OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

Course Work for Ph.D

School of Engineering

Session- 2018-21

Program Outcomes for Mechanical Engineering Doctoral Program

1. **Disciplinary knowledge and problem solving:** Accomplish in-depth knowledge of a Mechanical Engineering domain and apply it to identify, analyze and address the related research problems.
2. **Scientific Reasoning and analytical approach:** Apply theories, methodologies, knowledge, critical thinking, and inductive and deductive reasoning to design and drive research projects with appropriate hypothesis, experimental design, simulation, survey, case studies etc.
3. **Communication and digital skills:** Instill oral, written communication skills and life-long digital learning to prepare grant proposals; and publish and present their work.
4. **Moral and Ethics:** Imbibe moral/ ethical values for research, publications, and patents etc.
5. **Project management and finance:** Develop and apply knowledge of Mechanical engineering, finance, and management principles throughout the R&D projects.
6. **Leadership Readiness:** Interact with people from diverse backgrounds as both leaders/mentors and team members with integrity and professionalism.

Program Specific Outcomes for Mechanical Engineering Doctoral Programme:

PSO-1: Develops the ability to critically evaluate his current research topic, research techniques and methodologies.

PSO-2: Analyze information/data and synthesize information to generate new knowledge/understanding.

PSO-3: Learn about the research publications and present experimental findings to a peer review group.

PSO-4: Proficiency to effectively communicate research findings orally, graphically and in writing at diverse levels.

Scheme of Teaching and Examination
PhD Coursework in Mechanical Engineering Department

SN	Subject Code	Subject	Scheme of Examination					Credit
			Theory		Seminar		Total Marks	
			PRE	ESE	PRE	ESE		
1	PCW 101	Research Methodology	50	50	-	-	100	5
2	SOE-PhD-ME101	Elective - I	50	50	-	-	100	5
3	SOE-PhD-ME102	Elective - II	50	50	-	-	100	5
4	SOE-PhD-ME103	Seminar Presentation	-	-	50	50	100	5
		Total	**150**	**150**	**50**	**50**	**400**	**20**

Department Elective-I

S N	Board of Study	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit
							Theory / Practical			
				L	T	P	ESE	PRE		
1	**Mechanical**	SOE-PhD-ME101(1)	Applied Ergonomics	3	1	..	50	50	100	5
2	**Mechanical**	SOE-PhD-ME101(2)	Advanced Heat & Mass Transfer	3	1	..	50	50	100	5
3	**Mechanical**	SOE-PhD-ME101(3)	Engineering Fracture Mechanics	3	1		50	50	100	5
4	**Mechanical**	SOE-PhD-ME101(4)	Advanced Engineering Thermodynamics	3	1	..	50	50	100	5
5	**Mechanical**	SOE-PhD-ME101(5)	Robotics	3	1	..	50	50	100	5
6	**Mechanical**	SOE-PhD-ME101(6)	Advances in welding and Joining Technology	3	1	..	50	50	100	5
7	**Mechanical**	SOE-PhD-ME101(7)	Plant Maintenance and Safety	3	1	..	50	50	100	5

L- Lecture T- Tutorial

ESE- End Semester ExamT.A- Teacher's Assessment

Department Elective-II

SN	Board of Study	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit
							Theory / Practical			
				L	T	P	ESE	PRE		
1	**Mechanical**	SOE-PhD-ME104	Modelling and Simulation of Dynamic Systems	3	1	..	50	50	100	3
2	**Mechanical**	SOE-PhD-ME105	Advanced Refrigeration and Air Conditioning	3	1	..	50	50	100	3
3	**Mechanical**	SOE-PhD-ME108	Analysis and Modeling of Welding	3	1	..	50	50	100	3
4	**Mechanical**	SOE-PhD-ME111	Energy Management & Audit	3	1	..	50	50	100	3

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Applied Ergonomics** **Course Code: SOE-PhD-ME101**

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

Ergonomics is an applied scientific discipline that is concerned with how humans interact with the system/equipment/surrounding while performing tasks and other activities. The course syllabus is designed so as to cover work physiology, Engineering aspect of product, improvement in the cognitive capabilities etc. Students will be able to correlate the understanding of this subject with their day to day activities and will be aware of concepts related to increase in the human efficiency.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Analyze and synthesize knowledge of fundamentals in ergonomics and human factors after utilizing active learning methods in lesson.
CO2	Emphasize applications of ergonomics in design and methods that are multi-disciplinary incorporating knowledge of computer sciences, information sciences and psychological principles
CO3	Apply methods to analyze research and existing designs, as well as demonstrate their ability to create new knowledge through content analysis.
CO4	generate new understandings in specialized topics if interest while utilizing information literacy methods such as bibliometric analysis, content analysis and cluster analysis for the final project.
CO5	Able to apply tools and technique to solve research analysis in ergonomics.

Syllabus

Unit 1: Introduction and Overview of Ergonomics: Occupational Safety & Health, Work Physiology,

Physical Ergonomics: Introduction to work physiology and its relation with Physical Ergonomics. Musculoskeletal system, Metabolism, Cardiovascular System, Respiratory System and their relation with Work Physiology. Various biological systems of a human body such as Musculoskeletal System, Metabolism, cardiovascular system, Respiratory System. Anthropometric design principles. Anthropometry as the part of Human Oriented Design, Muscle strength and endurance Heat balance, thermoregulations.

Unit 2: Cognitive ergonomics: information processing of the human cognitive system and Human Vision in this system, hearing sense in the cognitive system of human body and importance of auditory performance. Different types of memories and their principles: Sensory Memory, Working Memory, Long term Memory. Response Selection, Response Execution, Factors affecting response selection & execution, Design Complexity, Response Expectancy, Compatibility and its types, Trade-off between Speed and Accuracy, SRK Model and Common Cognitive Tasks.

Unit 3: Physical work environment, Visual Environment and Lightning, auditory Environment, effect of Noise. Noise factors and effects and Noise Control, Climate of Work Place, Heat Stress, Cold Stress. Human Factor Engineering.

Unit 4: Tools and Techniques involved in Ergonomics. Anthropometry. Anthropometric Data, Measurements, Statistical Essentials In Ergonomics Tools and application; Measuring Tools, Software Tools, Application of CAD software tools. Research Methods for Ergonomics.

Unit 5: Work study: work systems, measure of productivity, Mathematical Formulation of productivity, Labor productivity, Human factor. motion and time study, Steps in work study, Time study, process chart symbols.

Reference Books:

- R. S. Bridger, Introduction to Ergonomics, CRC Press.
- Mikell P Groover, Work Systems and the Methods, Measurement, and Management of Work, Pearson Education, Inc., Upper Saddle River, NJ.
- Christopher D. Wickens, An Introduction to Human Factors Engineering.
- David C. A., The practice and management of Industrial Ergonomics.
- Don Harris, Engineering Psychology and Cognitive Ergonomics.

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	-	-	-	-	-	2	3	1	-
CO2	2	2	-	-	-	2	-	1	2	-
CO3	1	3	2	2	-	2	-	-	3	2
CO4	1	1	3		2	1	-	-	2	2
CO5	-	-	-	2	-	2	-	2	1	2

Note: 1: Low 2: Moderate 3: High

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Fracture Mechanics** **Course Code: SOE-PhD-ME103**

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

The objective of this course is to introduce the mathematical and physical principles of fracture mechanics and their applications to engineering design to develop the ability in students to compute the stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear and non-linear materials.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Correctly apply fracture mechanics to predict brittle fracture. Identify and describe the basic fracture and fatigue mechanisms
CO2	Understand crack resistance and energy release rate for crack criticality. Application of Linear Elastic Fracture Mechanics on brittle materials.
CO3	Correctly identify the cause of failure of a material based on fracture surface observations.
CO4	Understand the relationship between crack tip opening displacement, SIF and ERR and application of such parameters for ductile and brittle materials.
CO5	Understanding of experimental techniques to determine the critical values of parameters at crack tip.

Syllabus

Unit 1: Introduction to Fracture Mechanics: Stress-Strain Curve, Elements of dislocation theory, Historical perspective, Stress Concentration effect of flaws, Fracture Mechanics approach to design, Effect of material properties on fracture, Cleavage, Brittle and Ductile fracture, ductile brittle transition, modes of fracture failure, Fatigue and stress corrosion crack growth, Damage tolerance.

Unit 2: Linear Elastic Fracture Mechanics: An atomic view of fracture, Griffith Energy Balance, Energy release rate, instability and the R Curves, compliance, tearing modulus, Stress and Displacement field in isotropic elastic materials, Airy stress function, Westergaard approach for different modes of fracture, Stress analysis of crack, Stress intensity factor (SIF), relation between K and global behavior, Effect of finite size.

Unit 3:

Elastic-Plastic Fracture Mechanics: Crack tip deformation and plastic zone size, plane stress vs plane strain, effective crack length, Irwin plastic zone correction, Dugdale approach, effect of plate thickness

J Contour Integral: Relevance and scope, J as a path-independent line integral, J as a stress intensity parameter, Stress-Strain relations, J-Controlled fracture, Laboratory measurement of J, Crack Tip Opening Displacement (CTOD), Relationship between CTOD, K and G, Equivalence between CTOD and J, Determination CTOD from strip yield model, HRR Singularity.

Unit 4: Fatigue Fracture: Introduction to fatigue, factors affecting fatigue performance, fatigue loading, constant and variable amplitude loading, some characteristics of fatigue crack, Paris Law.

Unit 5: Experimental and Finite Element Estimates of Fracture Mechanics: Experimental determination of J-Integral, Critical Stress intensity factor and CTOD, Photo elasticity techniques, strain gage measurements, Fatigue crack initiation and propagation testing. Pre-processing in Finite Element Method, Element selection and meshing of crack, Load application, constraints, preprocessing checks, processing the model, post-processing.

Text Books:

1. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007. URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
2. T.L. Anderson, Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.

Reference Books:

1. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
2. K. R.Y. Simha, Fracture Mechanics for Modern Engineering Design, Universities Press (India) Limited, 2001
3. D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
4. Sanford R.J., Principles of Fracture Mechanics, Printice Hall, Printice Hall USA, 2003
5. Gdoutos E.E., Rodopoulos C.A. and Yates J.R., Problems in Fracture Mechanics- A Solution Guide, Kluwer Academic Publishers The Netherlands, 2003.

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	-	-	2	-	2	1	-	-
CO2	3	2	-	-	-	-	2	2	1	-
CO3	-	3	1	2	1	2	-	3	2	1
CO4	-	3	1	2	1	2	-	3	2	1
CO5	-	2	1	-	1	2	-	3	2	2

Note: 1: Low 2.: Moderate 3: High

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Modelling and Simulation of Dynamic Systems**

Course Code: SOE-PhD-ME104

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

Modern engineering projects are very complex with multiple physical domains interacting with each other. Students will describe the properties and characteristics of different numerical integration methods, select an appropriate integration method for a particular model, and describe and resolve the challenges that can arise when simulating a model with multiple physical domains.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand main principles of dynamic systems modeling and simulation, and understand the process from basic laws of physics via mathematical models to simulation and analysis.
CO2	Develop mathematical models of various linear and nonlinear dynamic systems
CO3	analyze system responses in time and frequency domains
CO4	Design and develop simulation models for linear and nonlinear systems
CO5	Demonstrate the basic knowledge using different tools and methods in a unified approach to perform dynamic simulations of multi-domain systems: mechanical-, hydraulic-, electrical- and thermal-energy systems.

Syllabus

Introduction to Modelling and Simulation: Introduction to control systems engineering, dynamic systems, modelling and simulation.

Modelling: Introduction, Review on mathematical modeling, Modelling of electrical systems; Modelling of mechanical systems, Lagrange's equation; Modelling of electromechanical system, other control systems, Linearisation, Other techniques of modelling, Case study.

System Response Analysis: Introduction, Time response, Classical solution of state equations, Time domain solution of state equations, Frequency response.

Numerical Solutions of Differential Equations: Introduction, Euler's method, More accurate methods, Runge-Kutta method, Integration step size.

Simulation: Introduction, Simulation block diagram, building a simulation, studying a system with a simulation, Non-linear systems, Simulation using MATLAB, analog simulation, Case study.

References

1) R.L. Woods and K.L. Lawrence, *Modeling and Simulation of Dynamic Systems*, Prentice Hall, New Jersey, USA, 1997.
2) N.S. Nise, *Control Systems Engineering*, John Wiley & Sons, USA, 2004.
3) B.T. Kulakowski, J.F. Gardner and J.L. Shearer, *Dynamic Modeling and Control of Engineering Systems*, Cambridge University Press, New York, USA, 2007.

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	-	-	-	-	3	2	-	-
CO2	3	2	1	-	2	-	2	2	2	2
CO3	-	3	-	-	2	1	-	3	2	-
CO4	2	3	1	-	-	2	3	2	2	-
CO5	-	2	3	-	2	2	-	2	2	3

Note: 1: Low 2.: Moderate 3: High

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Robotics** **Course Code: SOE-PhD-ME101**

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

Robotics as an application draws from many different fields and allows automation of products as diverse as cars, vacuum cleaners, and factories. The objective of this course is to impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	To learn about knowledge for the design of robotic
CO2	Calculate the forward kinematics, inverse kinematics and Jacobian for serial and parallel robots
CO3	Analyze the manipulator design including actuator, drive and sensor issues
CO4	Develop programming principles and languages for a robot control system
CO5	Discuss various applications of industrial robot systems

Syllabus:

UNIT 1

Introduction: Historical perspective of robots, classification of robot, major components of robot, fixed versus flexible automation. Current robotic application in the field of welding, spray painting, grinding parts sorting and assembly operations. Robot application in the future.

UNIT 2

System Overview of a Robot: Basic component of robot systems, robot system in an application, functions of robot systems, specification of robot systems.

UNIT 3

Transformation and Kinematics: Homogeneous coordinates, coordinate reference frames, properties of transformation matrices, establishing link coordinate frame, the denavithartenberg

matrix, comments on forming forward solution, examples of forward solution applied to 2-DOF planer manipulator arm, cylindrical arm, articulated arm and 3 DOF polar arm. Inverse Kinematics.

UNIT 4

Robotic Sensory Devices: Non optical position sensors, optical position sensors, velocity sensors, accelerometers, proximity sensors, touch and slip sensors, force and torque sensors.

UNIT 5

Computer Vision for Robotic Systems: Imaging components, image representation, hardware consideration, picture coding, object recognition and categorization, software consideration, need for vision training and adaptation.

Text Books

1. Robotic Engineering - An integrated approach – Richard D. Klafter etl, PHI Publication
2. Robot Technology Fundamentals -- James G. Keramas, Vikas Publication

Reference Books

1. Mechanics of Robot Manipulation – M. T. Mason, PHI Publication
2. Remote Control Robotics -- Craig Sayers
3. Computational Principles of Mobile Robotics -- Michael Jenkin, Gregory Dude

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	2	2	-	2	-
CO2	3	2	-	-	--	2	2	-	2	-
CO3	-	3	-	-	2	2	1	3	2	-
CO4	2	1	-	-	2	1	3	1	-	1
CO5	2	3	2	1	-	2	1	2	1	1

Note: 1: Low 2: Moderate 3: High

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Analysis and Modeling of Welding**

Course Code: SOE-PhD-ME101

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

Welding is an important fabrication process in manufacturing industries. Complex parts fabricated using forming, machining and metal removal processes are assembled into a larger part using welding. The welding process involves a number of physical processes that play a role in determining the performance of the joint. With newer and dissimilar combinations required to be joined as the technological advances take place in the area of manufacturing, it is important for practicing engineers, graduate students and prospective researchers to understand welding to take advantage of the developments taking place. This course offers detailed analysis and modeling techniques that apply to the different physical phenomena that take place during welding.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Students will learn the basics of fusion welding process
CO2	Students will be able to utilize the modelling knowledge in the field of welding technology
CO3	Students will be able to apply the concept of fluid flow in welding allied areas
CO4	Students will be able to describe the microstructure properties of weldments.
CO5	Students will be able to collaborate various welding processes to improve the weldability and scope of welding

Syllabus:

Unit 1: Introduction to fusion welding processes, Heat sources, Heat removal.
Unit 2: Thermal modelling, Zones in a weldment, Phase change
Unit 3: Fluid flow in the weld pool, Fusion zone, Conduction mode and Keyhole mode.
Unit 4: Introduction to microsegregation, Solute redistribution – Microscale, Microstructure evolution
Unit 5: Solute transfer – Macroscale, Defects in fusion welds, Effects of dilution, Weld Cladding

Unit 6: Distortion in welding, Dissimilar welding, Solutions to Dissimilar welding, Integrated approach.

References:

1. Welding Metallurgy – Sindo Kou, Wiley Interscience 2nd Edition (2002)

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2	-	-	-	2	2	2	2
CO2	3	3	3	-	-	-	3	3	3	3
CO3	3	3	2	-	-	-	3	3	3	3
CO4	3	2	3	-	-	-	3	3	3	3
CO5	3	3	2	-	-	-	3	3	3	3

Note: 1: Low 2: Moderate 3: High

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Advances in Welding and Joining Technology**

Course Code: SOE-PhD-ME101

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

The progress of several welding and joining processes is ever increasing with the development of new materials and their application in modern technologies. This course is primarily designed from fundamental understanding to the most recent advances in welding and joining technologies. The syllabus is oriented to the advancement of the joining technologies which is different from conventional welding and joining processes. The modules cover almost all the direction of joining technologies and it is blended with fundamental development to the recent technologies.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO	Course Outcome
CO1	Students will understand the theoretical aspects of welding technology in depth.
CO2	Students will be able to intelligently select the appropriate welding process for a particular application.
CO3	Students will be able to describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy.
CO4	Students will be able to choose or adjust welding parameters and techniques to optimize the weldment properties.
CO5	Students will demonstrate their ability to check the weldment quality using various inspection and testing methods.

Syllabus:

Unit-1

Introduction: Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding.

Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators.

Unit-2

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.

Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

Unit-3

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Unit-4

Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminium. Micro & Macro structures in welding.

Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/ testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.

Unit-5

Solidification of weld metal: Principle of solidification of weld metal, modes of solidification, effect of welding parameters on weld structure, grain refinement principle of weld metal, method of weld metal refinement, inoculation, arc pulsation, external excitation.

Heat affected zone and weld metal: Transformations in HAZ of steel, factors affecting changes in microstructure and mechanical properties of HAZ, reactions in weld pool- gas metal reaction, slag metal reaction.

Books and References:

1. J. F. Lancaster: The Physics of welding, Pergamon, 1986
2. R. W. Messler: Principles of Welding, John Wiley and Sons, 1999.
3. Y. N. Zhou: Microjoining and Nanojoining, Woodhead publishing, 2008.
4. W Steen: Laser Material Processing, Springer-Verlag, 1991.
5. Sindo Kou: Welding Metallurgy, Wiley, 2002
6. J. A. Goldak: Computational welding mechanics, Springer, 2005
7. M-K Besharati-Givi and P. Asadi: Advances in Friction-Stir Welding and Processing, Woodhead Publishing Limited, 2014

8. J. Norrish: Advanced welding Processes, Woodhead publishing, 2006
9. L-E Lindgren: Computational welding mechanics, Woodhead Publishing Limited, 2007
10. Ian Gibson, David W. Rosen, Brent Stucke: Additive Manufacturing Technologies, Springer, 2009.

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	1	-	2	2	2	2
CO2	3	3	3	-	1	-	3	3	3	3
CO3	3	3	2	-	-	-	3	3	3	3
CO4	3	3	3	-	2	-	3	3	3	3
CO5	3	3	2	-	-	-	3	3	3	3

Note: 1: Low 2: Moderate 3: High

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Plant Maintenance and Safety**

Course Code: SOE-PhD-ME101

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

Maintenance of equipment in industries is very critical issue to ensure quality and quantity of production. Industries are not able to survive and progress if proper maintenance of equipment is not done. In the absence of proper maintenance, industries are busy in every day fire-fighting to repair the breakdowns and manage production in very unsafe manner. This course provides information about wear, corrosion, lubrication, preventive maintenance; decision tree to diagnose faults, important provisions of factory act, alignment of equipment etc. This course also provides basic knowledge and skills regarding maintenance problems, their causes and remedies in industries.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO	Course Outcome
CO1	Understand about fundamental of maintenance and Carry out plant maintenance using tribology, corrosion and preventive maintenance
CO2	Develop decision tree for fault tracing in mechanical and electrical components.
CO3	Carry out plant periodic maintenance and preventive maintenance
CO4	Get aware about industrial safety norms as per act 1948
CO5	Select appropriate recovery method for machine elements and plan foundation and erection of equipment's in plant.

Syllabus:

Unit-I:

Fundamentals of maintenance engineering

Definition and aim of maintenance engineering. Primary and secondary functions and responsibility of maintenance department. Types of maintenance. Types and applications of tools used for maintenance. Maintenance cost & its relation with replacement economy. Service life of equipment.

Wear and Corrosion and their prevention

Wear- types, causes, effects, Wear reduction methods. Lubricants-types and applications. Lubrication methods –General sketch, working and applications. Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication. Wick feed lubrication; Side feed lubrication, Ring lubrication. Definition, principle and factors affecting the corrosion, Types of corrosion. Corrosion prevention methods.

Unit-II:

Fault tracing

Fault tracing-concept and importance. Decision tree-concept, need and applications. Sequence of fault finding activities, show as decision tree. Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipments like: Any one machine tool. Pump, Air compressor. Internal Combustion engine. Boiler, Electrical motors. Types of faults in machine tools and their general causes.

Unit-III:

Periodic and preventive maintenance

Periodic inspection-concept and need. Degreasing, cleaning and repairing schemes. Overhauling of mechanical components. Overhauling of electrical motor. Common troubles and remedies of Electric motor. Repair complexities and its use. Definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: Machine tools, Pumps, Air compressors, Diesel generating (DG) sets. Program and schedule of preventive maintenance of mechanical and electrical equipments. Advantages of Preventive maintenance. Repair cycle-concept and importance.

Unit-IV:

Industrial safety

Accident - causes, types, results and control. Mechanical and electrical hazards-types, causes and preventive steps/procedure. Describe salient points of Factories act 1948. for health and safety-, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc. Safety colour codes. Fire prevention and fire fighting, equipment and methods.

Unit-V:

Recovery, reconditioning and retrofitting

Definition of recovery, reconditioning and retrofitting. Methods of recovery and their applications. Selection criteria of recovery methods. Reconditioning - process, features and advantages. Retrofitting - concept, need and applications.

Installation, erection and commissioning of equipments

Design and planning of foundation. Erection and commissioning of equipment. Alignment and testing of equipment.

Text books:

1. Maintenance Engineering, H.P.Garg, S. Chand and Company.
2. Maintenance Engineering Handbook, Higgins & Morrow, DA Information Services
3. R.P.Blake, "Industrial Safety", Prentice Hall of India, New Delhi

References Books

1. Maintenance of Machine Tools, Gilbirg& Morrow.
2. Pump-hydraulic Compressors, Audels, McGrew Hill Publication.
3. Foundation Engineering Handbook, Winterkorn, Hans., Chapman & Hall London.
4. Heinrich H.W, "Industrial accident prevention", McGraw Hill Company, New York, 1980.

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	-	-	2	-	1	2	-	-
CO2	3	2	1	-	-	3	-	2	-	2
CO3	1	2	3	1	2	2	1	2	1	3
CO4	2	-	2	-	-	2	2	1	-	2
CO5	2	2	2	1	2	2	1	2	1	1

Note: 1: Low 2: Moderate 3: High

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Energy Management & Audit**

Course Code: SOE-PhD-ME101

Credits: 3 **No of Hours: 3 hours/week** **Max Marks: 100**

Course Description:

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO	Course Outcome
CO1	Acquaintance with conservation of energy and its management.
CO2	Knowledge of energy efficient systems, energy losses and their management.
CO3	Competency in energy analysis techniques and energy conversion planning.
CO4	Develop a proposal for energy efficiency improvements to a company.
CO5	Knowledge about energy forecasting, energy economics, pricing and incentives for energy conservation.

Syllabus:

Unit 1: Energy management: General Aspects General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy.

Unit 2: Procedures and Techniques: Data gathering: Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering. Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation. Evaluation of saving opportunities: Determining the savings in Rs, Noneconomic factors, Conservation opportunities, estimating cost of implementation. Energy Audit Reporting: The plant energy study report- Importance, contents, effective organization, report writing and presentation.

Unit 3: Energy Policy Planning and Implementation: Key Elements: Force Field Analysis, Energy Policy Purpose, Perspective, Contents and Formulation. Format and Ratification, Organizing: Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating – Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.

Unit 4: Energy Balance & MIS: First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification.

Unit 5: Heat Exchangers and Heat Recovery Systems: Heat Exchangers Classification Over all heat transfer coefficient, Fouling factor, Design of heat exchangers by L.M.T.D. and N.T.U. methods. Liquid to Liquid heat exchangers Shell and tube Heat exchanger. Sources of waste heat, Guidelines to identify waste heat, Grading of waste heat, Feasibility study of waste heat recovery, Gas to Gas and Liquid to liquid heat recovery, waste heat boilers.

Text Books

1. Energy Management: W.R. Murphy, G. Mckay (Butterworths).
2. Energy Management Principles: C.B. Smith (Pergamon Press).
2. Efficient Use of Energy: I.G.C. Dryden (Butterworth Scientific)
3. Energy Economics -A.V. Desai (Wieley Eastern)

Reference Books:

1. Industrial Energy Conservation: D.A. Reay (Pergammon Press)
2. Energy Conservation through Control – E.G. Shinskey – Academic Press.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley Interscience Publication)

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	3	1	2	1	2	1	-	-
CO2	2	3	1	2	-	2	2	2	2	-
CO3	2	2	2	1	3	3	-	3	3	2
CO4	3	2	1	3	2	1	2	-	2	2
CO5	2	3	2	1	3	1	2	2	2	2

Note: 1: Low 2: Moderate 3: High

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **PhD** **Semester: Coursework**

Name of the Course: **Seminar Presentation** **Course Code: SOE-PhD-ME112**

Credits: 2 **No of Hours: 4 hours/week** **Max Marks: 100**

Course Description:

This subject is related the techniques of scientific study and understanding related research mobility and how to express in a scientific framework. Seminar has its own importance in a career of a student to improve the logical communicative skills and confidences. The main objective is to set out the chosen research methods, including their theoretical basis, and the literature survey.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Know and understand skills and qualities needed to prepare a high-quality Literature survey
CO2	Understand and justify the relevance, soundness and research scope of the project's topic.
CO3	Know key aspects regarding complete and qualitative presentation of the work done.
CO4	Understand the importance of critical thinking in reading sources and writing text.
CO5	Understand the specifics of the language and style of presentation used in writing.

Syllabus

Student Presentation Guidelines:

1. Seminar topic should be from emerging area in which research should be carried out.
2. Plan on approximately a 40-minute presentation with about 10 minutes for questions
3. The presentation should provide sufficient background describing the problem addressed in the research. Remember, a good portion of your audience will not be familiar with your work. Specifically, you should answer: *f* What is the problem? *f* Why is the problem important?

4. Prepare a 1-page, double-sided sheet of some of your most important slides and bring 2 hardcopies to the seminar. Make sure the slides are legible; probably around 6 slides per side. The purpose of this sheet is to give your audience the chance to look at selected slides in more detail at their own pace.
5. The student presentations are not meant to be given only upon completion of the research/thesis. Rather, these presentations can be very useful for providing feedback and suggestions during the course of research.
6. The evaluation will be done based on the contents in report, report submitted, presentation, viva

CO-PO & PSO Correlation

	Program Outcomes						PSOs			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	2	2	1	2	2	2	2
CO2	3	2	2	2	2	1	2	2	2	2
CO3	2	-	2	-	2	2	2	-	2	2
CO4	1	3	-	-	2	2	1	2	2	-
CO5	-	2	3	-	2	1	-	-	2	2

Note: 1: Low 2: Moderate 3: High