Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME301	**Title of the Course**	MACHINE DESIGN	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	SOM	**Co-requisite**	ADVANCE MACHINE DESIGN				
Course Objectives	1. To provide fundamentals of Machine Design process. 2. To review concepts of statics and dynamic analysis. 3. To introduce fundamental approaches to failure prevention of components. 4. Study various types of Design approaches and methods. 5. To provide knowledge in the design of common machine elements such as fasteners, shafts, springs cotter joints and couplings.						

Course Outcomes	
CO1	The student can understand the concept of Product Development and Design Process and study of material properties and applications.
CO2	The student can understand the concepts of static and dynamic strength of components
CO3	Understand design and applications of mechanical fasteners and joints such as welded joints, screwed joints and riveted joints for various loads.
CO4	Know the classification and application of Shafts, Keys and Couplings and its Design Procedure.
CO5	Understand design & applications of various types of springs Design and Analyze screw jack, Power screw applications and their efficiency

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction Selection of Materials	Definition, Methods, Design Process, Need Analysis, Need based developments, Design by Evolution, Technology based developments, Examples, Case Studies and Brain-storming, Standards in design and selection of preferred size. Materials for static and fatigue loads, Materials for components subjected to creep, BIS system of designation of steels, steels, plastics and rubbers. AISI (American Iron and Steel Institute) and ASTM rubber testing methods.	8	CO1
2	Design against Static Load. Design against Fluctuating Load.	Modes of failure, Factor of safety, Review of Principal Stresses and Theories of failure. Stress concentration, Stress concentration factors, and fluctuating, alternating stresses, Fatigue failure, Endurance limit, Design for finite and infinite life, Soderberg and Goodman criteria.	8	CO2
3	Joints	Welded joints, Screwed joints, riveted joints Eccentric loading of above joints, Design for fatigue loading.	8	CO3
4	Shafts, Keys and Couplings	Design against static and fatigue loads, Strength and rigidity in design Selection of square and flat keys and splines, Rigid and flexible couplings.	8	CO4
5	Mechanical Springs. Design Analysis of Power Screws	Design of Helical and leaf springs against static and fatigue loading. Form of threads, Square threads, Trapezoidal threads Design of screw jack	8	CO5

Reference Books:

Mechanical Engineering Design: Joseph E. Shigley McGraw Hill Publications.

Machine Design: D.N. Reshetov, Mir Publishers: Moscow

Design of Machine Elements: Bhandari, TMH

Machine Design: Sharma and Agrawal, Kataria

Machine Design: Maleev and Hartman, CBS

Machine Design: M.F. Spott. Prentice Hall India

Machine Design: Black and Adams, McGraw Hill.

e-Learning Source:

https://www.youtube.com/watch?v=mzWMdZZaHwI&list=PL3D4EECEFAA99D9BE

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3							1	3	3	1	3
CO2	3	3	3	3							1	3	3	1	3
CO3	3	3	3	3							1	3	3	1	3
CO4	3	3	3	3							1	3	3	1	3

CO5	3	3	3	3							1	3	3	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME302	**Title of the Course**	Dynamics of Machines	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	Basic Mechanical Engg.(ME – 101) Kinematics of Machines(ME207	**Co-requisite**	NONE				
Course Objectives	1. Understand basic principles associated with theory of machine. 2. Construct turning moment diagram. 3. Perform dynamic analysis of mechanisms. 4. To understand the basics concepts of turning moment diagrams for IC engines and governors. 5. Design and Solve problems on power transmission elements.						

Course Outcomes	
CO1	Construct turning moment diagram.
CO2	To Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
CO3	To develop knowledge of solve problems on power transmission elements
CO4	Differentiate between various types of governors and its working along with the different important measures.
CO5	Analyse effect of gyroscopic couple on vehicles, ships and aeroplanes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Force Analysis	Force Analysis, Turning Moment and Fly Wheel : Static force analysis of linkages, Equivalent offset inertia force, Dynamic analysis of slider crank and 4 Bar mechanisms. Piston and Crank effort, Inertia, Torque, Turning moment diagrams, Fluctuation of energy, Flywheel.	8	**CO1**
2	Balancing of Machines	Balancing of Machines : Static and dynamic balancing of rotating and reciprocating masses, Primary and secondary forces and couples.	8	**CO2**
3	Friction	Friction : Pivot and collar friction, Friction circle, Single plate, Multiplate and Cone clutches, Michelle and Kingsbury thrust bearing and rolling contact bearing, Belts and pulleys, Flat and V-belts, design and selection. Brakes and Dynamometers (Mechanical Type): External and internal shoe brakes, Band and Block brakes, Hydraulic brakes, Absorption and Transmission dynamometers.	8	**CO3**
4	Governors	Governors : Dead weight and spring loaded governors, Sensitivity, Stability Hunting, Isochronism, Effort and Power, Friction and Insensitivity, Introduction to inertia Governors.	8	**CO4**
5	Gyroscopic Motion	Gyroscopic Motion : Principles, Gyroscopic acceleration, Gyroscopic couple and reaction. Effect of gyroscopic couple upon the stability of aeroplanes, ships, two and four wheelers. Mechanical Vibrations: Single degree, free and forced vibrations, Undamped and Damped vibrations, Critical speeds.	8	**CO5**

Reference Books:

1. Theory of Machines: Thomas Bevan, ELBS/CBS
2. Theory of Machines: S.S. Ratan, TMH
3. Theory of Machines: R.K. Bansal, Laxmi Publication
4. Mechanisms and Machines Theory: A.K. Ambekar, Jain Bros.
5. Theory of Machines: W.T. Green
6. Mechanisms and machines Theory: Rao and Duckipati, New Age
7. Theory of Machines and Mechanism; Ghosh and Mallik, EWP
8. Theory of Machines: P.L. Ballaney, Khann

1. Theory of Machines: Thomas Bevan, ELBS/CBS

e-Learning Source:

https://www.youtube.com/watch?v=p075LPq3Eas&list=PL46AAEDA6ABAFCA78

https://www.youtube.com/watch?v=p075LPq3Eas&list=PLABF8E04441DECA1B

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		3						3	3	2	2
CO2	3	3	3	2	2	3						2	3	3	2
CO3	3	3	3	2	2	3						3	3	2	2
CO4	3	3	3	2		3						2	3	2	2
CO5	3	1	1	1		3						2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME303	**Title of the Course**	Manufacturing Science-II	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design. 2. To cultivate the ability to develop and implement new improved manufacturing processes resulting in creation and distribution of value in engineering applications 3. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations. 4. To impart knowledge about welding behavior of machine and process during welding, analysis of common and newer welding techniques and metallurgical and weldability aspects of different common engineering materials						

Course Outcomes	
CO1	Know about the concepts and importance of Mechanics of metal cutting, Mechanics of chip formation ,Economics of metal cutting and Tool wear and tool life
CO2	Know about the Principle and types of lathe, different operations on it, operations on shaper, planer and slotter, Milling cutters, up and down milling, Dividing head and indexing and Geometry of twist drill
CO3	know about Grinding wheel, different types of abrasives, Grinding wheel specification, Grinding Wheel wear, different types of grinding operations, Super finishing operations: Honing , lapping, Polishing
CO4	Know about the Arc welding: Power sources and consumables, TIG and MIG welding processes and their parameters, Resistance welding, Soldering and Brazing. ,Thermodynamic and Metallurgical aspects in welding, and defects in welds, their causes and remedies.
CO5	Know about the Need of unconventional manufacturing processes, Principle of ECM, AJM, EDM, EBM, LBM, USM ETC, Plasma arc welding, Explosive welding, EBW , LBW, USW..

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Mechanics of metal cutting:	Mechanics of metal cutting. Geometry of tools and nomenclature in ASA system Orthogonal vs. oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces, power required in cutting. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Brief introduction to machine tool vibrations and surface finish. Economics of metal cutting.	8	CO1
2	Lathe	Lathe: Principle, types, operations, Turret/capstan, semi/Automatic lathes, Tool layout. Shaper, slotter, planer: operations and drives. Milling: Milling cutters, up and down milling, Dividing head and indexing, Maximum chip thickness and power required in milling. Drilling and boring: Drilling, boring and reaming tools. Geometry of twist drills.	8	CO2
3	Grinding	Grinding : Grinding wheels, abrasive, cutting action. Grinding wheel specification. Grinding Wheel- attritious wear, fracture wear. Dressing and truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centerless grinding. Super Finishing: Honing, lapping, polishing. Limits, Fits, Introduction to Limits, Fits and Tolerances IS standards, and Surface roughness.	8	CO3
4	Survey of welding and allied processes	Survey of welding and allied processes. Gas welding and cutting processes and equipment. Arc welding: Power sources and consumables. TIG and MIG welding processes and their parameters. Resistance welding-spot, seam and projection. Other welding processes such as atomic hydrogen, submerged arc, electro slag and friction welding. Soldering and Brazing. Thermodynamic and Metallurgical aspects in welding, Shrinkage and residual stresses in welds. Distortion in welds, defects in welds, their causes and remedies.	8	CO4
5	Introduction to Non Conventional Machining and Welding:	Benefits, applications and working principle of EDM, ECM, LBM, EBM, USM, AJM, WJM, Similarly, Nonconventional welding processes such as LBW, USW, EBW, Plasma arc welding and Explosive welding.	8	CO5

Reference Books:

1.Manufacturing Science: Ghosh and Mullick, EWP

2. Fundamentals of Metal Cutting and Machine tools: Boothroyd, McGraw Hill

3. Production Technology: R.K. Jain, Khanna

4. Production Technology H.M.T

e-Learning Source:

https://www.youtube.com/watch?v=A0dTvf_Q8BA&list=PL82E9A8429ED7BB27

https://www.youtube.com/watch?v=A0dTvf_Q8BA&list=PL9ssGyHa3fnz9_rVCIzGdba9_UZj-ssz9

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO1	3	3	2	2	2	2	1	2	2	2	1	3	3	2	2
CO2	3	3	3	2	2	2	1	2	2	2	1	2	3	2	2
CO3	3	2	3	2	2	3	1	3	2	2	1	3	3	2	1
CO4	3	2	2	2	3	3	1	2	1	2	1	2	2	3	2
CO5	3	2	2	2	2	2	1	1	2	3	1	3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME304	**Title of the Course**	HEAT AND MASS TRANSFER	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	ME202 CE201	**Co-requisite**	NONE				
Course Objectives	• Students will understand the basic concepts of conduction, convection and radiation heat transfer and able to solve one and two-dimensional conduction heat transfer problems. • Students will understand the fundamentals of extended surfaces and able to solve the problems of steady and unsteady heat transfer process. • Students will understand the fundamentals of the relationship between fluid flow and convection heat transfer. Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. • Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation. • 5. Students will understand the concepts of heat transfer process in heat exchangers and able to design the exchanger by LMTD and NTU method.						

Course Outcomes	
CO1	Basic concepts of conduction, convection and radiation heat transfer. Formulate and solve one and two-dimensional conduction heat transfer problems.
CO2	Fundamentals of heat transfer in extended surface and unsteady heat transfer process.
CO3	Widening the concepts of convection and solving problems related to its applications
CO4	Strengthening the basics of radiation and understanding the related laws.
CO5	Fundamentals of heat exchangers and its analysis using LMTD and NTU methods and understanding of mass transfer using analogy with heat transfer.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Heat Transfer. Conduction. Steady State One-Dimensional Heat Conduction.	Concepts of the mechanisms of heat flow; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. Composite System in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation.	8	CO1
2	Transient Conduction.	Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. Transient heat conduction Lumped capacitance method, Time constant, unsteady state heat conduction in one dimension only, Heisler charts.	8	CO2
3	Forced Convection Natural Convection.	Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer, Empirical heat transfer relations: Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts; Relation between fluid friction and heat transfer; Liquid metal heat transfer. Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical plates and cylinders, horizontal plates, cylinders, and spheres.	8	CO3
4	Thermal Radiation.	Basic radiation concepts; Radiation properties of surfaces; Black body radiation laws; Shape factor; Black-body radiation exchange; Radiation exchange between different non-black bodies in an enclosure; Radiation shields; Solar radiation	8	CO4
5	Heat Exchanger Condensation and Boiling. Introduction to Mass Transfer.	Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness- NTU method; Compact heat exchangers. Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube; Boling modes, pool boiling curve, forced convective boiling. Introduction; Flick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.	8	CO5

Reference Books:

1. Elements of Heat Transfer: Bayazitouglu and Ozisik, McGraw Hill
2. Heat Transfer: J.P. Holman, McGraw Hill
3. Schaum's Outline of Heat Transfer: Pitts and Sisson, McGraw Hill
4. Principles of Heat Transfer: Frank Kreith, McGraw Hill
5. Fundamentals of Momentum, Heat and Mass Transfer: James R.Welty, John Wiley
6. Heat Transfer: Vijay Gupta, New Age
7. Heat Transfer: V.C. Rao, University Press.

8. Heat Transfer; R. Yadav, Central Publishing House, Allahabad.
e-Learning Source:
https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
https://www.youtube.com/watch?v=sKnE5qvz0fc&list=PLbRMhDVUMngeygd_uWiLqa3fzA2h7vdRx
https://www.youtube.com/watch?v=IedD23t5jI4&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3
https://www.youtube.com/watch?v=rxTK_SvSmvs&list=PL1gvM10tgL1hK9666oGndGlWDQdpQzkY9

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	3	2				3	3	2	2
CO2	3	2	2	2	2	3	3	2				3	3	3	2
CO3	3	3	3	2	2	3	3	3				3	3	2	3
CO4	3	3	3	2	2	3	3	2				3	3	2	2
CO5	3	3	2	2	3	3	3				3		3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME305	**Title of the Course**	Project Management	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	To know about the project characteristics, nature and context of project management and project environment. Organizing human resources and project direction. • To learn about the various types of organizations, project contracts and its various types. • To know about the various types of project appraisals, cost analysis of project and project performance analysis. • To learn about network analysis based on PERT/CPM and crashing of network. • To know about the complexities of project scheduling, resource leveling and allocation in project scheduling. Also, to know about the common software packages of projects						

Course Outcomes	
CO1	Know about the project characteristics, nature and context of project management and project environment. Organizing human resources and project direction
CO2	Know about the various types of organizations, project contracts and its various types.
CO3	Know about the various types of project appraisals, cost analysis of project and project performance analysis.
CO4	Know about network analysis based on PERT/CPM and crashing of network.
CO5	Know about the complexities of project scheduling, resource leveling and allocation in project scheduling and also about the common software packages of projects.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Project Management Concepts	Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals. Nature and context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment and complexity. Organizing human resources, organizing systems and procedures for implementation. Project direction.	8	CO1
2	Project Organization and Project Contracts	Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure, project organization, selection of project organization structure, project break down structures, project contracts, types of contracts, types of payments to contractors.	8	CO2
3	Project Appraisal and Cost Estimation	Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis. Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.	8	CO3
4	Project Planning and Scheduling	Introduction to PERT and CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks and floats, PERT model, expected time for activities, expected length of critical path, calculating the project length and variance, PERT and CPM. Cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks. LOB technique	8	CO4
5	Modification and Extensions of Network Models	Complexity of project scheduling with limited resources, resource leveling of project schedules, resource allocation in project scheduling-heuristic solution. precendence networking-examples with algorithm, decision networks, probabilistic networks, computer aided project management-essential requirements of PM, software packages for CPM. Enterprise-wide PM, using spread sheets for financial projections.	8	CO5

Reference Books:

1. Project Management: Kerzner KBS.
2. Essentials of Project Management : Denis Lock, Grover
3. Project Management : Harvky Maylor

e-Learning Source:

https://www.youtube.com/watch?v=RQNZWCl6eXI&list=PLBd76GK9sWTwVXm9FlVHOTXXbGY2vZR8z

https://www.youtube.com/watch?v=obzp6biyAN0&list=PLCRPN3Z81LCKjPEbwO2SlPwLKA0pffUE9

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		3						3	3	2	2
CO2	3	3	3	2	2	3						2	3	3	2
CO3	3	3	3	2	2	3						3	3	2	2
CO4	3	3	3	2		3						2	3	2	2
CO5	3	1	1	1		3						2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME306	**Title of the Course**	MAINTENANCE ENGINEERING AND MANAGEMENT	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Knowledge about the essentials of Maintenance Engineering and Management. 2. Study various types of maintenance procedures with proper importance. 3. Study the various equipment replacement procedures. 4. Learn about the Assignment Model and Waiting Time Model pertaining to industry related problems. 5. Study about the maintenance organization, manpower planning and economics of maintenance.						

Course Outcomes	
CO1	Know about the concepts and importance of Maintenance Engineering and Management.
CO2	Know about the various types of maintenance procedures with respective importance.
CO3	Identify the various equipment replacement procedures and their proper applications.
CO4	Know about the Assignment Model and Waiting Time Model in the background of industrial need.
CO5	Know about the maintenance organization, manpower planning and economics of maintenance organization

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazard models, elements in series, parallel, mix, logic diagrams, improving reliability, redundancy-element, unit, standby, maintainability, availability, reliability and maintainability trade off.	8	CO1
2	Maintenance Strategies	Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.	8	CO2
3	Replacement planning maintain	Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.	8	CO3
4	Break down maintenance planning	Break down maintenance planning, assignment model, waiting time models expected waiting time, minimum cost service rate, PERT.	8	CO4
5	Maintenance Management	Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management	8	CO5

Reference Books:

1. Management of systems – R.N. Nauhria & R. Prakash
2. Operations Research – Wangner.
3. Maintenance Engineering & Management – M I Khan & N A Siddiqui

e-Learning Source:

https://www.youtube.com/watch?v=f58SW0Hwcf0

https://www.youtube.com/watch?v=vOykcERGw9Y&list=PLLy_2iUCG87DH0iQSVWZ8iamVl5SaLlXQ

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	2	2			3	3	2	2
CO2	3	3	3	2	2	2						2	3	3	2
CO3	3	2	2	1	2	2	3					3	3	2	2
CO4	3	2	2	2	3	3						2	3	2	2
CO5	3	2	2	2	2	2	1	2	3			2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME308	**Title of the Course**	Engineering Product Design	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. To impart basic concepts of engineering product design and their applications. 2. To impart knowledge about idea generation and creativity used in in the development of a product. 3. To let understand the use of economical aspect in product design. 4. To impart concepts related to reliability and ergonomics. 5. To impart basic knowledge about literature search, patents, standards and codes.						

Course Outcomes	
CO1	Explained the basic concepts of engineering product development design and their Applications. Also discussed the Design definitions, the role and nature of design, old and new design methods, Design by evolution. Physical reliability & Economic feasibility of design concepts.
CO2	Demonstrate about Morphology of Design. Divergent, transformation and convergent phases of product design.
CO3	Demonstrate the use of economical aspect in product design. Students come to know about utility concept, Utility value, Utility index, Fixed and variable costs. Break-even analysis.
CO4	Demonstrate the concepts of Reliability considerations in product design and the role of Ergonomic aspects in better design of a product.
CO5	Explained about the Information and literature search, patents, standards and codes. Environment and safety considerations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction to Product Design Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc. Need based development, technology based developments. Physical reliability & Economic feasibility of design concepts.	8	CO1
2	Morphology of Design	Morphology of Design Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist	8	CO2
3	Transformations Brainstorming & Synectics	Transformations Brainstorming & Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis.	8	CO3
4	Reliability	Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. Anthropometric data and its importance in design. Applications of Computers in product design.	8	CO4
5	Product Appraisal Information	Product Appraisal Information and literature search, patents, standards and codes. Environment and safety considerations. Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product. Innovation versus Invention. Technological Forecasting.	8	CO5

Reference Books:

1. Product Design & Manufacturing - A.K.Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall
3. The Art of Thought – Grohem Walls – Bruce & Co., New York
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall

e-Learning Source:

https://www.youtube.com/watch?v=HN9GtL21rb4&list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu

https://www.youtube.com/watch?v=9WPZStQp03Q&list=PLSGws_74K01-KPzaLUtCV7R-CognwVoP8

https://www.youtube.com/watch?v=oUeK6ZsCo8I&list=PLwdnzlV3ogoWth4Mdn-yFLk3aiqLVpg4e

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

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

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME309	**Title of the Course**	Machine design lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. To understand the practical viability of design methodologies. 2. To impart and apply basic design approach on simple members such as shafts, keys etc. 3. To design complex machines parts like coupling, screw jack and springs. 4. To impart design for important joints like welded joints, riveted joints etc. under static and dynamic load. 4. To provide working knowledge on Computer Aided Design methods and procedures						

Course Outcomes	
CO1	The student can understand the concepts of static analysis applied on shafts
CO2	Understand design and applications of mechanical fasteners and joints such as screwed joints and riveted joints.
CO3	Understand the design and drawing of a welded joint, knuckle joint/ cotter joint.
CO4	The student can design complex machines parts like coupling, screw jack and springs
CO5	The student can draw using different AutoCAD commands with proper dimensions on Computer Aided Design software.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Design and drawing of Riveted Joints	Demonstrate basic design approach and Auto-Cad commands for Riveted Joints.	2	CO2, CO5
2	Design and drawing eccentrically loaded welded joints	Demonstrate basic design approach and Auto-Cad commands for eccentrically loaded welded joints.	2	CO2, CO3
3	Design of stepped shaft	Demonstrate basic design approach and Auto-Cad commands of shaft for different loading conditions.	2	CO1, CO2
4	Design and drawing of rigid coupling (flanged type).	Demonstrate basic design approach and Auto-Cad commands of rigid coupling (flanged type).	2	CO4, CO5
5	Design and drawing of a helical spring/	Demonstrate basic design approach and Auto-Cad commands of a helical spring for a given application.	2	CO4, CO5
6	Design and drawing of Rotating shafts	Demonstrate basic design approach and Auto-Cad commands of shaft for different loading conditions	2	CO1, CO2
7	Design of leaf spring for a given application.	Demonstrate basic design approach and Auto-Cad commands of a leaf spring for a given application.	2	CO4, CO5
8	Design and drawing of a Screw Jack	Demonstrate basic design approach and Auto-Cad commands of screw Jack for a given application.	2	CO4, CO5

Reference Books:

Data Design Hand book by Mahadevan

Design of machine Elements by Bhandari

e-Learning Source:

https://www.youtube.com/watch?v=1y2Vec5XdXg&list=PLBY9jx3ikVaM00Va4Zrnu4neTPRj6zuQb

https://www.youtube.com/watch?v=EgKc9L7cbKc&list=PLC3EE33F27CF14A06

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	3			1	2		3	3	1	3
CO2	3	3	3	2	2	3			1	2		3	3	2	3
CO3	3	2	3	2	1	3			2	2		3	3	2	3
CO4	3	2	3	2	2	3			3	2		3	3	2	3
CO5	1	1	3	2	1	3			3	2		3	3	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME310	**Title of the Course**	Dynamics of Machines Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	Kinematics of Machines	**Co-requisite**					
Course Objectives	• To impart knowledge of the different types of links, joints, pairs, chains and mechanism. • To impart practical knowledge/ techniques to determine the gyroscopic couple by gyroscopic apparatus. • To impart practical knowledge/ techniques to determine the controlling force at a given speed, sensitiveness at given limits of lift and governor effort and governor power of the governor apparatus. • To impart practical knowledge to determine the torque and velocity ratio for the epicyclic gear train. • Imparting knowledge to to determine the critical speed of the shaft and compares it with the theoretical value.						

Course Outcomes	
CO1	Demonstrate basic experimental technique to determine the gyroscopic couple by gyroscopic apparatus.
CO2	Demonstrate basic experimental technique to determine the controlling force, sensitiveness , governor effort and power of the governor apparatus..
CO3	Demonstrate basic experimental technique to determine torque and velocity ratio for the epicyclic gear.
CO4	Demonstrate basic experimental technique to determine the critical speed of the shaft.
CO5	Demonstrate the different types of links, joints, pairs, chains and mechanism.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Gyroscopic Apparatus	To determine the gyroscopic couple by gyroscopic apparatus.	2	CO1
2	Governor Apparatus	To determine the controlling force at a given spped, sensitiveness at given limits of lift and governor effort and governor power of the governor apparatus (Porter, Proell, Hartnell).	2	CO1
3	Vibration Apparatus	To study the undamped free viberation of the spring.	2	CO2
4	Vibration Apparatus	To study the natural viberation of the spring-mass system (beam).	2	CO2
5	Torsional Vibration Apparatus.	To study the torsional viberation of a single rotor and double rotor system.	2	CO3
6	Whirling Apparatus	To determine the critical speed of the shaft and compare it with the theoretical value.	2	CO3
7	Epicyclic Apparatus	To determine the torque and velocity ratio for the epicyclic gear train.	2	CO4
8	Comparison	To study and sketch the different types of links, joints, pairs, chains and mechaanism.	2	CO5

e-Learning Source:

https://www.vlab.co.in/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	3			3	2		3	3	2	2
CO2	3	3	2	3	2	1			3	2		3	3	2	2
CO3	3	3	2	3	2	2			3	2		3	3	2	2
CO4	2	3	2	3	2	3			3	2		3	3	2	2
CO5	3	3	2	2	2	3			2	2		3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 207-18							
Course Code	ME311	**Title of the Course**	MANUFACTURING SCIENCE LAB-II	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	ME208	**Co-requisite**	None				
Course Objectives	• Demonstrate understanding of various tools in manufacturing processes. • To make the student conversant with grinding machine tool for Surface finish • To learn various operations on shaper machine like slot cutting. • To develop basic understanding of use of lathe machine and process. • Welding principles and classification like gas welding and arc welding. • Principle of spot welding and use of spot welding machine to make job.						

Course Outcomes	
CO1	Students will be able to identify various tools and tool specifications
CO2	Use of grinding machine to make job of surface finish
CO3	Students will be able to perform various operations on shaper machine
CO4	Basic knowledge of different welding process imparted to students like gas welding and arc welding
CO5	Students will be able to make joint on spot welding machine

Unit No.	**Title of Experiment**	**Content**	**Contact Hrs.**	**Mapped CO**
1	Tool angle	Study of various tool and tool geometry	2	CO1
2	Grinding Machine	Making surface finish job on specimen of mild steel and basic use of grinding machine	2	CO1
3	Shaper machine	Study of various operations and job making on shaper machine	2	CO2
4	Finishing	Surface finishing on mild steel specimen.	2	CO2
5	Thread Cutting	Study of lathe machine and job making for thread cutting on lathe machine	2	CO3
6	Gas Welding	Job making on gas welding machine	2	CO3
7	Arc Welding	Lap joint of mid steel specimen using arc welding	2	CO4
8	Spot Welding	Making lap joint on spot welding machine set up	2	CO5
e-Learning Source:				
https://www.vlab.co.in/				

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO
CO1	3	3	2	3	2	2			2			3	3	2	2			
CO2	3	3	3	3		3			2			2	2	3	2			
CO3	3	3	3	3				2				2	2	2	3			
CO4	3	3		3		3			2			1	2	2	2			
CO5	3	3	2	3		3			2			2	2	2	3			

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME312	**Title of the Course**	Heat and Mass Transfer Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	**0**	**0**	**2**	**1**
Pre-Requisite	ME202, CE201	**Co-requisite**	NONE				
Course Objectives	• To impart practical knowledge/ techniques to determine the thermal conductivity of different material. • To impart practical knowledge/ techniques to determine the heat transfer coefficient of natural and forced convection. • To impart practical knowledge/ techniques to determine efficiency of extended surface used as fins. • To impart practical knowledge/ techniques to determine critical heat flux in boiling. • To impart practical knowledge/ techniques to determine the effectiveness of different types of heat exchanger.						

Course Outcomes	
CO1	Demonstrate basic experimental technique to determine thermal conductivity and total thermal resistance in conduction.
CO2	Demonstrate basic experimental technique to determine to determine critical heat flux in boiling.
CO3	Demonstrate basic experimental technique to determine overall heat transfer coefficient of natural and forced convection.
CO4	Demonstrate basic experimental technique to determine Stefan's Boltzmann constant.
CO5	Demonstrate basic experimental technique to determine effectiveness of heat exchanger.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Composite wall	To study the heat transfer through conduction in composite wall, and calculate thermal resistance, thermal conductivity and plot the temperature profile along the composite wall.	2	CO1
2	Pool Boiling	To determine the experimental and theoretical value of the critical heat flux in pool boiling of water.	2	CO2
3	Natural Convection from tube	To determine the surface heat transfer coefficient for a vertical tube losing heat by natural convection.	2	CO3
4	Heat Pipe	To study the variation of heat sink temperature and longitudinal temperature distribution for heat pipe and compare it with stainless steel, copper and GI pipe.	2	CO3
5	Pin Fin	To determine the efficiency and effectiveness of a fin and study the temperature distribution in it.	2	CO3
6	Radiation	To determine the Stefan- Boltzmann's constant in the radiation heat transfer.	2	CO4
7	Parallel Flow Heat Exchanger	To determine the LMTD, overall heat transfer coefficient & the effectiveness of heat exchanger working in parallel flow mode.	2	CO5
8	Counter Flow Heat Exchanger	To determine the LMTD, overall heat transfer coefficient & the effectiveness of heat exchanger working in counter flow mode.	2	CO5

e-Learning Source:

https://www.vlab.co.in/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3			3	2		3	3	2	2
CO2	3	3	2	3	2	3			3	2		3	3	2	2
CO3	3	3	2	3	2	3			3	2		3	3	2	2
CO4	3	3	2	3	2	3			3	2		3	3	2	2
CO5	3	2	2	2	2	3			2	2		3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME313	**Title of the Course**	I.C Engine	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	ME202	**Co-requisite**	NONE				
Course Objectives	1. To give an overview of Internal Combustion Engines, their classification, and to carry out thermodynamic analysis of various cycles of operation, to give complete knowledge of type of conventional and nonconventional fuels used in IC engines 2. To give the knowledge about carburetors, MPFI system, Combustion phenomenon in SI engine, and Ignition system in SI engines. 3. To describe the fuel injection in CI engines, combustion phenomena in IC engines, and knocking in CI engine 4. To explain engine cooling, Lubrication, and supercharging of the engines. 5. To give the knowledge about different types of Compressors used in IC engines						

Course Outcomes	
CO1	To classify various types of I.C. Engines and Cycles of operations and have good knowledge about conventional and nonconventional fuels used in IC engine. Express the effect of various operating variables on engine performance
CO2	Understand the Fuel supply method, and ignition methods used in SI and CI engines.
CO3	Distinguish normal and abnormal combustion phenomena in SI and CI engines
CO4	Understand the cooling, lubrication and supercharging systems used in IC engines
CO5	Understand the suitability of different types of compressors used in IC engines

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to I.C. Engines	Engine classification, Air standard cycles, Otto, Diesel, Striling, Ericsson cycles, Actual cycle analysis, Two and fourstroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. Fuels for SI and CI engines, important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.	8	CO1
2	SI Engines	Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug.	8	CO2
3	CI Engine	Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, fuel injectors, Injection timings. Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. Scavenging in 2-Strock engines, pollution and it's control..	8	CO3
4	Engine Cooling Lubrication Testing and Performance Supercharging	Different cooling systems, Radiators and cooling fans. Engine friction and lubrication, Principal types of lubrication, Lubricating oils, Crankcase ventilation. Effect of altitude on power output, Types of supercharging. Performance parameters, Basic measurements, Testing of SI and CI engines.	8	CO4
5	Compressors	Classification, Reciprocating compressors, Single and multistage, Intercooling, volumetric efficiency.Rotary compressors, Classification, Centrifugal compressors, Elementary theory, Vestor diagram efficiencies,Elementary analysis of axial compressors, Surging and stalling, Roots blower, Waned compressor, Performanceanalysis.	8	CO5

Reference Books:

1. Fundamentals of Internal Combustion Engines: Gill,Smith, Ziurs, Oxford and IBH Publishing.
2. A Course in International Combustion Engines: Mathur and Sharma, Dhanpat Rai and Sons.
3. I.C Engines: Ganeshan, Tata McGraw Hill Publishers.
4. I.C Engines : R.Yadav, Central Publishing House, Allahabad.

e-Learning Source:

https://www.youtube.com/watch?v=CO2StedJtAc&list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC

https://www.youtube.com/watch?v=rvpMbBB6RrU&list=PL6kB4KeyhXc6GN3Gcvhl9YQEcMGD9M_Ym

https://www.youtube.com/watch?v=H_RgFXjg-5s

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		3						3	3	2	2

CO2	3	3	3	2	2	3						2	3	3	2
CO3	3	3	3	2	2	3						3	3	2	2
CO4	3	3	3	2		3						2	3	2	2
CO5	3	1	1	1		3						2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME314	**Title of the Course**	Fluid Machinery	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	CE201	**Co-requisite**	NONE				
Course Objectives	**1.** Impart knowledge of basic principles of operation of various types of fluid machines (Turbines and Pumps) and impulse turbine designing. **2.** Demonstrate knowledge and skills of reaction turbine designing. **3.** Knowledge of working / operation and design of centrifugal pump. **4.** Imparting knowledge of working / operation of positive displacement/rotary pump. **5.** Imparting knowledge about miscellaneous hydraulic machines (hydraulic lift, hydraulic crane, hydraulic ram hydraulic coupling etc.**)**						

Course Outcomes	
CO1	Demonstrate basic concepts of thermal sciences and their application in formulating the thermal engineering problems.
CO2	Demonstrate about steam generation, properties of steam and its application.
CO3	Demonstrate the use of steam in power generation in the efficient manner.
CO4	Demonstrate concepts related to I.C. engine and gas turbine and its analysis.
CO5	Analyze basic refrigeration and air conditioning systems.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction : Classification of Fluid Machines, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Impact of Jet: Introduction to hydrodynamic thrust of a jet on a fixed and moving surface (flat and curve), effect of inclination of jet with the surface. Hydraulic Turbines: Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, governing of pelton wheel.	8	**CO1**
2	Reaction Turbines	Reaction Turbines :Fransis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speeds, Performance characteristics, Selection of water turbines.	8	**CO2**
3	Centrifugal Pumps	Centrifugal Pumps: Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation and separation, Performance characteristics.	8	**CO3**
4	Positive Displacement Pumps	Positive Displacement Pumps :Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, Performance characteristics.	8	**CO4**
5	Other Machines	Other Machines :Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics. Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps.	8	**CO5**

Reference Books:

1. Hydraulic Machines: Jagdish Lal, Metropolitan Book Co.
2. Hydraulic Machines: Theory and Design, V.P. Vasandhani, Khanna.
3. Applied Hydraulics : Addison.
4. hydraulic Machines: R.K. Rajput, S. Chand and Co. Ltd.
5. Hydraulic Machines: D.S. Kumar.

e-Learning Source:

https://www.youtube.com/watch?v=C2sX9Wg6twI&list=PLbMVogVj5nJSurQymuzzJM9MwLpEb75lq

https://www.youtube.com/watch?v=wlPXZrP9vR8&list=PLCoE5wxWtHFYiVGswvsWRaHjv18vxZzE2

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		3						3	3	2	2
CO2	3	3	3	2	2	3						2	3	3	2
CO3	3	3	3	2	2	3						3	3	2	2
CO4	3	3	3	2		3						2	3	2	2
CO5	3	1	1	1		3						2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME325	**Title of the Course**	REFRIGERATION & AIR CONDITIONING	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**0**	**0**	**2**	**1**
Pre-Requisite	Applied Thermodynamics	**Co-requisite**	NONE				
Course Objectives	1. To impart the knowledge about air refrigeration cycles and methods air-craft refrigeration systems. 2. The course structures cover various types of Refrigeration Systems to familiarize the students with the fundamentals of Refrigeration System. 3. To give the knowledge about fundamentals of air conditioning and psychrometry. 4. To familiarize the students about the application and design of refrigeration and air conditioning equipments.						

Course Outcomes	
CO1	Understand air refrigeration cycles and its application to air craft refrigeration system.
CO2	Use p-h chart to solve vapour compression refrigeration problems and understand components of vapour compression refrigeration systems.
CO3	Understand temp-concentration and enthalpy concentration diagrams and its application in solving the problems of vapour absorption system. Understand components and working of vapour Absorption system.
CO4	Use psychometric chart in solving air conditioning problems. Understand the various types of air Conditioning systems and its cooling and heating load calculation.
CO5	Know the application of refrigeration in food preservation ,cold storage ,freezers ,ice plant and Water cooler. To design the transmission and distribution of air through ducts and fans.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Components of Air conditioner & refrigeration system	To study basic components of an air conditioning system and refrigeration system.	2	CO1
2	Window type air conditioner	To study of a Window type Air conditioner.	2	CO1
3	Type of Evaporators	To study different types of evaporator used in a refrigeration and air conditioning system.	2	CO2
4	Type of Expansion devices	To study different type of expansion devices used in refrigeration and air conditioning system.	2	CO2
5	COP of Refrigeration system	To study vapour compression refrigeration system(Test Rig) and determine its COP.	2	CO3
6	Study of Refrigeration Plant	To study and sketch the refrigeration plant	2	CO3
7	COP of A.C system	Experiment of air conditioning test rig and calculate COP of the test rig.	2	CO4
8	Study of A.C Plant	To study and sketch the air conditioning plant.	2	CO5

e-Learning Source:

https://www.youtube.com/watch?v=5dgRgBuWDZw

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	1	2	-	-	3	3	2	2
CO2	3	3	3	2	2	2	2	1	2	-	-	3	3	2	2
CO3	3	3	3	2	2	2	2	2	2	-	2	3	3	2	2
CO4	3	3	3	2	3	3	2	1	2	-	2	2	3	2	2
CO5	3	3	2	2	2	2	2	2	3	-	2	3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME316	**Title of the Course**	TRIBOLOGY	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. To equip the students with knowledge of the fundamentals of friction. 2. To provide the knowledge to wear and tear in machines and equipment. 3. To prepare students with a solid foundation to analysis of various failures due to friction and wear. 4. To prepare the graduates to find the probable routes to manufacture a particular engineering component by considering the effect of friction and wear.						

Course Outcomes	
CO1	Students become able to understand the basics of friction and their application in industry.
CO2	Students will demonstrate the ability to apply the fundamentals of different wear mechanism like abrasive wear, adhesive wear, erosive wear etc.
CO3	Students become able to understand the concepts of surface roughness and. they became able to find out the role of surface roughness in tribology.
CO4	Demonstrate the various types of lubrications (hydrodynamic lubrication, hydrostatic lubrication etc.) used in Machines to reduce the wear and tear in mechanical components and machines.
CO5	Demonstrate the fundamentals of bearings, bearing design considerations & characteristics

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Tribology	Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction. Friction theories. Surface contaminants, Effect of sliding speed on friction.	6	CO1
2	Wear	Definition, Scope, wear of metals, Types, Classification. Mechanism of wear, Quantitative laws. Hypothesis of Holm. Hypothesis of Burwell and Strang. Hypothesis of Archard, Rawe, Rabinowicz. Quantitative law for Abrasive wear, Bayerku surface fatigue theory. Delamination theory & Fatigue theory of wear, wear resistant materials. Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion.	10	CO2
3	Surface Interactions	Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact.	10	CO3
4	Lubrication	Definition & Scope. Generalized Reynold's equation. Flow and shear stress, energy equation. Mechanism of pressure development in bearings. Concept of Boundry Layer.	6	CO4
5	Bearing design considerations & characteristics	Bearing design procedure & steps. Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing. Infinitely short journal bearing. Future scope and applications.	8	CO5

Reference Books:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology --WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.

e-Learning Source:

https://www.youtube.com/watch?v=aoWBUhlN3-0&list=PLbMVogVj5nJRCfyN1QEiBsNFek8d00kWw

https://www.youtube.com/watch?v=7XBeRGmpLrE

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		3						3	3	2	3
CO2	3	3	3	2	2	3						3	3	3	2
CO3	3	3	3	2	2	3						3	3	2	2
CO4	3	3	3	2		3						2	3	2	2
CO5	3	1	1	1		3						2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME317	**Title of the Course**	SIX SIGMA METHODS, APPROACH AND APPLICATION	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Develop a broad understanding of Six Sigma principles and practices 2. Define the projects, the goals, and the deliverables to customers (internal and external) 3. Build capability to implement Six Sigma tools, especially in manufacturing operations 4. To analyze and determine the root cause(s) of the defects. 5. To make students capable to eliminate defects and Control the performance of the process.						

Course Outcomes	
CO1	To develop comprehension of the principles of quality for products and services alongwith statistical tools
CO2	Student can describe and quantify the defect and develop improvement methodologies
CO3	Student would be able to relate the tools and techniques of six sigma to increase productivity
CO4	Comprehension to build and analyse control charts for monitoring processes and calculate process capability in a manufacturing process
CO5	Student comprehend the way of six sigma implementation in modern manufacturing industry

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Quality perception	Introduction to Quality Concept, Quality in manufacturing, Quality in service sector, statistical foundation and methods of quality improvement. Descriptive statistics: data type mean, median, mode, range, deviation, skewness and kurtosis. Difference between conventional and six sigma concepts of Quality.	8	CO1
2	Basic of six sigma	Concepts of six sigma, defects DPMO, DPU, Z score, attacks on X's, understanding six sigma organization, leadership council, project sponsors and champions, master black belt, black belt and green belts, customer focus, six sigma for manufacturing, six sigma for service, six sigma success stories	8	CO2
3	Methodology of six sigma	DMAIC, DFSS, Six sigma tool: project charter, process mapping, measurement system analysis, hypothesis testing, quality function deployment, failure mode and effect analysis, design of experiments	8	CO3
4	Role of control charts	Role of control charts, Variable control charts, Attribute control charts, Interpretation of control charts, Process Capability Index, Estimating Capability and Performance Indices, Point Estimate for Capability and Performance Indices, Confidence interval for Capability and Performance Indices, Connection with Tolerance intervals	8	CO4
5	Steps in implementation	Steps in implementation of six sigma, selection of six sigma projects, sustenance of six sigma communication plan, company culture, reinforcement and control.	8	CO5

Reference Books:

Six Sigma, SPC and TQM in manufacturing and service: Geoff Tennant Gower

Six Sigma for managers: Greg Brue, TMH

What is Six Sigma: Peter S Pande, TMH

The Six Sigma way: Peter S Pande, TMH

Introduction to Six Sigma- Methods, Approach and Application – N A Siddiqui & Abhishek Dwivedi

e-Learning Source:

https://www.youtube.com/watch?v=SMOQV2CyVQo&list=PLF0D7509827D8CFD9

https://www.youtube.com/watch?v=iEM0df_0-0o

www.sixsigmatutorial.com

www.sixsigmaonline.org

www.sixsigmaspc.com

www.sixsigma.in

www.sixsigmaindia.net

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1						1	1	2	2	2
CO2	3	2	3	3	2						2	1	2	3	3
CO3	3	3	3	3	2						2	2	3	3	3

CO4	3	3	3	3	2						2	2	3	3	3
CO5	3	2	1	1	1					3	3	2	2	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME318	**Title of the Course**	Power Plant Engineering	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	Applied Thermodynamics (ME 202)	**Co-requisite**	NONE				
Course Objectives	1. To have the basic knowledge of different types of Power Plants and their site selection criteria. 2. To understand the working of different types of boilers. Fluidized bed combustion systems. 3. To understand the working principle of different types of Nuclear power plants. 4. To know Power Plant Economics, various energy storage devices and environmental considerations. 5. 5. To know the electrical system of a power plant.						

Course Outcomes	
CO1	Describe and analyze different types of energy resources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts
CO2	Understanding the working principle of diesel power plant, its layout, safety principles
CO3	Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.
CO4	Discuss the working principle and basic components of the hydro electric plants and the economic principles and safety precautions involved with it.
CO5	Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction Variable Load Problem Power Plant Economics and Selection	Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, steam generators steam prime movers, steam condensers, water turbines. Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass & energy balances, Availability Analysis, Evaluation of Energy conserving opportunities, Economic Analysis & life cycle costing Industrial production and power generation compared, ideal and realized load curves, terms and factors. Effect of variable load on power plant operation, methods of meeting the variable load problem. Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit, depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.	8	CO1
2	Steam Power Plant	Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. General layout of steam power plant. Different systems such as fuel handling system, pulverizers and coal burners, combustion system, draft, ash handling system, feed water treatment and condensers and cooling system, turbine, auxiliary systems such as governing, feed water heating, reheating, flange heating and gland leakage. Trouble shooting and remedies.	8	CO2
3	Diesel Power Plant Gas Turbine Power Plant	General layout. Performance of diesel engine, fuel system, lubrication system, air intake and admission system,supercharging system, exhaust system, cooling system, diesel plant operation and efficiency, heat balance, troubleshooting and remedies. Elements of gas turbine power plants, regeneration and reheating cogeneration, auxiliary systems such as fuel,controls and lubrication, operation and maintenance, performance and trouble shooting and their remedies. Combined cycle power plants.	8	CO3
4	Nuclear Power Plant Hydro Electric Station	Principal of nuclear energy, basic components of nuclear reactos, nuclear power station, trouble shooting and remedies. Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run-off size of plant and choice of UNIT, operation and maintenance, hydro systems, interconnected systems, trouble shooting and remedies. Introduction to non conventional power plants (Solar, wind, geothermal, tidal)	8	CO4
5	Electrical System	Generators and generator cooling, transformers and their cooling, bus bar. Instrumentation :Purpose, classification, selection and application, recorders and their use, Listing of various control rooms. Pollution due to power generation	8	CO5

Reference Books:

1. Power Plant Engineering : Arora Domkundwar
2. Power Plant Engineering : P.K Nag
3. Power Plant Technology : El-Vakil, McGraw Hill.
4. Power Plant Engineering : Verma Mahesh, Metropolitan Book Co.

e-Learning Source:

https://www.youtube.com/watch?v=tYBg-zsli98&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz

https://www.youtube.com/watch?v=D0i1E_lE_TE

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3								2	1	3
CO2	3	3	2	2	3								1	2	3
CO3	3	3	2	2	2								3	2	3
CO4	3	2	2	2	3								3	1	2
CO5	3	1	1	1	1								3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME321	**Title of the Course**	INDUSTRIAL ERGONOMICS	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. Have an ability to apply knowledge of the sciences of human factors and workplace ergonomics. 2. Have an ability to design and conduct experiments, as well as to analyze and interpret data. 3. Have an ability to design a system, component, or process to meet accepted human factors and workplace ergonomics standards within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. 4. Have an ability to function on multi-disciplinary teams. 5. Have an ability to identify, formulate and solve human factors and workplace ergonomics problems.						

Course Outcomes	
CO1	To identify, formulate and solve human factors and workplace ergonomics problems.
CO2	Have an understanding of professional and ethical responsibility
CO3	Have the broad education necessary to understand the impact of human factors and workplace ergonomics solutions in a global, economic, environmental, and societal context.
CO4	Have a recognition of the need for, and an ability to engage in, life-long learning.
CO5	Have the knowledge of contemporary issues.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction Skilled work:**	: Importance applications and principles of occupational ergonomics. Physiological Principles: Muscular work, Nervous control of movements, Improving working efficiency. Optimal useof muscle strength. /Guidelines for work layout. Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work.	8	CO1
2	**Heavy work**	: Energy consumption, Efficiency, Heart rate as a measure of workload. Work-station Design: Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated.	8	CO2
3	**Working Heights Handling Loads**	: Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages, disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Designof Key board. The Human spine, back troubles associated with industrial work, Intervertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back. Recommendations for handling loads. Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design in monotonous task.	8	CO3
4	**Human Visual System**	Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices.	8	CO4
5	**Noise and Violation**	: Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance. Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment.	8	CO5

Reference Books:

1.Fitting the task to the Man, E. Gandjean, Taylor and Francis.

2. A guide to Ergonomics of Manufacturing, Helander, M., East-West Press.

3. Human Factor in Engineering and Design, Sanders, M.S., and Mc Cormik, E.J., McGraw.Hill

e-Learning Source:

https://www.youtube.com/watch?v=qG_clin0Tis&list=PL819F5B524B56D0D3

https://www.youtube.com/watch?v=a2x-rCNJn3w

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2							3	2	3
CO2	3	3	3	3	3	2							3	2	3
CO3	3	3	3	3	3	2							3	2	3
CO4	3	3	3	3	3	2							3	2	3
CO5	3	3	3	3	3	2							3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME320	**Title of the Course**	Advanced Machine design	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	SOM, MACHINE DESIGN	**Co-requisite**	NONE				
Course Objectives	1. To provide fundamental approaches for static and dynamic design of complex members. 2. To provide basics of force analysis of complex elements. 3. To understand the application of data book in the design of mechanical members. 4. To develop ability to analyze critically and solve complex problems analytically.						

Course Outcomes	
CO1	The students can understand the application of gears, its classification, profiles, and strength of spur gears in bending and in wear.
CO2	The students can understand force analysis and design of and Helical Gears, Bevel Gears and Worm gears and their applications
CO3	The students can understand nomenclature, classification, application and force analysis of roller bearings.
CO4	The students can design Sliding contact bearings and understand its applications
CO5	Design the Engine Parts like connecting rod, crankshaft, and cylinder and piston.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Spur Gears	Conjugate action, Involute Gears, gear cutting methods, Tooth loads, Strength of spur gears in bending and in wear. Dynamic loading, Gear materials, design of gears and involute splines. Gear profile corrections, AGMA and Indian standards.	8	CO1
2	Helical Gears Worm and Bevel Gears:	Tooth relationship, tooth proportions. Design of helical gears, crossed helical gears, AGMA and Indian standards. Analysis of loads and stresses, power rating, Efficiency, Gear standards and proportions.	8	CO2
3	Bearing and Lubrication	Types of ball bearings, Roller bearing, Needle roller bearing, Life of bearing, Reliability considerations, Selection of ball, roller tapered roller and thrust bearings, Lubrication and sealing. Mounting of bearings.	8	CO3
4	Sliding Bearings	Hydrodynamic theory of lubrication, Types of bearings, Design of bearings using design charts, Boundary lubrication, hydrostatic bearings, hydrodynamic thrust bearings. Lubrication and lubricants.	8	CO4
5	Engine Parts	Design of engine parts such as connecting rod, crankshaft and cylinder and piston.	8	CO5

Reference Books:

Mechanical Engineering Design: Joseph E. Shigley McGraw Hill Publications.

Machine Design: D.N. Reshetov, Mir Publishers: Moscow

Design of Machine Elements: Bhandari, TMH

Machine Design: Sharma and Agrawal, Kataria

Machine Design: Maleev and Hartman, CBS

Machine Design: M.F. Spott. Prentice Hall India

Machine Design: Black and Adams, McGraw Hill.

e-Learning Source:

https://www.youtube.com/watch?v=3-J58q-NAc8&list=PLM-jfaoaU5iy3Ufc1wUhQC-oJ_yustLwU

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	**3**	3	2					1		1	3	3	1	2
CO2	3	3	3	2					1		1	3	3	1	2
CO3	3	3	3	2					1		1	3	3	2	3
CO4	3	3	3	2					1		1	3	3	2	3
CO5	3	3	3	2					1		1	3	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME322	**Title of the Course**	Applied Elasticity	**L**	**T**	**P**	**C**
Year	III	**Semester**	VI	3	1	0	4
Pre-Requisite	SOM, Machine design	**Co-requisite**	NONE				
Course Objectives	•To provide the foundation for pursuing other solid mechanics courses such as theory of plates and shells, elastic stability, composite structures and fracture mechanics to familiarize students with basic equations of elasticity. • Analyze and design compliant mechanisms • Review fundamental concepts of elasticity and mechanisms • Understand the difference between linear and nonlinear deflections. • To build the necessary theoretical background for further structural analysis and design courses						

Course Outcomes	
CO1	To analyze the fundamental concepts of stress for 3D dimensional elastic solids
CO2	To analyze the fundamental concepts of strain for 3D dimensional elastic solids
CO3	To built the basic concepts in stress strain relationship
CO4	To apply the Basic Equations of Elasticity for Solids
CO5	To analyze the structural sections subjected to torsion.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Analysis of Stress**	Concept of Stress, Stress Components, Equilibrium Equations, Stress on a General Plane (Direction Cosines, Axis Transformation, Stress on Oblique Plane through a point, Stress Transformation), Principal Stresses, Stress Invariants, Deviatoric Stresses, Octahedral Stresses, Plane Stress, Stress Boundary Condition Problem.	8	CO1
2	**Analysis of Strain**	Deformations (Lagrangian Description, Eulerian Description), Concept of Strain, Strain Components (Geometrical Interpretation), Compatibility Equations, Strain transformation, Principal Strains, Strain Invariants, Deviatoric Strains, Octahedral Strains, Plane Strain, Strain Rates.	8	CO2
3	**Stress-Strain Relations**	**:** One-Dimensional Stress-Strain Relations (Idealized Time independent and Time – dependent stress-strain laws), Linear Elasticity (Generalized Hooke's Law), Stress-Strain Relationships for Isotropic and Anisotropic Materials (Plane stress and Plane Strain).	8	CO3
4	**Basic Equations of Elasticity for Solids**	Stresses in Terms of displacements, Equilibrium Equations in terms of displacements, Compatibility equations in Terms of Stresses, Special cases of Elasticity equations (Plane Stress, Plane strain, Polar Co-ordinates), Airy's Stress Function (Plane stress, Plane strain, Polar Co-ordinates).	8	CO4
5	**Torsion**	**:** Introduction, Circular shaft, Torsion of non-circular cross-section, St. Venant's theory, Warping function, Prandtl's stress function, Shafts of other cross-sections, Torsion of bars with thin walled sections.	8	CO5

Reference Books:

Mathematical Theory of Elasticity by I. S. Sokolnikoff.

Advanced Mechanics of Materials by Boresi.

Theoretical Elasticity by A. E. Green and W. Zerna.

Theory of Elasticity by Timoshienko.

Advanced Strength and Applied Elasticity by A. C. Ugural and S. K. Fenster.

Applied Elasticity by R.T.Fenner.

Advanced Strength of Materials by L. S. Srinath.

e-Learning Source:

https://www.youtube.com/watch?v=TANFCoXVM9Q&list=PLjqHSJaE98hmXdG1hnfMUv85LUAaRF4-V

https://www.youtube.com/watch?v=4meZNc2wB4s&list=PLKZlPALGW-7TK51CrfZRyWcY8h2gaxVCy

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

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

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME319	**Title of the Course**	FEM	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	1. To impart proficiency in the application of the finite element method (modelling, analysis, and interpretation of results) to realistic problems through the use of a major commercial general-purpose finite element code. 2. Learn the theory and characteristics of finite elements that represent structures 3. Learn and apply finite element solutions to structural, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses performed by others 4. Apply knowledge and skills from mechanics and numerical methods to effectively evaluate static and dynamic problems 5. To develop ability to analyze critically and solve complex problems using FEM.						

Course Outcomes	
CO1	The students can understand and calculate the solution for BVP using different numerical techniques
CO2	Develop the ability to generate the general governing equations using Finite Element method in 1 D
CO3	Develop the ability to generate the general governing equations using Finite Element method in 2 D
CO4	Develop the ability to generate the governing Finite element equations for dynamic analysis.
CO5	The students learn the application of FEM, modelling, analysis, of complex problems and their applications

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction to finite difference method and finite elements method, Historical Backgrounds, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM. Basic equations of elasticity, stress,strain. Displacement relations. Finite element formulation of boundary value problems. Various methods used in FEM analysis, Steps used in FEM Analysis.	8	CO1
2	One dimensional finite element analysis	FE Modeling, general form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods ANALYSIS OF BEAMS: Shape functions-element stiffness matrix for two nodes, two degrees of freedom pernode beam element, load vector, deflection, stresses.	8	CO2
3	Two dimensional finite element analysis	Introduction – approximation of geometry and field variable – 3 node triangular Elements – four nodded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – is-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formula – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and ax symmetric applications	8	CO3
4	Dynamic analysis using finite element method	Introduction – vibration problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigen value problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods	8	CO4
5	Applications in heat transfer & fluid mechanics	One dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions – Applications to heat transfer in 2-Dimension – Application to problems in fluid mechanics in 2-D, Software based Analysis.	8	CO5

Reference Books:

Finite element methods by Chandrubatla & Belagondu.

J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press

Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill

J. N. Oden, Finite Element of Nonlinear continua, McGraw-Hill, New York 5. K. J. Bathe, Finite element procedures, Prentice-Hall

e-Learning Source:

https://www.youtube.com/watch?v=KR74TQesUoQ&list=PLbMVogVj5nJRjnZA9oryBmDdUNe7lbnB0

https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94

https://www.youtube.com/watch?v=vvLx-Ge6jag&list=PLwdnzlV3ogoXaOQbuifziA1e5z0qfoIo5

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2					3		1	3	3	1	2
CO2	3	3	3	3					3		1	3	3	1	3
CO3	3	2	3	3					2		1	2	2	1	3
CO4	3	3	2	3					3		1	3	3	1	3
CO5	2	3	3	3					3		1	2	3	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME324	**Title of the Course**	Fluid Machinery Lab	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**0**	**0**	**2**	**1**
Pre-Requisite	CE205	**Co-requisite**					
Course Objectives	• To impart practical knowledge/ techniques to determine impact of jet on vane and efficiency of Pelton turbine test rig. • To impart practical knowledge/ techniques to determine efficiency of Francis turbine test rig and Centrifugal pump test rig. • To impart practical knowledge/ techniques to determine efficiency of positive displacement pump i.e. Reciprocating pump and Gear oil pump. • To impart practical knowledge/ techniques to determine efficiency of hydraulic ram test rig. • Imparting knowledge to compare performance characteristics of different type of turbines and pump or experimental technique to determine efficiency of Kaplan turbine.						

Course Outcomes	
CO1	Demonstrate basic experimental technique to determine impact of jet on vane and efficiency of Pelton turbine.
CO2	Demonstrate basic experimental technique to determine efficiency of Francis turbine and Centrifugal pump.
CO3	Demonstrate basic experimental technique to determine efficiency of positive displacement pump i.e. Reciprocating pump and Gear oil pump.
CO4	Demonstrate basic experimental technique to determine efficiency of hydraulic ram.
CO5	Demonstrate the ability to compare performance characteristics of different type of turbines and pump or experimental technique to determine efficiency of Kaplan turbine.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Impact of jet	To compare the force exerted by the jet on different shapes of the vane.	2	CO1
2	Pelton Turbine	To draw the performance characteristic curves of Pelton turbine.	2	CO1
3	Francis Turbine	To draw the performance characteristic curves of Francis turbine.	2	CO2
4	Centrifugal Pump	To draw the performance characteristic curves of Centrifugal pump.	2	CO2
5	Reciprocating Pump	To draw the performance characteristic curves of Reciprocating pump.	2	CO3
6	Gear oil pump	To draw the performance characteristic curves of Gear oil pump.	2	CO3
7	Hydraulic Ram	To draw the performance characteristic curves of hydraulic ram.	2	CO4
8	Comparison	To compare the performance characteristic curves of Pelton turbine with Francis turbine and Centrifugal pump with reciprocating pump OR Technique to determine efficiency of Kaplan turbine.	2	CO5
e-Learning Source:				
https://www.vlab.co.in/				

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3			3	2		3	3	2	2
CO2	3	3	2	3	2	3			3	2		3	3	2	2
CO3	3	3	2	3	2	3			3	2		3	3	2	2
CO4	3	3	2	3	2	3			3	2		3	3	2	2
CO5	3	2	2	2	2	3			2	2		3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2017-18							
Course Code	ME315	**Title of the Course**	Refrigeration & Air Conditioning	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	VI	**3**	**1**	**0**	**4**
Pre-Requisite	Applied Thermodynamics (ME202) Heat and Mass Transfer (ME304)	**Co-requisite**	NONE				
Course Objectives	1. To impart the knowledge about air refrigeration cycles and methods air-craft refrigeration systems. 2. The course structures cover various types of Refrigeration Systems to familiarize the students with the fundamentals of Refrigeration System. 3. To give the knowledge about fundamentals of air conditioning and psychometric. 4. To familiarize the students about the application and design of refrigeration and air conditioning equipment.						

Course Outcomes	
CO1	Understand air refrigeration cycles and its application to air craft refrigeration system
CO2	Use p-h chart to solve vapour compression refrigeration problems and understand components of vapour compression refrigeration systems.
CO3	Understand temp-concentration and enthalpy concentration diagrams and its application in solving the problems of vapour absorption system. Understand components and working of vapour absorption system.
CO4	Use psychrometric chart in solving air conditioning problems. Understand the various types of air conditioning systems and its cooling and heating load calculation.
CO5	Know the application of refrigeration in food preservation, cold storage, freezers, ice plant and water cooler. To design the transmission and distribution of air through ducts and fans.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Refrigeration	Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect and 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. Simple air refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART)	8	CO1
2	Vapour Compression 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 and 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, Cascade system.	8	CO2
3	Vapour Absorption System Refrigerants	Working Principle of vapour absorption refrigeration system, Comparison between absorption and compression system, Elementary idea of refrigerant absorbent mixtures, Temperature-concentration diagram and Enthalpy-concentration diagram, Adiabatic mixing of two streams, Ammonia- Water vapour absorption system, Lithium Bromide water vapour absorption system, Comparison.**:** Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.	8	CO3
4	Air Conditioning	Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside and outside design conditions, Heat transfer through walls & roofs, Infiltration and ventilation, Internal heat again, Sensible heat factor (SHF), By-pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).	9	CO4
5	Refrigeration Equipment and Application	Elementary knowledge of refrigeration and air conditioning equipments e.g. compressors, condensers, evaporators and expansion devices, Air washers, Cooling towers and humidifying efficiency, Food preservation, cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, basic difference between comfort and industrial air conditioning.	7	CO5

Reference Books:

Refrigeration and Air conditioning : Manohar Prasad, New Age

Refrigeration and Air conditioning: C.P. Arora, TMH

Refrigeration and Air conditioning: Arora and Domkundwar, Dhanpat Rai

Refrigeration and Air conditioning: Stoecker and Jones

Refrigeration and Air conditioning: Roy J. Dossta

Refrigeration and Air conditioning: P.L. Baloney

Thermal Environment Engg. : Kuhen, Ramsey and Thelked

e-Learning Source:

https://www.youtube.com/watch?v=zqXgmVnI3L8&list=PLE2DA184A2E479885

https://www.youtube.com/watch?v=FEWF9N1LE6g&list=PLEaHqdgEVu6rgimtDDFGVeCfMPLp1q-TQ

https://www.youtube.com/watch?v=gKC5IpeBDaM

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CO2	3	3	3	2	2	2	2	1	2	-	2	2	3	3	3
CO3	3	3	3	2	2	2	2	2	2	-	2	3	3	2	2
CO4	3	3	3	2	3	3	2	1	2	-	2	2	2	3	1
CO5	3	3	2	2	2	2	2	2	3	-	2	3	3	2	2

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

Name & Sign of Program Coordinator	**Sign & Seal of HoD**