: Vibration of stretched cord, torsional vibration, longitudinal vibration of slender rod, lateral vibration of beams, Shear deformation and rotary inertia effect, Rayleigh`s quotient, Rayleigh`s-Ritz method.

Text/ Reference Books:

1. "Mechanical vibrations theory and applications' Tse.S,Morse R Rolland T . Hinkle. Ivan E. Published by Alllyn and Bacon ,Tne.
2. "Theory of vibrations with applications" Thomson T. William ,Prentice Hall of India.
3. "Mechanical vibrations" ,HartogDen , J.P. Tata McGraw Hills, 4th edition 1954.

Course Outcome:

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

1. Demonstrate a clear understanding of the basic principles and terminology of vibration theory.
2. Apply the appropriate equations of motion and solution techniques to analyse and solve vibration problems for single degree of freedom systems.
3. Utilize mathematical techniques, such as Fourier analysis and convolution integral, to analyze transient vibrations and determine system responses.
4. Analyze and interpret the behavior of multi-degree of freedom systems, including the identification of principal modes and the application of modal analysis techniques.
5. Apply numerical methods, specifically Rayleigh's method, to estimate natural frequencies in vibration systems with complex boundary conditions and assess their accuracy.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	1	2									3		
AVG	3	1.8	1	1.8									3		

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

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207TIC11	1	0	0	--	100	--	100	1

Innovation and Design Thinking (One Credit Course)

Course Objectives:

- To understand the concept of innovation and its importance in today's business world
- To identify the different categories of innovation and their applications in various industries
- To develop the skills required for creative problem-solving and idea generation
- To apply design thinking techniques and tools to identify, define, and solve complex problems in various contexts

Course Content:

CONCEPT OF INNOVATION - Why Innovation is important for businesses, What is Innovation, Difference between Innovation and Invention, Types of Innovation, Product Innovation, Process Innovation, and Business Model Innovation (2)

SKILL & PERSONALITY TRAITS FOR INNOVATION -Personality traits for innovation, Organisational Structure for Innovation. (1)

SPECIAL CATEGORIES OF INNOVATIONS - Disruptive Innovation, Reverse Innovation. (2)

TOOLS FOR FOSTERING INNOVATION - Value Chain Analysis, The 3 Box Approach to Innovation, Focus Groups and other tools, Software tools for Innovation. (3)

DESIGN THINKING - Design Thinking Mindset, Process of Design Thinking, Idea generation, Understanding the current situation, What if - alternatives, Prototyping, Testing, Cases of application of Design Thinking. (4)

Design Thinking & Innovation Projects in Groups. (4)

Total - 15

References:

1. Govindarajan, Vijay. The Three-Box Solution, Harvard Business Review Press, 2016.
2. Brown, Tim. "Design Thinking." Harvard Business Review, vol. 86, no. 6, 2008,
3. Larson, Chris. "Disruptive Innovation Theory: What It Is & 4 Key Concepts." Harvard Business School Online, January 26, 2021, https://online.hbs.edu/blog/post/disruptive-innovation-theory.
4. Christensen, Clayton M. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business Review Press, 1997
5. Soni, Pavan. Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving. Notion Press, 2018

Course outcomes

- Students will be able to define and explain the concept of innovation, its importance and role in modern businesses

- Students will be able to identify and differentiate between various types of innovation and their applications in different industries
- Students will be able to explain the principles and concepts of design thinking and apply them to real-world problems
- Students will be able to develop creative and innovative solutions to complex problems, and evaluate the feasibility and potential impact of these solutions

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

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

Proposed Evaluation system

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course developed by

Alok K Tripathi, BE, MBA, PhD

General Manager, NTPC (Regional Learning Institute)

Maintenance Engineering and Management
(ONE CREDIT COURSE)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207TIC12	1	0	0	--	100	--	100	1

Course objectives:

- To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To provide the concept of the Horizons of Maintenance Management and strategies used in industries.
- To impart the knowledge in Maintenance of Mechanical Equipments / Items used in Mining industries.
- To understand the conceptual description of Equipments, Methods & Mechanical Maintenance procedures.

1.0 Organization and Management of the Maintenance Function. (3 HRS)

1.1. – Redefining Maintenance- Delivery Reliability.
1.2.- Effective Maintenance Organization.
1.3.- Operating Policies of effective Maintenance.
1.4.- SixSigma Concept in Maintenance- Application of Quality Management Principles.

2.0 The Horizons of Maintenance Management (5 HRS)

2.1.- Corrective Maintenance
2.2.- Reliability based Preventive Maintenance.
2.3.- Predictive Maintenance.
2.4.- Condition Monitoring based Maintenance.
2.5.- Computer based Maintenance Management System (CMMS).
2.6.- Total Productive Maintenance (TPM).

3.0 Maintenance of Mechanical Equipments / Items used in Mining (For indicative purpose). (4 HRS)

3.1.- Bearings.
3.2.- Flexible Coupling for power transmission.
3.3.- Cranes: Overhead& Gantry.
3.4.- Lifting and Pulling device (Chain Pulley Block)
3.5.- Belt Drives.
3.6.- Mechanical Variable Speed Drives.
3.7.- Gear Drives and Speed Reducers.
3.8.- Pumps.
3.9.- Introduction to Underground Mining Machineries in operation in SECL- Side Discharge Loader / Load Haul Dumper/ Continuous Miner/ High Wall Mining Equipment / Long wall Mining **Equipments – Conceptual description of Equipments, Methods & Mechanical Maintenance procedures.**
3.10.- Case Studies.

4.0 Tools of Maintenance Engineering (3 HRS)

4.1.- Root Cause Analysis.

4.2.- Plant Maintenance Module in System Application Product (SAP) in ERP Platform.

After studying this course, the students are able to:

CO1 Implement the principles, functions and practices adapted in industry for the successful management of maintenance activities.

CO2 Evaluate the concept of the Horizons of Maintenance Management and strategies used in industries.

CO3 Explain the knowledge in Maintenance of Mechanical Equipments / Items used in Mining industries.

CO4 Analyze the conceptual description of Equipments, Methods & Mechanical Maintenance procedures.

Reference:

1. Maintenance Engineering and Maintenance by Sri R C Mishra & Sri K Pathak
2. Maintenance Engineering and Management by Sri D R Kiran
3. Computerized Maintenance Management system made easy by Sri Kishan Bagadia.
4. Modern ERP by Marianne Bradford.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PO11	PO12	PSO1	PSO2	PSO3
CO1																
CO2																
CO3																
CO4																

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

Evaluation system

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course Prepared by

1. **Sri A K Jha**, GM(E&M)/HOD, SECL HQ, Bilaspur and
2. **Sri Durgadas Adhikary**, Chief Manager (E&M), SECL HQ, Bilaspur

Course: Refrigeration & Air Conditioning (RAC) Lab

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207PPC01	**0**	**0**	**2**	**3 hrs.**	**30**	**20**	**50**	**1**

Course Objectives:

The objective of this lab is to understand the basic principles in the areas of Refrigeration and air conditioning systems through a series of experiments. In this lab the experiments are performed to measure performance parameters of the systems such as Refrigeration effect, heating load, Heating and cooling C.O.P.

Syllabus Contents:

Module no.	Experiment description	No. of hours
1	Determination of C.O. P on vapour compression system	3
2	Determination of C.O. P on Cascade Refrigeration system	3
3	Performance test on Air conditioning test rig (Window type)	3
4	Performance test on Air conditioning test rig (Duct type)	3
5	Determination of C.O.P of ice plant	3
6	Determination of C.O.P of Water –water Heat Pump	3
7	Determination of C.O.P of Air –water Heat Pump	3
8	Performance analysis in an experimental cooling tower.	3
	COURSE TOTAL	21

List of Equipment/Instruments/Machines/Software Required:

1. Air-water heat pump test rig.
2. Water-water heat pump test rig.
3. Vapour compression refrigeration test-rig. (water chilling plant)
4. Window air-conditioning cycle. (Window type) Test rig.
5. Air conditioning cycle test rig (Duct type)
6. Cascade refrigeration test rig.
7. Mini cold storage plant.
8. Cooling tower

Course Outcomes:

After studying, the students are able to:

1. Demonstrate a refrigeration system and identify its important components.
2. Find the refrigeration effect and C.O.P. of a vapor compression refrigeration system.
3. Find the heating effect and C.O.P. of a heat pump.
4. Find the properties of moist air and identify different air conditioning processes.
5. Illustrate the components of a basic air conditioning system and to analyze its performance.
6. Understand the functioning of cascade refrigeration system.

CO-PO Mapping

COs	PROGRAM OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	1	-	-	1	2	1	1
CO3	2	1	-	-	-	-	-	-	1	-	-	1	2	1	1
CO4	2	1	-	-	-	-	-	-	1	-	-	1	2	1	1
CO5	1	-	-	-	-	-	-	-	1	-	-	1	2	1	1
CO6	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Average	1.5	1	-	-	-	-	-	-	1	-	-	1	2	1	1

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207PPE01	-	-	2	2 hours	30	20	50	1

ENGINES AND COMBUSTION

Subject Code	Course Objectives
1	To understand about the components & combustion phenomenon of SI and CI engines.
2	To understand cooling, lubrication & Carburation systems in engines.
3	To Evaluate the performance parameters of IC engines.

List of Experiments:

S. No.	Experiment Details
1	To Study about Ignition System of SI Engine
2	To Study of Carburetion system in SI Engine
3	To Study about working of Single Cylinder 4 Stroke Petrol Engine with Test Rig
4	To Study about Working Model of Lubricating System
5	Single Cylinder 4 Stroke Diesel Engine Test Rig with Dynamometer
6	To Study about 4 stroke diesel Engine Components with Cut Section model
7	To Study about 4 stroke petrol engine with Cut Section model
8	To Study about 2 stroke petrol engine with Cut Section model
9	To Study about working of 4 Stroke Diesel Engine with Test Rig

Subject Code	Course Outcomes	Bloom's Taxonomy Level
	After successful completion of the course, the students shall be able to:-	
CO1	Demonstrate the components & combustion phenomenon of SI and CI engines.	Understand
CO2	understand cooling & lubrication systems in engines	Understand
CO3	calculate performance parameters of IC engines.	Apply
CO4	Evaluate the performance parameters of IC engines.	Analyze

Text/Reference Books:

1. I. C. Engines by Mathur & Sharma, Dhanpatrai
3. I. C. Engines by V.Ganeshan, Tata McGraw Hill
4. I. C. Engines by R. Yadav, Central Pub., Allahabad
5. A Text Book of Internal combustion engines by R.K. Rajput, Laxmi Pub, Pvt., 2006

Course Outcomes and their mapping with Programme Outcomes:

COs	PROGRAM OUTCOMES (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III
	3	**10**	**10**	**11**	**1**	**5**	**3**	**3**	**12**	**5**	**12**	**12**	**3**	**1**	**1**
CO1	**3**												**3**		
CO2	**3**												**3**		
CO3	**3**												**3**		
CO4	**3**	**1**											**3**		
CO5	**3**												**3**	**3**	
Average	**3**	**1**											**3**	**3**	

MINOR PROJECT: DESIGN AND FABRICATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME207PRJ03	0	0	4	--	100	--	100	2

Course Objective:

- To enhance the ability to apply theoretical knowledge and engineering principles to design and develop mechanical systems or components for real-world applications
- To improve technical competence in areas such as Computer Aided Design, Manufacturing, prototyping, material selection, and fabrication techniques
- To develop project management skills, including planning, scheduling, resource allocation, and coordination, to successfully execute design and fabrication projects within given constraints
- Encourage effective communication and collaboration skills through teamwork and project presentations.
- To enhance oral and written communication skills, including the ability to present design concepts, project progress, and final outcomes effectively.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Course Outcome:

Upon the completion of this course the students will be able to

CO1 Apply engineering principles and design methodologies to conceptualize, analyze, and develop a mechanical system or component that meets specified requirements and constraints.

CO2 Execute a comprehensive project plan, including defining project scope, setting objectives, creating a work breakdown structure, allocating resources, and adhering to a timeline for successful project completion.

CO3 Utilize appropriate fabrication techniques, tools, and equipment to manufacture and assemble mechanical components or systems based on design specifications, ensuring accuracy and quality.

CO4 Communicate project progress, design considerations, analysis results, fabrication processes, and final outcomes through written reports, technical drawings, and oral presentations.

CO5 Demonstrate effective teamwork, communication, and presentation skills by working collaboratively on a group project and presenting project outcomes to peers and faculty members

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1															
CO2															
CO3															
CO4															
CO5															

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

Power Plant Engineering

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208TPC14	3	0	0	--	30	70	100	3

Course objectives:

1. To impart knowledge on sources of energy and types of power plants
2. To understand construction and working of Steam Power Plants, Hydro Electric power station, diesel power station, and Nuclear Power Plants.
3. To impart knowledge about various performance characteristics and analysis of power plants.
4. To understand the layout, construction and working of the components of various Renewable energy based power plants.
5. To impart knowledge about energy, economic and environmental factors associated with power plants.

Course contents:

UNIT-I: Coal based thermal power plants, basic Rankine cycle and its modifications, 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.

UNIT-II: Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, binary cycles and cogeneration systems, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III: Basics of nuclear energy conversion, 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.

Diesel Power Plant-Introduction – types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

UNIT-IV: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

UNIT-V: Energy, 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 options for coal and nuclear plants.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

Reference Books:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill,1998.
2. Arora and S. Domkundwar, A Course in Power Plant Engineering, Dhanpat Rai & Co, 2011.

Course Outcomes

After successful completion of the course, the students should be able to

CO1 Discuss the layout of thermal power plant and working principle of various components used in the power plants.

CO2 Explain the layout, construction and working of the components inside Gas and Combined cycle power plants.

CO3 Discuss the various types of nuclear reactors used in nuclear power plant and the working principle of diesel power plant.

CO4 Summarize the principles and working of various renewable energy power plants.

CO5 Explain the energy, economic and environmental issues of power plants.

Course Outcomes and their mapping with Programme Outcomes:

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

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

Automotive Engineering

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208TPE61	3	0	0	--	30	70	100	3

Subject Code	Course Objectives
1	This introduces the student about automobiles, its components and give them a brief idea about electric vehicles and its importance.
2	To study the importance of assembly components of automobiles.
3	The course provides the knowledge of various transmission, drive shaft design, four and all-wheel drive systems.
4	To study the importance of steering system, suspension system, braking system and wheels & tires.
5	This course gives basic technical foundation regarding electric vehicles

Syllabus Content:

UNIT-I:

Introduction to automobiles: Main units of automobile chassis & body, different systems of the automobile, description of the components of IC engine, automobiles & electric prime movers. Resistance to motion, tractive effort & traction, road performance curves.**Introduction to Electric vehicles:**Understanding the foundations of the electric vehicles, basics of electric motors, basics of motor controller (EVs).

UNIT-II:

Transmission system: Layout of transmission system, main function of the different components of transmission system, traditional & modern transmission system, clutch, four wheel drives. Hotchkiss & torque tube drive. Ward Leonard Speed Control System. Communication Protocols (in case of EVs).

Gear box: Sliding mesh, constant mesh & synchromesh gear box, overdrive, torque converter, semi & fully automatic transmission. Hook's joint, Propeller shaft, differential, rear axles, types of rear axles, front axles and front wheel drive.

UNIT-III:

Front wheel geometry & steering system: Camber, Castor, Kingpin inclination, toe-in & toe-out, condition for true rolling motion of wheels during steering. Components of steering mechanism, power steering.

Wheels & tires: Types of wheels, Slip angle, under & over steering, tire specification, tubeless tire.

UNIT-IV:

Suspension & Safety system: Types of suspension system, leaf spring, coil spring & torsion bar. Telescopic type shock absorber, pneumatic suspension system, air bag, crash resistance & passenger comfort.

Braking system: Hydraulic braking system, braking of vehicles when brake is applied to rear, front and all four wheel, theory of internal shoe brake, disc brake, power brake & antilock braking system.

UNIT-V:

Modern Vehicle Technology: Fuel cells technology for vehicles, Types of fuel cells, Current state of the technology, Potential & challenges, Latest engine technology. Basics of Lithium-ion batteries (used in EVs), Battery management system (in EVs), Charging technology and implementation (in EVs).

Text/ Reference Books:

1. Automobile Engineering, K.K. Ramalingam, Scitech Publications Pvt Ltd.
2. Automobile Technology, Dr. N.K. Giri, Khanna Publishers.
3. Automobile Engineering, Prof. Amitosh De, Galgotia Publications Pvt Ltd.
4. Modern Transmission Systems, A.W.Judge, Chapman & Hall Ltd.
5. Automotive Mechanics-Principle & Practice, Josepe Heitner, East West Press.
6. Torque Converter, P.M.Heldt, Chilton Book Co.

Course Outcome:

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

Course Outcomes	Bloom's Taxonomy
Understanding design and analysis of transmission & drive system, use of suitable materials in making automobile components.	Analyze
Graduates will be able to demonstrate & get an idea in identifying the problems in conventional automobiles & electric vehicles.	Understand
Course will develop a strong base for understanding future developments in the automobile industry to the graduates.	Understand
Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.	Understand
Identify Modern technology and safety measures used in Automotive Vehicles	Understand

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Y	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-
CO2	Y	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-
CO3	Y	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-
CO4	Y	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-
CO5	Y	Y	Y	-	-	-	-	-	-	-	-	-	Y	-	-

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208TPE62	3	-	-	3 hrs	30	70	100	3

Solar Energy

Course Objectives:

The objectives of the course

- To impart knowledge on solar energy and its conversion technologies
- To understand construction and working of solar thermal collectors
- 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

Syllabus Content

Unit 1

Solar Energy—Basic Concepts (8) The sun as source of energy - sun, earth radiation spectrum measurement of solar radiation - solar time - solar radiation geometry - solar day length - empirical equations for estimating terrestrial solar radiation on horizontal surface - solar radiation on inclined plane surface.

Unit 2

Solar Thermal Collectors (9) Solar collectors – liquid flat plate collector - flat plate air heating collector - 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 - paraboloidal dish collector - central tower receiver.

Unit 3

Solar Thermal Applications (9) 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 4

Solar Photovoltaic energy conversion (10) Solar cell fundamentals - solar cell characteristics – various generations of solar cell- classification – Si wafer-based pv technology - thin film amorphous si technologies - thin film crystalline si cell technologies - dye-sensitized solar cell technology - organic solar cell technology - quantum dot solar cell Technology-Perovskite solar cells – Solar PV applications.

Unit 5

Solar energy: Indian markets, economics and policies (9) 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.

Text/Reference Books:

1. Garg H.P., Prakash J., Solar Energy – Fundamentals and Applications, Tata McGraw HillEngineering Thermodynamics – P.K. Nag, McGraw Hill
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, 2017Basic and Applied Thermodynamics – P.K. Nag, McGraw Hill
4. Napoleon Enteria and Aliakbar Akbarzadeh, Solar Energy Sciences and Engineering Applications, CRC press, 2014.
5. Robert Foster, Majid Ghassemi and Alma Cota, Solar Energy: renewable Energy and the Environment, CRC press, 2010.

Course Outcome:

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

After successful completion of the course, the students shall be able to:-

- Demonstrate a basic principles of solar energy geometry and its conversion principles
- Analyze, and evaluate the performance of solar thermal collectors for domestic and industrial applications.
- Apply sustainable practices in solar thermal applications.
- Acquire knowledge in design of solar photovoltaic power plants. This includes, sizing of panels, batteries, and inverters depending on demand and site conditions.
- Evaluate the economic feasibility and financial aspects of solar thermal systems and understand the policies related to Indian government initiatives to promote solar energy.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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
AVG															

Course: INTRODUCTION TO INDUSTRY 4.0

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208TPE63	3	0	0	3 hrs	30	70	100	3

Course Objectives:

To introduce the basic ideas in Industry 4.0.

To make the students understand the applications of Industrial 4.0 System across the Industries.

UNIT I: INTRODUCTION TO INDUSTRY 4.0

Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - The Journey so far: Developments in different parts of the world - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT II: ROAD TO INDUSTRY 4.0

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III: IIOT

Fourth Revolution – Sustainability assessment of Manufacturing Industry – Lean Production system – Smart and connected business perspective – smart factories – cyber-physical systems – collaboration platform and PLM

UNIT IV: APPLICATIONS

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance in Industries; Smart Cars, Self-Driving Cars, Introducing Google‘s Self-Driving Car, Intellectual Property Rights.

UNIT V: BUSINESS ISSUES IN INDUSTRY 4.0

Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era – Strategies for competing in an Industry 4.0 world

Total: 45 Hours

REFERENCES

1. “The Fourth Industrial Revolution” by Klaus Schwab, World Economic Forum, Portfolio Penguin, 2017
2. “Internet of Things: A Hands-On Approach” by Arsheep Bahga and Vijay Madisetti, University Press, 2015
3. “NOC: Introduction to Industry 4.0 and Industrial Internet of Things” Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press, Taylor and Francis, 2020
4. Industry 4.0 - The Industrial Internet of Things, Alasdair Gilchrist, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
5. Industry 4.0: Managing the Digital Transformation, Alp Ustundag, EmreCevikcan, Springer, 2018 ISBN 978-3-319-57869-9.
6. Designing the industry - Internet of things connecting the physical, digital and virtual worlds, OvidiuVermesan and Peer Friess, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
7. The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, Springer Gabler, 2017 ISBN 978-3-6581-6502-4
8. The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world, Miller M, Pearson Education, 2015, ISBN: 9780134021300.
9. Industry 4.0, Jean-Claude André, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
10. Handbook of Industry 4.0 and SMART Systems, Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Taylor and Francis,2020

Course Outcomes

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

CO1 Understand the basics of Industrial Revolution	K2
CO2 Understand the basic concepts of Industry 4.0	K2
CO3 Understand the Concepts of Industrial IOT in various sectors	K2
CO4 Appreciate the applications of Industrial IOT	K3
CO5 Understand the Business issues in Industry 4.0	K2

COs	PROGRAM OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	1	1	1	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	1	-	-	-	-	-	-	1	-	1	1	-	-	-
AVG															

Course: Production Planning Control (PPC)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208THS05	3	0	0	3	30	70	100	3

Course Objectives:

1. Understand the various architectures of Quality Control (QC), Statistical QC and control charts.
2. Familiarize from quality assurance system and different Sampling methods and schemes.
3. Perceive the different philosophies of TQM's gurus from application perspective to solve the real industrial problems.
4. Understand the various models of ISO 9000 and waste management & QC tools.
5. Experience the various fundamental aspects of Reliability and its mapping system.

Syllabus Contents:

UNIT-I:

Basic concepts of Quality: Inspection, quality, quality control, cost of quality, value of quality, Statistical Quality Control (SQC), Need and advantages of SQC.

Frequency distribution: Variables & attributes, quality characteristics, Theory of control charts, control chart for variable X & R chart, Control chart for attribution p, np, C, Chart & process capability.

UNIT-II:

Quality Assurance: Quality assurance manual, quality circle, characteristics of quality circle and the process of operation of quality circle, quality Policy & procedure &objectives.

Acceptances Sampling: Concept of sampling, O-C curve & its construction, sampling plans, single, doubles & multiple sampling plans.

UNIT-III:

Contribution of Various Quality Management Gurus: Juran triology, Deming's 14 Points, P-D-C-A Wheel, Taguchi's philosophy, Design of experiment, Old and new seven QC tool of quality, Philip crosby's zero defect, quality function deployment.

UNIT-IV:

Introduction to ISO 9000: Various models of ISO 9000, clauses of 9000, Total Quality Control (TQC), Total Quality Management (TQM), Tools for TQC & 5's TQM, Kaizen. Seven types of waste, six sigma, TQM**,** bench-marking process.

UNIT-V:

Reliability: Definitions, bathtub curve, design for reliability, failures & causes of failures, FMEA-stages, types, maintainability & availability, MTBF, and reliability models, components in series & in parallel, mixed arrangement, fault-tree-technique.

Course Outcomes:

After studying, the students are able to:

1. Utilize the Quality Control (QC), Statistical QC and control charts to satisfy customers.
2. Frame the quality assurance system and various sampling methods as well as schemes to void 100% inspections.
3. Execute the various philosophies of TQM's gurus to solve the industrial problems.
4. Apply the waste management & QC tools practices to the gain the ISO 9000 for own industries.
5. Practise the reliability models for mapping reliability of industrial systems using models.

Text/Reference Books:

1. Grant & Livingsworth (2016). SQC, Tata Mc. Hill Publisher.
2. Juran & Gryna (2017). Quality Planning & Analysis, Tata Mc. Hill Publisher.
3. Feigenbaum (2017). Total Quality Control- Tata Mc. Hill Publisher.
4. Mahajan (2018). SQC, Dhanpatrai Publisher.
5. Besterfield (2018). Total quality management, Tata Mc. Hill Publisher.
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8. Suganthi & Sannuel (2021). Total Quality Management-PHI Publisher.
9. James (2022). Total Quality Management, South Western Educational Publisher.
10. Besterfield Dale (2022). Total Quality Management (TQM), 5th edition, Pearson Paperback.

CO-PO Mapping

COs	PROGRAM OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	3	-	2	-	3	1	3	-	3
CO2	3	2	-	-	-	-	3	-	-	-	2	-	3	-	3
CO3	-	-	-	-	-	-	3	1	-	-	2	-	-	-	-
CO4	3	3	1	-		-	3		-1	-	3	1	3	-	3
CO5	3	3	1	-	1	-	3	-	-	-	-	-	3	-	3
Average	3	2.5	1	-	1	-	3	1	1.5	-	2.5	1	3	-	3

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208TIC12	1	0	0	--	100	--	100	1

Environment friendly power generation from coal (One Credit Course)

Course Objectives:

- To understand the importance and challenges associated with power generation from coal in the context of environmental sustainability.
- To explore various technologies and techniques for mitigating the environmental impact of coal-based power generation.
- To examine the potential of clean coal technologies and their application in reducing emissions from coal-fired power plants.
- To promote critical thinking and problem-solving skills in identifying innovative solutions for reducing the carbon footprint of coal-based power generation

Course content

Session 1

Basic aspects of thermal power generation: Power plant cycle, Fuels and its handling, ash handling, Turbine, Feed water heaters, Generator, Condenser, Cooling tower and its types etc.,

Session 2 &3

Types of fuel and its preparation, constituents of fuel and its effect on emission.

Furnace, types of burner, Fuels combustion in boiler – Coal, biomass, co-combustion in the boiler, combustion arrangement, Tangential firing, front and rear wall firing systems.

Session 4 & 5

Air requirement in boiler – Primary, Secondary air, Flue gas generation, Gas velocity, Ash formation, types of waste generation in a power plant, non hazardous, hazardous, waste storage, waste disposal.

Session 6 & 7

Pollutant formation in the boiler, SOx, NOx, CO2, Particulate matter etc. measurement of pollutants, instruments, emission norms, various measures to reduce emission.

Session 8 &9

Heat transfer mechanism in boiler and in auxiliaries like air pre heater, Economiser, Water wall, Super heater, Reheater etc.,

Session 10 & 11

Particulate Matter formation and its control methods. – ESP, bag filter, ash handling systems, Dry and wet ash evacuation its effect on water consumption.

Session 12 & 13

SOx formation and its control techniques – different types, FGD, Wet FGD, Dry FGD, Ammonia FGD, effect of FGD on power plant operation, gypsum formation etc.,

Session 14 &15

NOx formation and its control techniques – different types, SCR, SNCR, combustion modification, effect of NOx control on power plant operation etc.,

Total Hours: 15

References

1. Power Generation from Solid Fuels (Power Systems) by Hartmut Spliethoff
2. Abatement systems for SOx, NOx, and particles — Technical options by Stanley C. Wallin
3. Environmental Impact of Power Generation, By The Royal Society of Chemistry, R.E. Hester, R. M. Harrison

Course outcomes

By the end of this course, students will be able to

CO1 Explain the environmental impact of coal-based power generation, including greenhouse gas emissions, air pollution, and water usage.

CO2 Identify and evaluate different technologies for reducing emissions and improving the efficiency of coal-fired power plants, such as advanced combustion techniques, flue gas desulfurization, and carbon capture.

CO3 Understand the concept of clean coal technologies and their application in minimizing environmental pollutants.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

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

Proposed Evaluation system

Industry Integrated course / one credit course will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course developed by

Dr. M. Muthuraman, M.E (NIT, Trichy), Ph.D. (Japan)
Additional General Manager,
Environment Management Group (EMG),
NTPC Sipat,
Bilaspur 495 555

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
	1	0	0	--	100	--	100	1

Metal Cutting (One Credit Course)

Course Objectives:

- To provide students with a comprehensive understanding of the principles and techniques of metal cutting
- To develop students' proficiency in using various metal cutting tools and machines
- To enhance students' ability to interpret engineering drawings and select appropriate metal cutting methods for specific applications
- To cultivate students' problem-solving skills in analyzing and resolving issues related to metal cutting processes

Course Content

Basics of Metal Cutting - Various operations - Concepts of stationary and rotary tools 3hrs

Cutting tool evolution – Cutting tool materials – Latest trends in the cutting tools – Grades and Geometries – Coating processes of cutting tools 6 hrs

Workpiece materials – Properties- Cutting tool selection – Machining Concepts – High Speed Machining – Cutting fluids – Wet and Dry Machining 3 hrs

Machine tools – Turning lathe – VMC – HMC – Twin mill centre – Clamping systems – Fixtures 3 hrs

Course Outcomes

CO1	Students will be able to explain the fundamental concepts and theories related to metal cutting, including the mechanics of chip formation, tool wear, and cutting forces
CO2	Students will demonstrate competence in operating and setting up different types of metal cutting machines, such as lathes, milling machines, and bandsaws.
CO3	Students will be able to interpret engineering drawings and select appropriate cutting tools, speeds, and feeds for specific machining operations
CO4	Students will develop the ability to analyze and troubleshoot common problems in metal cutting processes, such as chatter, surface roughness, and dimensional inaccuracies

References:

1. Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja, G.S.Sekhon and Nitin Seth, 2nd edition, New Age International (P) Ltd, 2005.
2. Metal cutting & Tool Design By Ashok Kumar Singh, 1st edition, Vayu Education of India; First Edition, 2014.
3. Metal cutting Theory & Practice, Stephenson, David A.; Agapiou, John S, CRC press, 1997.
4. Machining & Machine Tools, AB Chattopadhyay, Wiley; Second edition, 2017
5. CNC Machines & Automation, Khusdeep Ghoyal, S.K. Kataria & Sons; 2014.

Course Outcomes and their mapping with Programme Outcomes:

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

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

Proposed Evaluation system

Industry Integrated course / one credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for internal assessment such as assignments, seminars, quiz, projects, etc.

Course developed by
B.R.Naresh, B.E., MBA,
CZAR Solutions,
Pune

MAJOR PROJECT WORK

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ME208PRJ05	0	0	16	--	200	--	200	8

COURSE OBJECTIVES

- To develop practical skills in design, analysis, and implementation of mechanical systems and processes through a project-based approach
- To cultivate independent thinking, problem-solving, and decision-making abilities by engaging in a real-world engineering project
- To encourage effective communication and collaboration skills through teamwork and project presentations
- To enhance project management skills through planning, scheduling, and monitoring project progress
- To nurture an understanding of ethical and social responsibilities in engineering by identifying and addressing potential environmental, safety, and societal impacts of the project

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 2 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOME

Upon the completion of this course the students will be able to

CO1 Design and develop a prototype or proof-of-concept for a mechanical system, product, or process using appropriate tools and techniques

CO2 Apply engineering principles and analytical methods to analyze and optimize the design and performance of a mechanical system, product, or process

CO3 Demonstrate effective teamwork, communication, and presentation skills by working collaboratively on a group project and presenting project outcomes to peers and faculty members

CO4 Apply project management skills to plan, schedule, and execute a project, and monitor project progress to ensure timely delivery of outcomes

CO5 Evaluate the potential environmental, safety, and societal impacts of the project and propose solutions to address any issues that may arise

Course Outcomes and their mapping with Programme Outcomes:

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

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