OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

B Tech

School of Engineering

Session- 2019-23

(POs) Program Outcomes for Engineering Graduate

1. **Engineering Knowledge and Problem Analysis** -- Apply the knowledge of engineering domain with adequate amalgamation of science, mathematics, and management to Identify, formulate, and critically analyze complex engineering problems.
2. **Modern tools and techniques for investigating complex problems** – Apply appropriate tools and techniques to analyze, predict and simulate the data for valid conclusion with clear understanding of limitations.
3. **Design and development of innovative systems**: design and develop system components or processes to provide solutions of complex engineering problems that meet the specified conditions of societal, health, safety, and environmental needs.
4. **Communication and Teamwork -** Develop skills to communicate effectively to diverse platforms and contribute meaningfully to different capacities as a leader, team member or individual.
5. **Project management and finance**: Develop and apply knowledge of engineering, management, and finance principles to handle a project in a multidisciplinary environment.
6. **Life-long learning**: Acquire fundamental knowledge for lifelong learning to participate in the extensive context of socio-technological change as a self-directed member and a leader.
7. **Ethics and citizenship**: Apply ethical principles and commit to professional ethics, norms, and responsibilities of the engineering practice; and act with informed awareness to participate in civic life activities.
8. **Society, Sustainability and Environment** -- Understand the impact of various solutions in the context of societal, economical, health, safety legal and environmental impact for sustainable development.

(PSOs) Program Specific Outcomes of Mechanical Engineering Department

PSO 1: Develop an attitude to meet global challenges and apply the knowledge of mechanical engineering to solve problem related with thermal, design, manufacturing and interdisciplinary field.

PSO 2: Demonstrate knowledge and skill for solving social, real industrial problems using modern software and hardware tools.

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering

B. Tech in Mechanical Engineering (I- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-FY101	Maths	Mathematics- I	4	1	0	30	20	50	100	5
2	SOE-B-FY102	Chemistry	Engineering Chemistry	3	0	0	30	20	50	100	3
3	SOE-B-FY103	Physics	Physics- I	3	0	0	30	20	50	100	3
4	SOE-B-FY104	CSE	Basic Computing	3	0	2	30	20	50	100	4
5	SOE-B-FY105	Mechanical	Engineering Graphics	1	0	4	30	20	50	100	3
6	SOE-B-FY106	EE	Basic Electrical & Electronics Engineering	3	0	0	30	20	50	100	3
7	SOE-B-FY107	EE	Basic Electrical & Electronics Engineering Lab	0	0	2	-	30	20	50	1
8	SOE-B-FY108	Chemistry	Engineering Chemistry Lab	0	0	2	-	30	20	50	1
9	SOE-B-FY109	Humanities	Spoken English Communication	0	0	2	-	30	20	50	1
			TOTAL	**17**	**01**	**12**	**180**	**210**	**360**	**750**	**24**

L: Lecture T: Tutorial P: Practical ESE: End Semester Examination T.A: Teacher's Assessment. PRE- Progressive Review Examination

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: I Sem**
Name of the Course: **Mathematics-I** **Course Code: SOE-B-FY101**
Credits: 5 **No of Hours :05/week** **Max Marks: 100**

Course Description:

Learning Objective 1. Find the Rank and Inverse of matrix by using Elementary Transformations. 2. Solve systems of linear equations (homogeneous & non-homogeneous), Eigen values and Eigen vectors of matrix. 3. Find the nth derivative by using Leibmitz's, Taylor's and Maclaurin's Theorem. 4. Differentiation of functions having more than one variable. 4. Integration of functions having nth power, double and triple integral and applications. 5. Gradient, divergence and curl, line integral, Surface integral and Volume integral. 6. Relation between line integral, Surface integral and Volume integral.

Course Outcomes:

On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Find Rank and Inverse of matrix by using Elementary Transformations and Solve systems of linear equations.
CO2	Understand applications in Engineering Problems
CO3	Understand Successive Differentiation, Leibmitz's Theorem for nth derivative of two functions.
CO4	Understand Taylor's and Maclaurin's Theorem and tracing of curves.
CO5	Understand Limits, continuity and differentiability of function of several variables.
CO6	Understand Partial derivatives, Maxima and minima of function of two or more variables.
CO7	Understand Reduction formulae, Double and triple integrals, Change of order of integrations. Beta and Gamma functions; Applications to area and volume.
CO8	Understand Beta and Gamma functions, Applications to area and volume.
CO9	Understand Gradient, divergence and curl and Properties of gradient, divergence and curl.
CO10	Understand Line integral, Surface integral, Volume integral, Green's theorem in a plane; Gauss's Divergence theorem; Stoke's theorem.

Syllabus

Unit 1: Linear Algebra

Matrix algebra; Elementary transformations; Inverse of a matrix; Rank of matrix; Systems of linear equations (homogeneous & non-homogeneous); Eigen values and Eigen vectors; Cayley-Hamilton theorem; Applications of matrices in Engineering.

Unit 2: Differential Calculus

Successive differentiation; Leibnitz's theorem; Taylor's and Maclaurin's series; Radius of curvature; Curve tracing.

Unit 3: Multivariable Calculus

Limits, continuity and differentiability of function of several variables; Partial derivatives; Maxima and minima of function of two or more variables; Method of Lagrange's multipliers; Differentiation under integral sign.

Unit 4: Integral Calculus

Reduction formulae; Double and triple integrals; Change of order of integrations; Beta and Gamma functions; Applications to area and volume.

Unit 5: Vector Calculus

Scalar and vector point functions; Gradient, divergence and curl; Properties of gradient, divergence and curl; Line integral; Surface integral; Volume integral; Green's theorem in a plane; Gauss's Divergence theorem; Stoke's theorem.

Text Books:

1. Advanced Engineering. Mathematics by Erwin Kreyszig (8th edition) – John Wiley & Sons.
2. Higher Engineering. Mathematics by B. S. Grewal (38th edition)-Khanna Publishers.
3. Applied mathematics for Engineers & Physicists by Louis A. Pipes – Mc Graw Hill.
4. Advanced Engineering Mathematics by R. K. Jain & S. R. K. Iyengar – Narosa Publishing House.

Reference Books:

1. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
2. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
3. D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ray Wylie C and Louis C Barret, Advanced Engineering Mathematics, Tata Mc-Graw-Hill; Sixth Edition.
6. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	-	1	2	-	2	1	1	-
CO2	2	-	-	-	-	1	-	2	2	-
CO3	1	-	1	-	1	-	1	-	1	-
CO4	1	-		-	2	-	-	-	-	1
CO5	1	2	2	2	-	-	2	1	1	-
CO6	1	-	-	-	2	2	-	-	1	-
CO7	1	1	1	-	-	-	-	1	-	1
CO8	1	-	1	-	-	1	2	-	-	-
CO9	2	-	-	1	1	-	-	1	2	-
CO10	1	-	1	-	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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Engineering Chemistry** **Course Code: SOE-B-FY102**
Credits: 3 **No of Hours : 03/week** **Max Marks: 100**

Course Description:

This course aims at giving students theoretical understanding about the basic concepts of Chemistry and to acquire the skills required for an engineer. Reaction rates and factors that influence the reactions and the importance & utility related to it is introduced. The importance of water in industrial usage, significance of corrosion control to protect the structures, polymers and their usage as an important material to be studied. The students will gain knowledge about fuel, characteristics and ranking.

Course Outcomes (CO): Students will be able to

CO Number	Course Outcomes
CO1	Demonstrate an understanding of scientific facts and concepts, scientific methods and techniques, scientific terminology, and methods of presenting scientific information
CO2	Apply and use scientific facts and concepts, scientific methods and techniques, scientific terminology to communicate effectively and apply appropriate methods to present scientific information
CO3	Facilitate the application of chemical principles in engineering and technology for future technopreneurs and researchers

Syllabus

Unit I: Reaction Kinetics

Factors affecting rate of reaction (reactant concentrations, temperature, physical states and surface areas, solvent and catalyst); Rate of reaction, mathematical expression, units, instantaneous & average rate; Rate Law-Differential & Integrated Rate law, order and molecularity, determination of rate law- Differential, Integral, Half-life, Initial rate & graphical method, rate constants (up to second order with one reactant only); Half-lives and radioactive decay kinetics (carbon dating); Collision model of reaction kinetics, activation energy, Arrhenius equation; Catalysis.

Unit II: Corrosion Chemistry

Corrosion fundamentals (causes, consequences & driving force); Theories of Corrosion: Dry/ Chemical Corrosion & Wet/ Electrochemical corrosion; Forms of corrosion-Galvanic, Concentration Cell / Differential aeration, wire-fence, waterline, pitting, crevice, stress corrosion, corrosion fatigue, microbial & soil corrosion; Factors affecting

corrosion: nature of the metal & corroding environment: Corrosion Control- Proper design, materials selection, protective coatings, use of inhibitors, modifying/ alteration of environment, cathodic protection (sacrificial anodic & impressed current cathodic).

Unit III: Water Chemistry

Introduction, sources of water, impurities present in water & their effect, requirement of boiler feed water; Alkalinity – types & determination (including numerical problems); Hardness - definition, types, determination; Water softening process- Lime and Soda, Zeolite & Ion Exchange Process (including numerical problems)**;** Boiler problems (causes & removal) **-** sludge and scale, caustic embrittlement, boiler corrosion, priming and foaming; Conditioning of boiler feed water (carbonate, phosphate, colloidal & calgon conditioning).

Unit IV: Fuels Chemistry

Introduction (definition & classification, characteristics, combustion); Calorific value (HCV & LCV) & its determination - by Dulong's formula & Bomb Calorimeter (principle & working); Coal, ranking & analysis - proximate & ultimate analysis and their importance in ranking; Coke, importance as fuel, manufacturing & carbonization- high temp & low temp carbonization.

Unit V: Polymer Chemistry

Fundamentals (nomenclature, degree of polymerization, monomer units & classification), Polymerization- Addition, Condensation & Co-polymerization; glass transition temperature, tacticity & Ziegler-Natta catalyst; Preparation, properties, and technical application of major polymers (polyethylene, PVC, Teflon, Nylon 6,6, Bakelite); Introduction to Resin, Types of Resins, Thermoplastic & thermosetting Resin, Industrial applications of resin; Elastomers, natural rubber & vulcanization process.

Textbooks:

1. Engineering Chemistry by P.C. Jain & Monica Jain, 2008
2. A textbook of Engineering Chemistry by Dara, S.S. & Umare, S.S., S Chand, 2013
3. Engineering Chemistry by Palanna O.G., Mc Graw Hill Edu., 2017

Reference Books

1. Chemistry in Engineering and Technology (Vol-2) by J. C. Kuriacose, J. Rajaram (Tata McGraw Hill).
2. Engineering Chemistry by M.M. Uppal, Revised by S.C. Bhatia (Khanna Publishers).
3. Corrosion for Science and Engineering, Trethewey and Chamberlain, 2nd Edition, Pearson Education 1998
4. Corrosion Engineering, Fontana, 3rd Edition, McGraw Hill, 1986
5. Corrosion Engineering, Roberge, McGraw Hill, 2008

6. Principles of Chemistry, Laidler, K.J., Harcourt, Brace & World, New York, 1966
7. Physical Chemistry, Moore, W.J., Prentice-Hall, 1962
8. Inorganic Chemistry, Moeller, T., John Wiley, 1982

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	1							1	
CO2	1	2							1	1
CO3		1	1						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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Physics-I** **Course Code: SOE-B-FY103**
Credits: 3 **No of Hours :03/week** **Max Marks: 100**

Course Description:

Applied Physics is a science course for students interested in the technical fields. This course is designed for the student who needs a broad understanding of physics and the ability to apply those principles in the work force. The Physics-I course is basically fundamentals of electronics, theory and applications of laser, concepts of Newton's law of motion, parameter of Mechanics, interference of light, good conditions for interference and its engineering applications. The purpose of studying Physics-I is to introduce the mind to the scientific method of analysis through which, the practical problems can be identified, explanations generated and logical solutions selected which in essence are requisites for the development of good engineering sense.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand basics of Solid State Physics.
CO2	Know the fundamental principles of semiconductors
CO3	Understand the interference from wave optics concepts and know its applications.
CO4	Acquire knowledge and understanding of fundamental principles of modern physics relevant to problems of Electrical and Electronics Engineering

Syllabus:

Unit I.

Solid State Theory: Formation of energy bands in metals, Classification of solids on the basis of energy band diagram, Conductivity of Semiconductors, mobility in conductor & semiconductor.

Unit II.

Electronics: Electrons and holes in an intrinsic semiconductors, Donor and acceptor impurities, Fermi level, Carrier densities in semiconductor, Hall effect, Diffusion, Recombination, Junction Diode, PN junction characteristic, Effect of Temperature, Depletion Layer, Breakdown Mechanism: Zener and Avalanche Breakdown, Half wave and full wave rectifiers, filters, Zener diode as a regulator, Transistors(PNP & NPN) Operation, CE, CB, CC configuration.

Unit III.
Lasers: Principles and working of laser, population inversion, Laser characteristics, components of laser, Einstein's coefficients, He-Ne laser, Ruby laser, Laser applications.

Unit IV.
General Mechanics: Central and non-central forces, Inverse square force, Potential energy function F = -grad V, equipotential surfaces and meaning of gradient. Conservative and non-conservative forces, Conservation laws of energy & momentum, Harmonic oscillator, Damped harmonic motion forced oscillations.

Unit V.
Interference of light: Superposition of Waves, Conditions for Interference, Methods of formation of coherent sources, Theory of Interference, Fresnel's Biprism, Newton's ring, Diffraction grating, Rayleigh's criterion of resolution, Engineering applications of Interference phenomenon.

Texts/ References:

1. Beiser, Perspectives in Modern Physics, McGraw Hill, 1969.
2. Lengyel, Introduction to Laser Physics, Wiley Interscience 1971.
3. E. Siegman, An Introduction to Laser and Masers, McGraw Hill 1971.
4. S. H. Patil, Elements of Modern Physics, Tata McGraw Hill, 1989.
5. A.K. Ghatak and S. Loknathan, Quantum Mechanics, Theory and Applications, McMillan India, 1984.
6. Michael Sayer & Abhai Mansingh, "Measurement, Instrumentation and experiment design in physics and engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
7. P. Malvino, "Electronic Principles", Tata McGraw-Hill, 1979.
8. H. V. Malmstadt, "Electronics for Scientists", New York: W. A. Benjamin, 1962.
9. J. W. Goodman, An Introduction of Fourier Optics, McGraw Hill,N.Y., 1968.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	2	2	2	2	2	2	2	1
CO2	3	2	2	1	2	3	2	2	2	2
CO3	2	3	3	2	2	2	2	2	2	2
CO4	3	1	1	2	1	2	2	3	2	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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Basic Computing** **Course Code: SOE-B-FY104**
Credits: 4 **No of Hours :04/week** **Max Marks: 100**

Course Description:
This course will expose students to developments in computer technology and understand the working of a computer system. It will introduce end-user computing and build problem solving skills by using C programming.

Course Outcomes:
On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Makes students gain a broad perspective about the uses of computers in engineering industry.
CO2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
CO3	Develops the ability to analyze a problem, develop an algorithm to solve it.
CO4	Develops the use of the C programming language to problem solving and develops the basic concepts and terminology of programming in general.
CO5	Introduces the more advanced features of the C language for implementation in diverse platforms.

Syllabus:

Unit I: Introduction to Computers
Basic Concepts, Evolution, Computer Organization, Peripheral Devices, Software – System Software, Application Software, Computer Languages – Low Level, Machine Level and High Level Languages, Compiler and Assembler, Microprocessors, Memory, Technological Trends. Algorithms and Flow Chart: Algorithm and its characteristics, flowchart, Algorithm involving Decisions and Loops, Problem solving methods. Pseudo code, top down & bottom up approaches of program design

Unit II: Introduction to C
History of C, Features of C Language, Structure of a C program, Basic Input Output Execution of C Program- Compiling, Linking, debugging, and running a program. Variables, Constants and Operators: C character set – Tokens, Constants Keywords, identifiers, and Variables. Data types – Data type Qualifiers, Declaration of variables, Arithmetic, Logical, Assignment, Relational, Increment and Decrement, Conditional, Bit wise, Special Operator, Precedence and Associativity

Unit III: Looping and Functions

Branching & Looping: Introduction – Simple if statement, if-else, else-if ladder, nested if-else, Switch statement, go to statement. Loops - while, do-while, for loop, nested loops infinite loops Functions: Introduction to functions – Declaration, definition and calling of function, Function arguments and return value, scope and lifetime of variables call by value, call by reference. Storage classes. Recursion. Library functions

Unit IV: Arrays and Pointers

Arrays: Declaration and initialization of one dimensional, two dimensional and character arrays, accessing and manipulating array elements, array applications - matrix operations, searching, sorting. String manipulations. Pointers: Pointers concepts, pointers and function arguments, pointer arithmetic

Unit V: Structures and File Handling Structure

Structure declaration, definition, initialization and accessing. Structure Assignment, Nested Structure, Structures and Functions, Structures and arrays. File Handling: Concept of a file – Data Organization, reading, writing, manipulating and troubleshooting, file types, file opening modes.

Textbooks

1. "Let us C" by Yashvant Kanetkar, BPB Publications.
2. Raja Raman V., "Fundamental of Computers" (4th edition.), Prentice Hall of India, New Delhi.

Reference Books

1. "C Programming Language" by B. W. Kernighan & D.M. Ritchie.
2. "Programming with C (SCHAUM's Outlines Series)" by Byron Gottfried.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	1	3	-	-	-	2	-
CO2	1	-	2	2	-	-	-	-	2	-
CO3	3	-	1	1	2	-	2	-	2	2
CO4	2	-	-	1	-	-	-	-	-	2
CO5	-	1	-	-	1	-	2	3	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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Engineering Graphics** **Course Code: SOE-B-FY105**
Credits: 3 **No of Hours :03/week** **Max Marks: 100**

Course Description:
The course in Engineering Graphics is aimed at inculcating the ability of imagination in the mind of the students, to improve their visualization skills and logical thinking, to build in them a capability of communicating through this unique language of engineers by learning conventional graphical techniques as well as computer-aided drawing skills, to develop interpretation competencies of professional drawings, to transfer an abstract object onto the paper through drawing.

Course Outcomes:
On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Gain knowledge of Fundamentals of Engineering drawing.
CO2	Draw orthographic projections of lines, planes, and solids
CO3	Draw sections of solids and development of lateral surfaces including cylinders, cones, prisms, and pyramids.
CO4	Construct isometric scale, isometric projections, and views.
CO5	Draw projections of lines, planes, solids, and sections of solids including cylinders, cones, prisms, and pyramids using AutoCAD.

Syllabus:

Unit 1:
Fundamentals of Engineering Drawing
Introduction to Drawing instruments & their uses, Engineering Lettering, Drawing sheet - Layout of drawing sheets, sizes of drawing sheets, Line – Types of lines and their applications in Engineering Drawing, Dimensioning. Introduction to scales
Engineering Curves: Conic sections and Basic construction of Cycloid, Involutes
Introduction to Computer-Aided Drafting (CAD):
Basic Drawing and Editing Commands, Dimensioning, Knowledge of setting up layers, Text. **(To be covered with CAD package)**

Unit 2:
Projections of Points
Introduction to projections, Projection of points in all four quadrants.
Projections of Lines

Projections of lines (by First angle projection method only) parallel to one or both the reference planes, perpendicular to one of the reference planes. Projections of lines inclined to either horizontal plane or vertical plane and both the planes i.e., oblique lines. Trace of a line.

Unit 3:

Projection of Planes

Projections of planes (by First angle projection method only) inclined to either horizontal plane or vertical plane and both the planes i.e., Oblique planes. Use change of positions or Auxiliary plane method.

Projection of Solids

Introduction to Solids, Types of Solids, Projection of Solids inclined to one and both the reference plane. Use change of positions or Auxiliary plane method.

Unit 4:

Section of Solids

Projections of geometric solids cut by plane perpendicular to at least one reference plane (Exclude Curved Section Plane).

Development of Surfaces

Methods of development of lateral surfaces of various solids, development of surfaces of cut solids.

Unit 5:

Orthographic Projection

Orthographic projections of given pictorial view by First angle method of projections only. Drawing of orthographic projections using Auto CAD **(only for Term Work)**

Isometric Projection

Introduction, Isometric scale, Isometric projection and Isometric views of solids and objects.

Text books:

1. N. D. Bhatt and V.M. Panchal, Engineering Drawing, Plane and Solid Geometry, Charotor Publication House, Anand, Gujarat, India.
2. Dhaanjay A. Jolhe, Engineering Drawing with an Introduction to Auto CAD, Tata Megraw-hill Publishing Co. Ltd, New Delhi, India.
3. Basant Agrawal and C.M. Agrawal, Engineering Drawing, Tata Megraw-hill Publishing Co. Ltd, New Delhi, India.
4. K. L. Narayana and P.L. Kannaiah, Engineering Drawing, Second Edition, Scitech Publications (India) Pvt. Ltd. Chennai.
5. K. C. John, Engineering Graphics for Degree, PHI Learning Pvt. Ltd. New Delhi, 2009
6. A. R. Bapat, Engineering Graphics, Allied Publications, New Delhi, India.
7. D. N. Johle, Engineering Drawing, S. Chand and Company Ltd., New Delhi, India.

Reference Books:

1. W. J. Luzadder, Fundamental of Engineering Drawing, Prentice Hall of India.
2. Basudeb Bhattacharyya, Machine Drawing Include Auto CAD Supplements, Oxford University Press, India.
3. French and Vierck, Graphic Science, Mc- Graw Hill international
4. K. Venugopal, Engineering Drawing and Graphics, New Age Publication.
5. R. K. Dhawan, Engineering Drawing, S. Chand and Company Ltd., New Delhi, India.
6. N. B. Shaha and B. C. Rana, Engineering Drawing, Person Education.
7. C. Jensen, J. D. Helsel and D. R. Short, Engineering Drawing and Design, Tata Megraw-hill Publishing Co. Ltd, New Delhi, India.
8. T. Jeyaproovan, Engineering Drawing and Graphics by using Auto CAD, Vikas Publication house, Pvt. Ltd. New Delhi, India.
9. M. L. Dhabhade, Engineering Graphics, Association of technical Authors, Pune India.
10. B. V. R. Gupta, M. Raja Roy, Engineering Drawing, I. K. International Pvt. Ltd, India.
11. R. K. Dhawan, Engineering Drawing, S. Chand and Company Ltd., New Delhi, India.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	1	2	-	2	-	-	3	3
CO2	3	3	1	2	-	2	-	-	2	3
CO3	3	3	1	2	-	2	-	-	2	3
CO4	3	3	1	2	-	2	-	-	2	3
CO5	3	3	1	2	-	2	-	-	2	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: **B.Tech.** **Semester: I Sem**

Name of the Course: **Basic Electrical & Electronics Engineering**
Course Code: SOE-B-FY106
Credits: 3 **No of Hours :03/week** **Max Marks: 100**

Course Description:
The subject curriculum focuses on fundamentals of electrical and electronic circuits. It covers the DC and AC electrical circuit analysis, magnetic circuit analysis and description of basic electronics components and their applications.

Course Outcomes:
On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Understand the basic concepts of Core Electrical Engineering subjects.
CO2	Analyse different network theorems.
CO3	Draw phasor diagram for various electrical circuits.
CO4	Understand the fundamental of semiconductor devices.
CO5	Know the different application of transistors.

Syllabus:

UNIT-1: DC Electrical Circuit Analysis:
Voltage and current sources, dependent and independent sources, Source Conversion, Star-delta and delta-star conversions, Ohm's Law, Kirchhoff's Laws & their limitations, Nodal analysis, loop analysis and Mesh current methods, Superposition principle, Thevenin's and Norton's theorems, Maximum power transfer theorem.

UNIT-2: AC Circuits:
Single- phase AC Circuits: Single phase emf generation, average and effective values of sinusoids, R.M.S. value, form factor and peak factor of AC quantity, Concept of phasor diagram, Concept of Power factor, impedance and admittance, Active, reactive and apparent power, analysis of R-L, R-C, R-L-C series, parallel and series-parallel circuit and Resonance condition.

UNIT-3: Magnetic Circuits:
Basic definitions, magnetization characteristics of Ferro magnetic materials, self-inductance and mutual inductance, energy in linear magnetic systems, coils connected in series, AC excitation in magnetic circuits, magnetic field produced by current carrying conductor, Force on a current carrying conductor. Induced voltage, fundamental laws of electromagnetic Induction, direction of induced E.M.F.

UNIT-4: Semiconductor Diodes:
Introduction to semiconductor, Formation of P-N Junction, P-N Junction Diodes; Semiconductor Diodes, V-I Characteristics, Effect of Temperature on V-I Characteristics, Ideal Diode, Diode equation, Diode Resistance, Transition and Diffusion Capacitance. Light Emitting Diode, Zener Diode, Photodiode. Applications of Diodes.

UNIT-5: Transistors:
Transistor: Introduction, Construction, Types: npn and pnp, Current components. Transistor as amplifier, Transistor Characteristics.
Digital logic fundamentals, Boolean Algebra, truth table, Logic Gates.

Text Books:

1. E. Hughes, Electrical Technology, ELBS, 1997.
2. B L Theraja, Electrical technology, Basic Electrical Engineering, Volume 1, S Chand.
3. Integrated Electronics: Analog & Digital Circuit Systems – Jacob Millman & Halkias, TMH.
4. Electronic Devices and Circuit Theory – Boylestad & Nashelsky

Reference Books:

1. Charles & Sadiku, Fundamentals of Electric circuits, TMH, Third Edition.
2. V. D. Toro, Basic Electrical Engineering, PHI, 2000.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	2	-	-	2	-	-	3	1
CO2	3	3	2	-	-	-	-	-	2	3
CO3	3	3	3	-	-	-	-	-	2	3
CO4	3	3	3	-	-	-	-	-	3	1
CO5	3	3	3	-	-	2	-	-	2	2

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech.** **Semester: I Sem**

Name of the Course: **Basic Electrical & Electronics Engineering Lab**

Course Code: SOE-B-FY107

Credits: 1 **No of Hours :01/week** **Max Marks: 50**

Course Description:

The response of Electrical Circuit can be verified practically by applying different theorems and fundamental techniques. The students will become sure that the theoretical tricks which they have learned from books are true. The students will become competent in the field of circuit analysis.

Course Outcomes:

On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Get the basic knowledge about the Electric circuits.
CO2	Understand the basic construction of transistors.
CO3	Get the knowledge about various measuring instruments.
CO4	Know about the components of electronic circuits

Syllabus:

List of Experiments:

1. Study of Electrical Safety precautions.
2. Study of CRO, DSO, Function Generator, Multimeter, Power supply.
3. To verify KCL and KVL.
4. To verify Thevenin's and Norton's Theorem.
5. To verify Superposition Theorem.
6. Determine resonant frequency of series R-L-C circuit.
7. To measure Current, Power, Voltage and Power Factor of series R-L-C Circuit.
8. To measure the armature and field resistance using Ohm's law.
9. Determine the VI Characteristics of PN junction Diode
10. Design and study the characteristics of Common Emitter configuration of NPN transistor

11. Design and Study the characteristics of Common Collector Configuration of NPN transistor
12. Study Different logic gates and verify their truth table.

Reference Books & Manuals:

1. Basic Practical in Electrical Engineering: P. S. Dhogal (Author), Standard Publishers Distributors (2004).

Equipment's/Machine/Software required:

Different types of meters, resistors, DC supply, variac, transformers, rheostat. Some experiments can be done by MATLAB.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	2	-	-	2	-	-	2	2
CO2	3	3	2	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	2	2
CO4	3	3	3	-	-	-	-	-	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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Engineering Chemistry Lab** **Course Code: SOE-B-FY108**
Credits: 1 **No of Hours :01/week** **Max Marks: 50**

Course Description:
This Engineering Chemistry Laboratory is common to first year branches of UG Engineering. The course enables students to

- Apply and use knowledge, methods and techniques for analysis
- Develop an ability to analyze, evaluate and synthesize scientific information
- Develop experimental and investigative scientific skills

Course Outcomes (CO): Students will be able to

CO Number	Course Outcome
CO1	Understand the use of instruments, sensors and methods for analyzing various parameters
CO2	Collect, process and analyze data using ICT tools

List of Experiments

1. Determination of type and extent of Alkalinity in the given sample of water using hydrochloric acid solution (acid-base titration)
2. Determination of chloride ion content in a given water sample by Mohr's method ($AgNO_3$, Cl- titration)
3. Determination of the Dissolved Oxygen in a given water sample by Wrinkler's method using Std. Sodium thiosuphate solution (iodometric titration)
4. Determination of temporary & permanent hardness in water sample by EDTA method (complexometric titration)
5. Determination of order and rate law expression of acid decomposition of thiosulfate ion solution (kinetics study)
6. Determination of the concentration of unknown solution of an electrolyte by conductivity measurement (using data loggers with conductivity probe and drop counters)
7. Determination of equivalence point and concentration of acid by pH measurement (using data loggers with pH probe and drop counters)
8. Demonstration of different types of Corrosion of metals
9. Kinetics ICT Exercise: Determination of order and rate constant of reaction using a spreadsheet and graphical techniques

10. Acid & Base ICT Exercise: Determination of equivalence point and concentration of acid (or base) using spreadsheet and graphical techniques.

Text Books:

1. Laboratory manual on Engineering Chemistry by Dr. Sudha Rani (S. Chand and Company).
2. A Textbook on Experiments and Calculations in Engineering Chemistry by S.S. Dara (Dhanapat Rai Publishing Company Pvt. Ltd.).
3. Experimental in General Chemistry; C.N.R. Rao & U. C. Agrawal,. East–West Press.

Reference Books:

1. Advance Practical Chemistry, by ILPC, Wilkinson G., Murrillo, C.A. and Bochmann, Wiley.
2. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
3. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
4. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.Text Book of Chemical Science by F.W. Billmeyer, John Wiley & sons, 1994.
5. Vogel's Texbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney.
6. Applied Chemistry: Theory and Practice (Latest ed.), by O.P. Vermani and A. K. Narula.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	1	1	1						1	
CO2	2	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: **B.Tech.** **Semester: I Sem**
Name of the Course: **Spoken English Communication** **Course Code: SOE-B-FY109**
Credits: 2 **No of Hours :02/week** **Max Marks: 50**

Course Description

This course examines the process of spoken communication in English language with an emphasis to develop fluency in it. Through individual and group activities, students work on improving pronunciation, practice conversation strategies and delivering oral presentation.

Course Outcome

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Reduce anxiety by recognizing and using communication strategies.
CO2	Apply principles of effective and ethical speaking during conversation at the various situations.
CO3	Formulate the speech according to the purpose, audience and time constraints
CO4	To recognize and use effectively non-verbal clues in communication
CO5	Give effective presentation.

Syllabus

Unit 1: Basics of Communication

Introduction to Communication, Types of Communication, Barriers to Communication, Listening Skill.

Unit 2: Grammar in Use

Sentence Structures, Determiners and Preposition, Modals in Conversational Usage, , Voice, Punctuation.

Unit 3: Oral Communication

Speaking: An Overview, Combating Stage Fright, Describing Objects/Situations/People, Delivering Just-a-minute Sessions, Dialog delivery, one to one conversation

Unit 4: Body Language

Body Language - the role of body postures, movements, gestures, facial expressions, dress and make up in effective communication, Conduct while facing interviews,

Unit 5: Professional Presentation

Presentation, Power point Presentation, Group Discussion, Role Plays, Delivering Different Types of Speeches.

Texts Books:

1. A Communicative Grammar of English by Geoffrey N. Leech and Jan Svartvik, Longman
2. Technical Communication for Engineers by Shalini Verma, Vikas Publishing House.
3. A Practical Course in Spoken English by Gangal J.K, Prentice Hall India Learning Private Limited.

Reference Books:

1. English for Technical Communication (With CD) by Aysha Viswamohan, McGraw Hill Education.
2. Comprehensive English Grammar by Madan Sood, Goodwill Publishing House.
3. Spoken English by Alison Reid, Goodwill Publishing House.
4. All about Words: An Adult Approach to Vocabulary Building by Nurnberg, M and M. Rosenblum, W.R. Goyal Publishers & Distributors.
5. High School English Grammar and Composition by WREN & MARTIN , S Chand Publication

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	-	-	-	2	1	1	1	-	-	1
CO2	-	-	-	3	1	2	-	-	-	-
CO3	-	-	-	3	2	-	2	-	-	1
CO4	-	-	-	3	1	-	1	-	-	-
CO5	-	-	-	3	1	1	1	-	-	2

Note: 1: Low 2: Moderate 3: High

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering

B. Tech in Mechanical Engineering (II- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
							PRE		ESE	Total Marks	
				L	T	P	Mid Sem	TA			
1	SOE-B-FY201	Maths	Mathematics- II	4	1	0	30	20	50	100	5
2	SOE-B-FY202	Physics	Physics- II	3	0	0	15	10	25	50	2
3	SOE-B-FY204	Civil	Basics of Civil Engineering	3	0	0	30	20	50	100	3
4	SOE-B-FY205	Mechanical	Engineering Mechanics	3	0	2	30	20	50	100	4
5	SOE-B-FY207	Chemistry	Environmental Studies	1	0	2	15	10	25	50	2
6	SOE-B-FY208	CSE	Introduction to Artificial Intelligence	2	0	2	30	20	50	100	3
7	SOE-B-FY203	Physics	Physics- II Lab	0	0	2	-	30	20	50	1
8	SOE-B-FY206	Mechanical	Workshop Practice	0	0	2	-	30	20	50	1
9	SOE-B-FY209	Humanities	Written English Communication	0	0	2	-	30	20	50	1
			TOTAL	**16**	**01**	**12**	**150**	**190**	**310**	**650**	**22**

L: Lecture T: Tutorial P: Practical ESE: End Semester Examination T.A: Teacher's Assessment.

PRE- Progressive Review Examination

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: II Sem**
Name of the Course: **Mathematics-II** **Course Code: SOE-B-FY201**
Credits: 5 **No of Hours :05/week** **Max Marks: 100**

Course Description:

Learning Objective 1. Evaluate first order differential equations including separable, homogeneous, exact, and linear. 2. Show existence and uniqueness of solutions. 3. Solve second order and higher order linear differential equations. 4. Create and analyze mathematical models using higher order differential equations to solve application problems such as harmonic oscillator and circuits. 5. Solve differential equations using variation of parameters 6. Solve linear systems of ordinary differential equations**.**

Course Outcomes:

On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Understand ordinary differential equation.
CO2	Understand applications in Engineering Problems
CO3	Understand higher order differential equation with constant coefficient.
CO4	Understand simultaneous linear equations with constant coefficients.
CO5	Understand Linear partial differential equation of first order.
CO6	Understand Non-homogeneous linear partial differential equations
CO7	Understand Euler's Formula, Functions having points of discontinuity Understand Fourier series, Linear and quasi linear equations
CO8	Understand Harmonic analysis.
CO9	Understand Method of separation of variables; Solution of heat equation;
CO10	Understand Wave equation; Laplace equation & Poisson's equation

Syllabus:

Unit 1: Ordinary Differential Equation of First order

Review of ordinary differential equation of first order; non linear differential equation of first order and their applications to engineering problems (viz. Simple electrical circuits, Heat conduction problem, Rate of decay of radio-active material, Chemical reactions and solutions, etc.).

Unit 2: Differential Equation of Higher order

Linear differential equations of higher order with constant coefficients; Method of variation of parameters; Cauchy's & Legendre's linear equations; simultaneous linear equations with constant coefficients; Applications to engineering problems.

Unit 3: Partial Differential Equation

Formation of partial differential equation; Linear partial differential equation of first order; Standard forms; Charpit's method; Homogeneous linear partial differential equations with constant coefficients; Non-homogeneous linear partial differential equations.

Unit 4: Fourier series

Euler's Formula; Functions having points of discontinuity; Change of interval; Even and odd functions; Half range series; Harmonic analysis.

Unit 5: Application of Partial Differential Equation

Method of separation of variables; Solution of heat equation; Wave equation; Laplace equation & Poisson's equation

Text Books

1. Advanced Engineering. Mathematics by Erwin Kreyszig (8th edition) – John Wiley & Sons.
2. Higher Engineering. Mathematics by B. S. Grewal (38th edition)-Khanna Publishers.
3. Higher Engineering Mathematics by B. V. Rammana-Tata Mc Graw Hill.
4. Advance Engineering Mathematics by R. R. Greenberg- Pearson Publication.
5. Ordinary and Partial Differential Equations by MD Rai Singhania-S. Chand & Sons.

Reference Books

1. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
2. Maurice D. Weir, Joel Hass, Frank R. Giordano, Thomas, Calculus, Eleventh Edition, Pearson.
3. D. Poole, Linear Algebra : A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4. Veerarajan T., Engineering Mathematics for first year, Tata Mc Graw-Hill, New Delhi, 2008.
5. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	1	-	2	1	-	1	1	1	-
CO2	1	-	-	-	-	1	-	1	1	-
CO3	1	-	1	-	1	-	1	-	-	1
CO4	2	-	-	-	2	-	-	-	-	-
CO5	2	2	2	2	-	-	1	1	1	-
CO6	1	-	-	-	2	1	-	-	-	1
CO7	2	1			-	-	-	1	-	-
CO8	1	-	1	-	-	1	2	-	1	-
CO9	2	-	-	1	1	-	-	1	-	-
CO10	1	-	1	-	1	-	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Physics-II** **Course Code: SOE-B-FY202**
Credits: 2 **No of Hours :02/week** **Max Marks: 100**

Course Description:

Applied Physics is a science course for students interested in the technical fields. This course is designed for the student who needs a broad understanding of physics and the ability to apply those principles in the work force. The Physics-II course is basically fundamentals of X-rays, its characteristics, its production method and uses, basics of nuclear energy and nuclear reactor, concepts of relativity its applications, formulation and solving the engineering problems on electromagnetism, Introduction to quantum physics and application in 1D and Various interpretations about the origin of Universe. The purpose of studying Physics-II is to develop the basic knowledge on the development and time-to-time applications of physics in diverse field.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Acquire knowledge Atomic and Nuclear physics and explore their technological applications in diverse fields.
CO2	Acquire knowledge of basic principles of Relativity and able to differentiate between classical and quantum mechanics.
CO3	Knowledge of propagation of electromagnetic energy through transmission lines and the design of propagation medium based on the requirements.
CO4	Gain basic knowledge of quantum mechanics and origin of Universe.

Syllabus:

Unit I.

Atomic & Nuclear Physics: X-rays, Properties of X-rays, Bragg's law, Bragg's X-ray spectrometer, Characteristic X-ray spectrum, Moseley's law, Daune-Haun't criteria. Nuclei: properties, Mass defect, Binding energy, Criteria of Critical mass, Nuclear cross section, Nuclear fission: Controlled and uncontrolled chain reaction, Nuclear reactor and its site selection, Nuclear fusion, stellar energy (C-N cycle and P-P cycle).

Unit II.

The theory of relativity Frame of reference, Galileo's Transformations, Michelson-Morley experiment and its negative result, Einstein's theory of relativity (postulates), Lorentz Transformation, Time dilation, Length contraction, Twin's Paradox, Doppler's

effect, Addition of Velocities, Relativistic mass- Variation of Mass with Velocity, Equivalence of mass and energy.

Unit III.

Electromagnetism: Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focusing, Gauss law, continuity equation, in consistency in Ampere's Law, Maxwell's equations (differential and integral forms), propagation of plane electromagnetic waves in conducting and non-conducting medium. Gradient, divergence, and curl of scalar and vector fields, Formulation and solving the engineering problems on electromagnetism.

Unit IV.

Quantum mechanics: Introduction to quantum physics, black body radiation, photon concept, de Broglie hypothesis, wave-particle duality, verification of matter waves, wave function and its properties, Phase & group velocity, Uncertainty principle, Schrodinger's equation and its application to particle in 1-D box.

Unit V.

Origin of Universe: Various interpretations about the origin, Big Bang Theory, Large Hadron Collider (LHC) experiment, Hawkins theory about the universe.

Texts/ References:

1. Beiser, Perspectives in Modern Physics, McGraw Hill, 1969.
2. M.A. Preston and R.K. Bhaduri, Structure of the nucleus, Addison- Wesley, 1975.
3. M.K. Pal, Theory of Nuclear Structure, Affiliated East West Press, 1982.
4. S. H. Patil, Elements of Modern Physics, Tata McGraw Hill, 1989.
5. A.K. Ghatak and S. Loknathan, Quantum Mechanics, Theory and Applications, McMillan India, 1984.
6. Michael Sayer & Abhai Mansingh, "Measurement, Instrumentation and experiment design in physics and engineering", Prentice Hall of India Pvt. Ltd., New Delhi – 110 001, 2003.
7. P. Sivaramakrishna Das and C. Vijayakumari, Engineering Mathematics, 1st Edition, Pearson India Education Services Pvt. Ltd.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	2	2	3	2	1	2	1	2
CO2	3	2	2	2	2	2	1	2	2	2
CO3	3	2	2	2	2	1	1	2	3	3
CO4	3	2	2	2	2	1	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Basics of Civil Engineering** **Course Code: SOE-B-FY204**
Credits: 3 **No of Hours :03/week** **Max Marks: 100**

Course Description:

Civil Engineering as a profession; General introduction to history of civil engineering; types and classification of buildings; setting out of buildings; building materials- various types of bricks, various types of cements, natural and fly ash aggregates, cement mortar and concrete, TMT and structural steel; Overview of foundation engineering; Introduction to traffic and transportation engineering; Case studies of some advance technologies in civil engineering.

Course Objectives:

1. To provide the students an overview of profession of civil engineering.
2. To give the students an illustration of the use and properties of various civil engineering materials, foundations, traffic and plans of civil engineering structures.
3. To appraise the students with latest technologies in civil engineering.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Explain the importance of civil engineering in the infrastructural development of the society.
CO2	Illustrate the types, uses and properties of various civil engineering materials, foundations, traffic and plans of civil engineering structures.
CO3	Understand the latest technologies in the construction of different civil engineering structures.

Syllabus:

Unit- I: Civil Engineering Materials

Masonry Materials: Types and characteristics of burnt clay and fly ash bricks, AAC blocks, paver blocks; various bonds in masonry.

Cement: Raw materials, Initial and final setting times, types and manufacturing process of cements.

Aggregate: Coarse and fine aggregates and their characteristics.

Steel: Difference among cast-iron, wrought iron, steel, mild steel, tor-steel and 550D grade of steel.

Mortar and Concrete: Proportions of cement mortar and concrete and their characteristics, self-healing concrete.

Activity: Industrial visit to any one of following (student will submit visit report)

1. Brick manufacturing plant
2. Cement manufacturing plant
3. Steel rolling mill.

Unit-II: Building Plans:

Components of residential, industrial, commercial and public buildings. Concepts of smart buildings and smart city.

Activity: Study of architectural principles of any one in following (student will submit a report)

1. Central jail building
2. Church
3. Auditorium
4. Industrial building
5. Power station
6. Software technology park
7. Naya Raipur development authority, smart city

Unit- III

Basic concepts of transportation and traffic engineering, signage and signals. Kinetic roadway and walk ways, automation in tunnelling and bridge construction.

Activity: Case study any one of following (student will submit a report)

1. Warli Bandra sea link
2. Britain France chunnel
3. Pumbam bridge

Unit-IV: Civil Engineering Foundations

Various types of foundations for high rise building, bridges, dams, roads.

Activity: Case study of any one of following (student will submit a report)

1. Burj Khalifa,
2. Petronas towers
3. Statue of unity
4. Swaminarayan temple of the Bochasanwasi in Dubai
5. Flipkart headquarters at Bangalore

Unit-V: Advance Technologies in Civil Engineering

Modular construction, cloud collaboration, supply chain management in civil engineering. Introduction to software in civil engineering, photovoltaic glassing,

augmented and virtual reality in civil engineering. Overview of total station and application of drones in civil engineering.

Activity: Any one case study in (student will submit a report)

1. Cloud collaboration in civil engineering,
2. Supply chain management in civil engineering,
3. Software application in civil engineering
4. Application of drones in civil engineering

Text Books:

1. Chen,W.F. and Liew, J.Y.R., The Civil Engineering Handbook, 2nd Ed., CRC Press, Taylors and Francis, (2002).
2. Kandya A.A., Elements of Civil Engineering, Charotar Publishing House, (2015).

Reference Books:

1. Gopi, S., Basic Civil Engineering, 1st Ed., Pearson Publishers, (2009).
2. Ahuja, T.D. and Birdi, G.S., Civil Engineering (Building Construction), 8th Ed., Rajsons Publications Pvt. Ltd., (2018).
3. Relevant BIS codes and CPWD Manuals.

Assessment:

Assessment will be on the basis of Attendance, Class Work, Tutorials, Assignments, Quizzes, Activities and Exams.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	-	2	-	-	1	-	1	-	-
CO2	3	-	-	-	-	1	-	-	-	-
CO3	3	3	2	-	-	1	-	1	1	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Engineering Mechanics** **Course Code: SOE-B-FY205**
Credits: 4 **No of Hours :04/week** **Max Marks: 100**

Course Description:
This course helps in understanding the various types and system of forces. Resolution and addition of forces. It helps the way to apply the condition of equilibrium in various forces system. It also helps in understanding the friction, centroid, and center of gravity etc. At last, it helps in understanding the concept of kinetics of rigid body and energy principle.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand various force system and apply various concepts to solve problems related with force.
CO2	Understand the different structures like Frame, Trusses, and structures.
CO3	Understand the role of friction and its industrial applications.
CO4	Understand and apply the concept of kinetics and energy principles.

Syllabus:

UNIT-1:
Definitions of mechanics, statics, dynamics, characteristics of a force, principle of transmissibility, Composition and resolution of forces, moment of forces.
System of Coplanar forces: Introduction to coplanar & non-coplanar force system.
Forces and their components. Moment of the force about a point, couple.
Resultant of coplanar force system: Resultant of concurrent forces, parallel forces, non-concurrent non-parallel system of forces. Varignon's theorem.

UNIT-II: Equilibrium of coplanar force system:
Meaning of equilibrium, free body diagrams, equilibrium of concurrent, parallel and non-concurrent non-parallel (general) system of forces. Types of supports, determination of reactions at supports for various types of determinate beams.
Analysis of pin jointed frame/truss: Perfect truss, Imperfect truss, Analysis of truss by method of joints and method of sections.

UNIT-III: Friction

Definition of friction, force of friction, Limiting frictional force, coefficient of friction, angle of friction, angle of repose, relation between angle of friction and coefficient of friction. Cone of friction, types of friction, laws of friction, advantages and disadvantages of friction. Equilibrium of bodies on level plane, external force applied on horizontal and inclined up and down. Equilibrium of bodies on inclined plane external forces is applied parallel to the plane, horizontal and inclined to inclined plane.

UNIT-IV: Centroid:

Definition, centroid of basic geometrical figures such as square, rectangle, triangle, circle, semicircle and quarter circle. Centroid of composite figure.

Centre of Gravity: CG of simple solids such as cylinder, sphere, hemisphere. Cone, cube, and rectangular block. Centre of gravity of composite solids.

Moment of inertia: of plane areas, parallel axis theorem. Introduction to polar moment of inertia, product of inertia and mass moment of inertia. Problems on moment of inertia of composite areas.

UNIT-V: Kinetics of particles:

Newton's laws of motion, D' Alembert's principle, equation of dynamic equilibrium linear motion, curvilinear motion. Kinetics of rigid bodies, D' Alembert's principle for bodies under rotational motion about a fixed axis.

Energy principles: Work done by a force, potential and kinetic energy, power, work energy equation, principle of conservation of energy.

Text Books:

1. B.C. Punmia-Theory of structures, Laxmi Publication.
2. Engineering Mechanics (Statics and Dynamics) by A.K. Tayal, Umesh Pub.,
3. Engineering Mechanics by K.L. Kumar, Tata McGraw Hill.

Reference Books

1. Engineering Mechanics (Statics and Dynamics): R.C. Hibbeler, Pearson
2. Engineering Mechanics: Meriam and Kreige, John Wiley and sons
3. Therodynamics: Cengel and Boles, TMH
4. Essential of Engg. Mechanics: S. Rajasekharan and G. Shankara Subramaniyam, Vikas Publications
5. Engineering Mechanics by Beer & Johnson, Tata McGraw Hill
6. Engineering Mechanics by F.L. Harper & Raw Publication.
7. Engineering Mechanics by Shames, Prentice Hall, India.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	1	2	-	2	-	1	2	2
CO2	3	2	1	2	-	2	-	1	2	2
CO3	3	2	1	2	-	2	-	1	2	2
CO4	3	2	1	2	-	2	-	1	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Workshop Practice** **Course Code: SOE-B-FY206**
Credits: 2 **No of Hours :02/week** **vv Max Marks: 50**

Course Description:
To familiarize with the basic manufacturing processes and to study the various tools and equipment used, hands-on training is given in different machine tools and instruments and use them to prepare joints of specific shape and size.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Graduates will gain a strong foundation in machine tool engineering.
CO2	Acquire knowledge and hands-on competence in applying the concepts of manufacturing science in the development of mechanical systems.
CO3	Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
CO4	Work effectively with engineering and science teams as well as with multidisciplinary designs.
CO5	Skillfully use modern engineering tools and techniques for mechanical engineering design, analysis and application.

Syllabus:

S.N	Content
1	**CARPENTRY SHOP** 1. Introduction. 2. Various types of woods. 3. Different types of tools, machines and accessories. 4. Demonstration of different wood working tools / machines. 5. Demonstration of different wood working processes, like planning, marking, chiseling, grooving, turning of wood etc. 6. One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.
2	**WELDING SHOP** 1. Introduction 2. Types of welding, ARC welding, Gas welding, Gas Cutting. 3. Welding of dissimilar materials, Selection of welding rod material Size of welding rod and work piece.

	4. Different types of flame. 5. Elementary symbolic representation, 6. Safety precautions in welding safety equipment's and its use in welding processes. 7. Demonstration of different welding tools / machines. 8. Demonstration on Arc Welding, Gas Welding, gas cutting and rebuilding of broken parts with welding. 9. One simple job involving butt and lap joint
3	**MACHINE SHOP** 1. Introduction about various machine tools 2. Principal parts of a lathe 3. Measuring instruments 4. Cutting parameters 5. Tool materials 6. Lathe operations 7. Safety precautions 8. One simple job involving lathe operations.

Text Books:

1. Manufacturing Technology (Vol. – I & II) – P.N. Rao – Tata McGraw Hill Pub. Company, New Delhi.
2. A Text Book of Production Technology (Manufacturing Processes) – P.C. Sharma – S. Chand and Company Ltd., New Delhi.
3. Machine Tool Engineering – G.R. Nagpal – Khanna Publishers, New Delhi.
4. A course in workshop Technology (Vol- I & II) – B.S. Raghuvanshi – Dhanpat Rai & Sons, New Delhi.

References Books:

1. Kent's Mechanical Engineering Hand book, John Wiley and Sons, New York.
2. Workshop Technology by H.S. Bawa, Tata McGraw Hill Publishers.
3. Workshop Technology by S.K. Hajara Chaudhary, Media Promotors and Publishers.
4. Chapman, W.A.J. and Arnold E., "Workshop Technology" Vol. I & III, Viva Low price student Edition, 1998.
5. Chaudhary, Hajra, "Elements of Workshop Technology" Media Promoters & Publishers, 1997.
6. Raghuwanshi, B.S., "Workshop Technology" Vol I 7 II, Dhanpat Rai and Sons 1998.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	-	2	3	-	1	1	-	3	-
CO2	3	2	2	2	2	1	2	2	2	2
CO3	3	2	-	2	2	1	-	2	2	3
CO4	2	3	2	2	3	2	-	3	2	2
CO5	2	3	1	-	-	1	-	2	2	3

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: II Sem**
Name of the Course: **Environmental Studies** **Course Code: SOE-B-FY207**
Credits: 2 **No of Hours :02/week** **Max Marks: 50**

Course Objectives:

The course will empower the undergraduate students by helping them to Gain in-depth knowledge on natural processes and resources that sustain life. Understand the consequences of human actions on the web of life and quality of human life. Develop critical thinking for shaping strategies for environmental protection, conservation of biodiversity, environmental equity, and sustainable development. Acquire values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones. Adopt sustainability as a practice in life, society, and industry.

Course Outcomes (CO): Students will be able to

CO Number	Course Outcomes
CO1	Gain in-depth knowledge on natural processes and resources that sustain life.
CO2	Understand the consequences of human actions on the web of life and quality of human life.
CO3	Develop critical thinking for shaping strategies for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
CO4	Acquire values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
CO5	Adopt sustainability as a practice in life, society, and industry.

Syllabus

Unit I: Ecology and Bio-Diversity

Ecology, Environment & Ecosystem, Biotic & Abiotic Components; Structure & functions of Ecosystem, Productivity, Decomposition, Energy Flow, Nutrient cycling, Food Chain & Food Web, Ecological Pyramids; Ecological succession; Bio-diversity: Concept, Importance, and Threats & Conservation

Unit II: Environment and Natural Resources

Earth's Environment: Atmosphere, Lithosphere, Hydrosphere & Biosphere, functions and related problems; Environmental degradation and its causes; Natural resources, Renewable and Non-renewable Resources & associated problems; Study of major Resources on Earth (overview): Forest, Water, Mineral, Food, Energy and Land.

Unit III: Air Pollution

Classification of air pollutants, sources and effects of CO, SOx, NOx, Hydrocarbons, PM, Acid Rain, Ozone, Photochemical Smog & Peroxy Actyl Nitrate (PAN). Earth's energy balance, Green House Effect, Global warming; Stratospheric Ozone & its Depletion; Lapse rate & Temperature Inversion; Ambient Air Quality standard; Air pollution Control Techniques for Gaseous and Particulate air pollutants & equipment used.

Unit IV: Water Pollution & Soil Pollution

Point & non-point source; Water pollutants & types, sources and effects; Water Quality measurement, Dissolved Oxygen, BOD & COD; Wastewater Management, Primary, Secondary & Tertiary stages: Objective, Process overview and Equipment used.
Soil formation, composition & profile; Sources of Soil pollution & effect; Solid Waste Management: Objective, Process & Disposal Techniques.

Unit V: Sustainability & Social issues and Environment

Concept of Sustainable Development (SD), models, indicators and principles of Sustainability. Water conservation- Rain water harvesting, Watershed management. Population Growth, variation among nations, Population explosion, Family Welfare Programme; Environment and human health

Text Books:

1. Kurian Joseph & R. Nagendran, "Essentials of Environmental Studies", 1st Edition, Pearson Education, 2004.
2. A. K. Dey "Environmental Chemistry" New Age International Publishers.
3. Smriti Srivastava. "Environment & Ecology" S.K. Kataria & Sons, New Delhi.

References Books:

1. Keerthinarayana & Daniel Yesudian, "Environmental Science and Engineering", 1st Edition, Hi-Tech publications, 2004.
2. Erach Bharucha, "A Text Book for Environmental Studies", Text Book of University Grants Commission, 2004.
3. Peavy, H.S., D.R. Rowe & T. George, "Environmental Engineering", New York: Mc Graw Hill, 1987.
4. Metcalf & Eddy, "Wastewater Engineering: Treatment and Reuse", New Delhi, Tata McGraw Hill, 2003.
5. Principles of Environmental Science Inquiry & Applications by W.P. Cunningham & Mary Ann Cunningham (Tata Mc Graw Hill Publishing Company Ltd.).

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	1	-	-	-	-	-	1	-	1	1
CO2	-	-	-	-	-	-	1	1	1	2
CO3	1	-	1	-	-	1	-	1	2	2
CO4	-	-	-	1	-	-	-	1	1	1
CO5	-	-	1	-	-	1	-	1	1	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: II Sem**
Name of the Course: **Physics-II Lab** **Course Code: SOE-B-FY203**
Credits: 1 **No of Hours :01/week** **Max Marks: 100**

Course Description:
This course deals with practical knowledge of basic physics including mechanics, optics and electronics.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Gain practical knowledge of mechanics
CO2	Acquire hands-on experience of optics experiments using laser.
CO3	Gain knowledge of measuring moment of inertia of fly wheel, acceleration due to gravity, frequency of AC signal, and viscosity of different liquids.
CO4	Gain knowledge of solar cell

Syllabus:

At least ten experiments are to be performed by each student from the following list.

1. Determination of wavelength of given light by Newton's ring method.
2. Determination of grating element of diffraction grating using He-Ne laser source.
3. Determination of NA (Numerical Aperture) of an optical fiber.
4. Determination of e/m by Thomson method.
5. Determination of AC frequency using Sonometer.
6. Determination of energy gap of semiconductor diode.
7. To study solar cell characteristics.
8. To study the characteristics of PN junction diode.
9. To determine the divergence of laser beam.
10. To study the Hall effect.
11. To study the transistor characteristics in CE mode.
12. Determination of wavelength of He-Ne laser using diffraction grating.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	2	2	3	2	1	2	1	2
CO2	2	2	2	1	2	2	1	3	2	2
CO3	2	2	2	1	2	1	1	2	3	3
CO4	3	2	2	1	2	1	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Introduction to Artificial Intelligence**
Course Code: SOE-B-FY208
Credits: 3 **No of Hours :03/week** **Max Marks: 100**

Course Description:
In this course, students will study the most fundamental knowledge for understanding AI. The course will introduce some basic search algorithms for problem solving, Computing methods like Hard computing & soft computing, various soft computing approaches for learning through neural network. Hands-on with Python programming will enable students to develop AI applications.

Course Outcomes:
On successful completion of this course, students will be able to:

CO Number	Course Outcome
CO1	Understand the basics of Artificial Intelligence.
CO2	Understand overview of problem solving through search methods.
CO3	Understand the difference between Hard and Soft computing approaches.
CO4	Understand basic Neural network structure and activation functions.
CO5	Implement the AI concepts using Python programming.

Syllabus:

Unit-I Overview and search techniques
Introduction to AI, AI Definition, Philosophy of AI, Related Fields: Robotics, Machine Learning, Data Science, Deep Learning, Applications: Self Driving Cars, Content Recommendation System, Video/Image processing.AI problem Solving and Games, A* Search.

Unit- 2 Machine Learning and Knowledge representation Odds and Probability:
Why probability matters, Various examples like card playing, Dice, Uncertainty in real life like train ticket confirmation. How to deal with uncertainty, Odds and Expected outcomes, Bayes Rule, Prior and Posterior odds: Basic Principles. Application areas of Bayes classification. Knowledge representation in AI, Types of Knowledge in AI

Unit-III: Advanced Topics in Machine Learning Data Preparation:

Validation, Dimensionality, Missing, Values, Dimensionality, Encoding, Basics of confusion matrix Classification in Machine Learning, MNIST Data set identification, Supervised, Unsupervised and Reinforced Learning.

Unit–IV Introduction to Artificial Neural Network Neural Network Basics

Elements of Neural Network, Why Develop Artificial Neural Networks: Modelling Key features, How Neural networks are Built: Weights and Input, Activation and Output: Identity Function, Step function, Sigmoid Function. Perceptron, Neural Network, Neural Network classifier. Advanced Neural network techniques: Convolutional Neural Network, Generative adversarial networks (GANs), Deep Learning: It's application on data processing.

Unit–V Application and Case Studies in AI Case study:

Auto Driving Cars, Smart Home and IoT Applications, Robotics, Mine Detections, Medical Diagnosis, Applications in multiple domains. Smart City, Implications of AI, Predicting the Future and Social Implications

Textbooks

1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Prentice Hall of India.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and applications by S. Rajashekran and G.A. Vijayalakshmi, Prentice Hall of India.
3. Python Programming Fundamentals by Nischay Kumar Hegde, Educreation Publishing.
4. A Textbook of Discrete Mathematics by Swapan Kumar Sarkar, S. Chand Publishing.
5. Discrete Mathematics and its Applications by Kenneth H. Rosen, McGraw-Hill Publication.

Reference Books

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.
2. Principles of Artificial Intelligence by Nils J. Nilsson, Narosa Publishing house.
3. Introduction to Artificial Neural Network by Jacek M. Zurada, West Publishing Company.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	3	-	2	1	2	-
CO2	1	-	-	2	-	-	-	2	2	2
CO3	3	-	-	1	-	2	-	-	2	2
CO4	-	1	2	-	3	-	-	-	2	-
CO5	3	-	1	2	-	-	-	3	2	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: **B.Tech.** **Semester: II Sem**
Name of the Course: **Written English Communication**
Course Code: SOE-B-FY209
Credits: 2 **No of Hours :02/week** **Max Marks: 50**

Course Description

The purpose of the course is to acquire accuracy and clarity in written communication. It helps to develop written text of varying lengths and styles that communicate effectively accurately and appropriately across various situations**.**

Course Outcome:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Communicate by writing clearly and precisely without errors
CO2	Draft various business correspondence in correct styles and format
CO3	To prepare various forms of the report
CO4	Know the principles of effective written communication
CO5	Develop advance corporate writing skills

Syllabus

UNIT 1: Basics of Writing

An introduction to writing: Definition, Characteristics of effective writing, Principles of writings(7C's), Modes of Writing: Narrative, Descriptive, Argumentative, Expository.

UNIT 2: Grammar in Use

Sentence structure, Subject-Verb concord, Tenses, Voice, Narration, Identifying common errors in writings, Précis writings, Paragraph writings.

UNIT 3: Letter Writing

Types of letters, Elements of letters, Styles of letter writing, Basics of official correspondence, Preparation of Resume and Job application, Quotation, Order, Complaint letter.

UNIT 4: Report Writing

Characteristics of good report, Elements of report, Preparation and writings of report, Use of illustrations in reports, Preparation of Bibliography and References.

UNIT 5: Corporate Writing

Notice, Agenda and Minutes Writing techniques, Tenders, Advertising, Sales Letter

Texts Books:

1. A Communicative Grammar of English by Geoffrey N. Leech and Jan Svartvik, Longman
2. Effective Technical Communication- M.Ashraf Rizvi Tata McGraw Hill Company limited New Delhi.
3. Developing Communication Skills- Krishna Mohan and Meera Banerjee, Mc Millan India Ltd, New Delhi.

Reference Books:

1. Introduction to Communication studies- John Fisk, Rotledge London
2. Writing Technical Papers- D.H.Menzel, H.M.Jonest. Mc GrawHill . New Delhi.
3. A Remedial English Grammar for Foreign Students- F.T. Wood Mc Millan India Ltd.
4. Living English Structure- W. Stannard Allen, Orient Longman London Fourth edition.
5. Technical Communication for Engineers by Shalini Verma, Vikas Publishing House.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	1	-	-	2	1	1	1	-	1	1
CO2	-	-	-	3	2	1	1	-	-	-
CO3	1	-	1	2	2	1	-	-	-	-
CO4	-	-	-	2	1	-	-	-	-	1
CO5	-	-	-	3	2	2	2	-	-	-

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

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering

B. Tech in Mechanical Engineering (III- Semester)

S.N	Subject Code	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit
			L	T	P	PRE		ESE	Total Marks	
						Mid Sem	TA			
1	SOE-B-ME304	Advanced Engineering Mathematics	3	1	0	30	20	50	100	4
2	SOE-B-ME301	Thermo Fluids- I	4	0	0	30	20	50	100	4
3	SOE-B-ME302	Computer Aided Machine Drawing	3	0	0	30	20	50	100	3
4	SOE-B-ME303	Mechanics of Materials	4	0	0	30	20	50	100	4
5	SOE-B-ME304	Engineering Metallurgy	3	0	0	30	20	50	100	3
6	SOE-B-ME305	Plant Maintenance & Safety	2	0	0	15	10	25	50	2
7	SOE-B-CE305	Disaster Management	1	0	0	15	10	25	50	1
8	SOE-B-ME306	Thermo Fluids – I Lab	0	0	2	0	30	20	50	1
9	SOE-B-ME307	Computer Aided Machine Drawing Lab	0	0	4	0	30	20	50	2
10	SOE-B-ME308	Mechanics of Materials Lab	0	0	2	0	30	20	50	1
		TOTAL	**20**	**1**	**8**	**180**	**210**	**360**	**750**	**25**

L: Lecture T: Tutorial P: Practical ESE: End Semester Examination T.A: Teacher's Assessment.

PRE- Progressive Review Examination

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: III Sem**
Name of the Course: **Advanced Engineering Mathematics**
Course Code: SOE-B-MA304
Credits: 4 **No of Hours :04/week** **Max Marks: 100**

Course Description:
This course offers lecture to impart teaching and learning to develop problem solving approaches to Engineering problem using complex variable, Laplace Transform, Numerical Methods, Probability and basic statistics. This course covers fundamental concepts of complex variable, Laplace Transform, Numerical Methods, Probability and basic statistics

COURSE OUTCOMES:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Limits, continuity and differentiability of functions of complex variable.
CO2	Complex integration by Cauchy's theorem, Cauchy integral formula and residue theorem.
CO3	Transform of elementary functions, properties of Laplace transform, Transform of derivatives & integrals, Multiplication by t^n, Division by t, Inverse Laplace Transform, Convolution theorem, Unit step function and Unit impulse function
CO4	Application to solution of ordinary differential equations.
CO5	Roots of algebraic and transcendental equations by various methods.
CO6	Solution of Ordinary Differential Equation by various method.
CO7	Measures of central tendency, Measures of dispersion, Measures of skewness and Measures of kurtosis.
CO8	Basic probability theory, Axiom of probability, Some elementary theorems, Conditional probability and Bayes' theorem.
CO9	Discrete Random variables and Continuous Random variables. Expectation, Variance, Standard deviation and Moments.
CO10	Binomial, Poisson, Normal and exponential distributions.

Syllabus:

Unit I: Complex variable
Limits, continuity and differentiability of functions of complex variables; Cauchy-Riemann equations; Analytic functions; Harmonic functions; Application to fluid flow problems; Complex integration; Cauchy's theorem; Cauchy integral formula; Taylor and Laurent series; Singularities and their classifications; Residue and residue theorem; Real definite integrals about unit circle and semi-circle.

Unit II: Laplace Transform
Definition; Transform of elementary functions; Properties of Laplace transform; Transform of derivatives & integrals; Multiplication by t^n; Division by t; Inverse Laplace

Transform; Convolution theorem; Unit step function; Unit impulse function; Periodic function; Application to solution of ordinary differential equations.

Unit III: Numerical Methods

Errors; Roots of algebraic and transcendental equations: Bisection method; Regula-Falsi Method; Secant method; Newton-Raphson method; Single step methods: Picard's method; Taylor's series method; Euler's method; Euler's modified method; Multi step methods: Runge-Kutta Methods; Predictor-corrector methods, Milne Simpson's method; Adams-Bashforth Moulton method.

Unit IV: Basic Statistics and Probability

Descriptive measures: Measures of central tendency; Measures of dispersion; Measures of skewness and Measures of kurtosis; Theory of probability: Basic probability theory; Axiom of probability; Some elementary theorems; Conditional probability; Bayes' theorem.

Unit V: Random variables and Probability distribution

Discrete Random variables; Discrete probability Distribution; Discrete probability distribution function; Continuous Random variables; Continuous probability distribution; Continuous probability distribution function; Expectation; Variance; Standard deviation; Moments; Moments generating function; Coefficient of skewness and coefficient of kurtosis; Binomial, Poisson, Normal and exponential distributions.

Text Books:

1. B.S. Grewal-Higher Engineering Mathematics (38th edition)-Khanna Publishers.
2. N G Das-Statistical Methods, McGraw Hill
3. S C Gupta- Fundamentals of Statistics, Himalaya Publishing House
4. Dr. B.S. Grewal- Numerical Methods in Engineering and Science, Khanna Publishers.
5. S. S. Sastry-Numerical Methods, Prentice Hall Inc. India.

Reference Books:

1. Erwin Kreyszig -Advanced Engineering. Mathematics (8th edition) – John Wiley & Sons.
2. R.K. Jain & S.R.K. Iyengar- Advanced Engineering Mathematics– Narosa Publishing House.
3. M. K. Jain, S. R. K. Iyengar & R. K. Jain-Numerical Methods for Scientific and Engineering Computation-Wiley Eastern Limited
4. Irwin Miller Marylees Miller- John E. Freund's Mathematical Statistics with Applications Eighth Edition, PEARSON Publication
5. Richard L. Scheaffer, Madhuri S. Mulekar, James T. McClave- Probability and Statistics for Engineers, 5th Edition Brooks/Cole, Cengage Learning.
6. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, Elsevier Academic Press.

CO-PO & PSO Correlation

	Program Outcomes								PSOs	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	-	2	-	-	-	1	-	-	1	2
CO2	-	-	-	-	-	1	-	-	-	1
CO3	-	-	-	-	-	2	-	-	1	2
CO4	2	2	2	-	-	1	-	-	-	2
CO5	3	1	1	-	-	1	1	1	1	1
CO6	-	-	-	2	-	1	-	-	1	1
CO7	-	-	1	-	-	1	-	-	-	1
CO8	-	-	-	-	-	2	-	-	1	2
CO9	2	-	-	1	1	1	-	1	-	2
CO10	2	1	1	-		1	1	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: **B.Tech.** **Semester: III Sem**

Name of the Course: **Thermo Fluids – I** **Course Code: SOE-B-ME301**

Credits: 4 **No of Hours: 04/week** **Max Marks:100**

Course Description:

This course is the first part of a newly-designed two course sequence and is made by combining the two traditional thermal disciplines - thermodynamics and fluid mechanics. In thermodynamics learners will be introduced to the application of first and second law of thermodynamics in accessing the thermal performance of various systems, energy, entropy, and availability. In fluid mechanics learners will be introduced to the basic concepts of fluid mechanics including – fluid statics, kinematics, dynamics: various conservation laws, and boundary layer theory.

Course Outcomes:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Explain the basic concepts of thermodynamics, state and apply the first law of thermodynamics for various systems, and evaluate the feasibility of a thermodynamic process/cycle using the second law of thermodynamics.
CO2	Develop fundamental relations between commonly encountered thermodynamic properties and to use various equations of state and heat capacities to evaluate thermodynamic properties
CO3	Understand the basic fundamentals of fluid mechanics and solve problems of simple fluid-based systems including pressures and forces on submerged surfaces
CO4	Analyze the different types of fluid flow and determine the velocity and acceleration of a fluid particle at a given location in flow field
CO5	Implement Bernoulli's equation to solve fluid flow problems and boundary layer concept to evaluate the lift and drag forces on a submerged body.

Syllabus:

Unit-I:

First Law of Thermodynamics: Introduction and Fundamental Concepts, Thermodynamic state and equilibrium, modes of energy, work and heat transfer, first law referred to cyclic processes, first law referred to non- cyclic processes, internal energy and enthalpy, Conservation of energy for an open system (Flow Process).

Second law of thermodynamics: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin- Planck and Clausius Statements and their Equivalence, PMM of Second kind, reversibility and irreversibility, causes of irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.

Entropy: Clasius theorem, the property of entropy, the inequality of Clausius, Entropy principle and its applications, Entropy change during different thermodynamic processes.

Availability and Irreversibility: Available energy, availability of a closed system, availability function of a closed system availability of steady flow system, availability function of open system, Helmholtz function, Gibbs functions, Irreversibility for closed and open system, Second law efficiency.

Unit-II:

Thermodynamic Relationships: Maxwell's equations, T-ds equations, difference in heat capacities, coefficient of Volume expansion and isothermal compressibility, adiabatic compressibility, ratio of specific heat, energy equations, Joule-Kelvin effect, Clausius-Clapeyron equation.

Equation of state: Ideal gas equation of state, deviation of Real gas from ideal gas, vander waal's equation of state, correction for the intermolecular attractions, correction for finite size of molecules, evaluation of constants a and b, virial expansions, limitations of the vander Wall's equation, Reduced coordinates, compressibility factor, the law of corresponding states as per vander Wall's principle.

Unit-III:

Properties of fluid: Fluid, ideal and real fluid, properties of fluid: mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Newtonian and non-Newtonian fluids

Fluid Statics: Pressure, Pascal's law, Hydrostatic law, Manometry, Hydrostatic force on submerged plane and curved surface, Buoyancy and Flotation.

Unit- IV:

Fluid Kinematics: Description of fluid motion, Langragian and Eulerian approach, Type of fluid flow, Type of flow lines-path line, streak line, stream line, stream tube. Continuity equation, acceleration of a fluid particle, motion of fluid particle along curved path, Normal and tangential acceleration, Rotational flow, Rotation and Vorticity, circulation, stream and potential function, flow net, its characteristics and utilities.

Unit-V:

Fluid Dynamics: Euler's Equation, Bernoulli's equation and its practical application, Venturimeter, Orifice meter, Nozzle, Pitot tube. Impulse momentum equation, Moment of Momentum equation, Kinetic energy and Momentum correction factor, Vortex motion, Radial flow.

Boundary Layer Theory: Boundary layer definition and characteristics, momentum equation, Laminar and turbulent boundary Layer, Total drag, separation, introduction to drag and lift.

Text Books:

1. Thermodynamics- An Engineering Approach – Cengal& Boles – McGraw Hill
2. Engineering Thermodynamics – P.K. Nag – TMH Publishers.
3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria& Sons – New Delhi
4. A text of Fluid Mechanics – R. K. Rajput – S. Chand & Company Ltd., Delhi

References Books:

1. Fundamental of engineering thermodynamics- R.Yadav ,CPH, Allahabad
2. Thermal Science & Engineering – D.S. Kumar – S.K. Kataria& Sons
3. Fundamental of Thermodynamic- Claus Borgnakke, Richard E. Sonntag, Wiley, Delhi
4. An Introduction to Thermodynamics-Y.V.C.Rao University Prass, Hyderabad
5. Fluid Mechanics & Hydraulics Machines-R.K.Bansal-Laxmi Publications., Delhi
6. Mechanics of Fluid – B.S. Massey – English Language Book Society (U.K.)
7. Fluid Mechanics- Yunush A. Cengel, John M. Cimbala- TMH, Delhi

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	1	-	-	1	-	1	3	1
CO2	2	1	-	-	-	1	-	-	2	-
CO3	2	1	-	-	-	1	-	-	2	1
CO4	2	1	1	-	-	1	-	-	2	1
CO5	3	1	-	-	-	1	-	1	3	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 :	**B.Tech.**	**Semester :**	**III Sem**
Name of the Course:	**Computer Aided Machine Drawing**	**Course Code:**	**SOE-B-ME302**
Credits :	**3**	**No of Hours:**	**03 hours/week**
Max Marks:	**100**		

Course Description: Computer Aided Machine drawing is used to communicate the necessary technical information required for manufacture and assembly of machine components. These drawings follow rules BIS and IS 1946. Hence the knowledge of the different standards is very essential. Students have to be familiar with industrial drafting practices and thorough understanding of production drawings to make themselves fit in industries.

The following topics have been covered to fulfill the course objectives and course outcomes. Classification of Machine Drawings, Principles of Drawings, Sectioning, Dimensioning, Limits, Fits and Tolerance, Symbols and Conventional Representation, Screw Fasteners, Key Joints, Coupling and its Types, Riveted Joints, Welded Joints, Structural Applications, Assembly Drawings, Production Drawings, Reproduction of Drawing, Introduction of Computer Aided Drafting, Introduction of Solid 3D Modeling

Course Outcomes (COs)

At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	Acquire the knowledge of various standards and specifications about standard machine components.
CO2	Prepare 2D and 3D model using CAD software (Pro-E) & able to read production drawing, the knowledge of limits, fits and tolerances for various applications.
CO3	Understand the concept of section and types of sections and its applications in the industry.
CO4	Make the detail drawing with the help of given assembly drawing
CO5	Make the assembly drawing with the help of given part drawing.

Syllabus:

Unit – I: Drawing Standards:

Code of Practice for Engineering Drawing, BIS specifications, Conventional representation, welding symbols, riveted joints, keys, Couplings, Shafts, Screw Fasteners, Reference to hand book for the selection of standard components like bolts - nuts - screws - keys etc.

Fundamentals of Computer Graphics: Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation

Unit – II: Production Drawing and Reading Blue Prints:

Types of production drawings, size, shape and description; Limits, Fits and tolerances, Allocation of fits for various mating parts, Tolerance data sheet, Tolerance table preparation, Geometric tolerance, surface roughness and surface roughness symbols, reading the blue prints.

Unit – III: Sectional Views:

Introduction and need of sectional views, Types of section: Full section, half section, partial section, off-set section, revolved sections, removed sections, auxiliary section, guidelines for hatching, examples of sectional orthography view on all above types of sections of machine elements.

Unit – IV: Details Drawing:

Introduction to detail drawing, steps involved in preparing assembly drawing from details and vice versa. Cotter and knuckle joint, sunk, parallel, woodruff, saddle, feather, Clapper block, Single tool post, Lathe & Milling tail stock etc.

Unit – V: Assembly Drawings:

Simple, solid, bushes, pedestal, footstep, I.S. conventional representation of ball and bearings, Flat belt, V-belt, rope belts, fast and loose pulleys: flanged joints- spigot and gland and stuffing box, expansion joint, union joint. Coupling: Simple, muff, flanged, protected flange coupling, Oldham's coupling and Universal coupling.

Text Books:

1. N.D. Bhatt, V. Panchal, Machine Drawing, Charotar Prakashan, ed. 46.
2. R.K. Dhawan, A text book of Machine Drawing, S. Chand. Edition. 2. New Delhi.

Reference Books:

1. K. L. Narayana, P. Kannaiah, K. V. Reddy, Machine Drawing, New Age International, Edition 4.
2. K.C. John, "A textbook of Machine Drawing", Phi Learning, ed.1.
3. I.S. Code: SP 46: 2003, Engg. Drg. Practice, Standard Publication.
4. P.S. Gill, B.D., Machine Drawing: Kataria & Sons, Ludhiana.10th edition, Katson Pb. House.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	-	2	-	-	-	1	3	1
CO2	3	1	2	-	2	-	2	1	3	2
CO3	3	-	2	-	-	-	-	1	3	1
CO4	3	-	1	-	2	2	-	2	2	3
CO5	3	-	1	-	2	-	-	2	3	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: **B.Tech** **Semester: III Sem**
Name of the Course: **Mechanics of Materials** **Course Code: SOE-B-ME303**
Credits: 3 **No of Hours: 03 hours/week** **Max Marks: 100**

Course Description:

This course is the foundation to many advanced techniques that allow engineers to design machine components, mechanisms, predict failure and understand the physical properties of materials. Mechanics of Materials gives the student basic tools for stress, strain and deformation analysis

Course Outcomes:

CO Number	Course Outcome
CO1	Gain knowledge of different types of stresses, strain and deformation induced in the mechanical components due to external loads.
CO2	Understand the distribution of various stresses in the mechanical elements such as beams, shafts etc. Also able to draw the shear force diagram and bending moment diagram for different types of loads and support conditions
CO3	Compute and analyze stresses induced in basic mechanical components.
CO4	studied the effect of component dimensions and shape on stresses and deformations.
CO5	Analyze buckling and bending phenomenon in columns and beams respectively

Syllabus:

Unit-I

Simple Stresses and Strains: Introduction, Types of loads and deformation, Types of stresses and strains, Hooke's law, stress-strain diagram for ferrous and non-ferrous materials, Modulus of elasticity (E), Modulus of rigidity (G) and Bulk modulus (K) of materials, Poisson's ratio, volumetric strain, Relation between E, G and K, Stresses in Bars of varying cross sections, composite sections, Thermal stresses and strains, thermal stresses in composite sections, Strain energy, Resilience, Proof resilience, Modulus of resilience, Gradually applied load, Suddenly applied loads and Impact loads.

Unit-II

Shear Force & Bending Moment Diagrams: Definitions, types of loading, types of beams, Shear force and bending moment, sign conventions, S.F. and B.M. diagrams for Cantilever, simply supported and subjected to Point loads, uniformly distributed loads and Combination of these loads, Point of contra-flexure, numerical problems on above.

Unit-III

Bending Stresses in Beams: Theory of simple bending, assumptions made in simple bending theory, Position of Neutral axis and neutral surface, Moment of resistance, Section Modulus of symmetrical sections such as rectangular, circular & I- sections,

Bending stresses in symmetrical section and simple problems, Beam of uniform strength.

Shear Stresses in Beams: Introduction, Shear stress equation, assumptions made, Distribution of shear stresses over various sections, such as rectangular, circular, I, L & T sections, Simple numerical problems.

Deflection of Beams: Introduction, Strength and Stiffness of a beam, Curvature of a bent beam, Derivation of equation for slope and deflections of beam in case of cantilever & simply supported beam loaded with point loads, uniformly distributed load, Simple numerical problems.

Unit-IV

Torsion of Shaft:

Definition of torsion, Assumptions, Torsion equation, Strength of solid and hollow circular shafts, Calculation of shaft diameter on the basis of strength and stiffness for given power transmitted, Torsional Rigidity, Maximum torque comparison of solid and hollow shaft, Size of shaft for a given torque.

Principal Stresses: Principal plane, Principal stress, Tangential and Normal stress, Maximum Shear stress, Major and Minor principal stresses derivation for different cases, Mohr's circle graphical method, Theories of Failure.

Unit-V

Columns and Struts: Definition, Crippling load, different end conditions, Slenderness ratio, equivalent length, Euler's theory, Limitation of Euler's formula, Rankine's formula, Rankine constant for different materials, Simple problems.

Thin Pressure Vessels: Cylindrical and spherical vessels subjected to internal pressure, Hoop stress, longitudinal Stress, Volumetric strain, change in volume.

Text books:

1. Subramanyam-Strength of Materials, Oxford University Press, Edition 2005
2. B.C Punmia Ashok Jain, Arun Jain- Mechanics of Materials, Lakshmi Publications, New Delhi.
3. Basavarajaiah and Mahadevappa -Strength of Materials, Khanna Publishers, New Delhi.
4. Singer Harper-Strength of Materials, Row Publications.
5. Timoshenko and Young- Elements of Strength of Materials, East-West Press.
6. R. K. Rajput- Strength of Material, S. Chand Publications, Delhi.

References Books

1. James M. Gere-Mechanics of Materials (5th Edition), Thomson Learning
2. S. Ramamrutham -Strength of Materials, Dhanpat Rai Pvt. Ltd.
3. S. S. Rattan-Mechanics of Materials, TMH Pvt. Ltd.
4. S. B. Junnarkar- Mechanics of Structures, Charotar Publication.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	2	2	-	1	-	-	3	3
CO2	3	2	1	2	-	1	2	1	3	2
CO3	3	3	3	2	-	1	-	-	3	3
CO4	3	3	2	2	-	1	-	-	3	3
CO5	2	3	2	3	-	1	1	-	2	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: III Sem**
Name of the Course: **Engineering Metallurgy** **Course Code: SOE-B-ME304**
Credits: 3 **No of Hours: 03/week** **Max Marks: 100**

Course Description

The student able to learn the fundamental science and engineering principles relevant to materials. Understand the concept of structure property relationship using characterization and testing techniques for the material. Have the experimental and computational skills for a professional career or graduate study in materials. Also understand the significance of research, the value of continued learning and environmental/social issues surrounding materials.

Course Outcome:

Materials Science and Engineering, the graduate will develop: -

CO Number	Course Outcome
CO1	Ability to apply mathematics, science and engineering skills to the solution of materials engineering problems.
CO2	Awareness of Societal, safety and Environmental challenges, and be able to involve in public debate regarding these issues.
CO3	Be able to apply core fundamentals and logics in Materials Science to solve engineering problems.
CO4	Be knowledgeable of contemporary issues relevant to Materials Science and Engineering.
CO5	Be able to select material candidates for design and construction.
CO6	Ability to design and conduct experiments, and analyze data and life-long learning.
CO7	Understand the professional and ethical responsibilities of a materials scientist and engineer.
CO8	Ability to work both independently and as part of a team and ability to communicate effectively.
CO9	Possessing skills and techniques necessary for modern materials engineering practice.

Syllabus:

Unit-I: Introduction:
Importance of materials, historical perspective, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bonding.
Crystallography and Imperfections:
Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices, Crystal Structure determination,

Imperfections, Defects & Dislocations in solids.

Unit-II: Mechanical properties and Testing:
Stress strain diagram, Ductile & brittle material, Stress vs. strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testing of material such as Strength tests, Hardness tests, Impact tests, Fatigue tests, Creep tests, and Non-destructive testing (NDT).
Micro structural Exam:
Microscope principle and methods, Preparation of samples and Microstructure examination and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel.

Unit-III: Equilibrium Phase Diagram:
Unary and Binary diagrams, Phase rules, Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram.
Diffusion: Diffusion of Solids, Ficks I and II law.

Unit-IV: Heat Treatment:
Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering (Austempering, Martempering), and various case hardening processes. Time Temperature Transformation (TTT) diagrams.
Ferrous materials: Various types of carbon steels, alloy steels and cast irons, its properties and uses.

Unit-V: Engineering Materials:
Non-Ferrous metals and alloys: LMA, HSLA, Brass and Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys. Dielectric Materials, Magnetic Materials, Ceramics, Polymers, Plastics, Composite Materials and its uses, Smart materials, Bio-materials.

Text Books:
1. William D. Callister, Jr, (Adopted by R. Balasubramaniam)-Materials Science and Engineering, Wiley India Pvt. Ltd.
2. Raghavan-Materials Science and Engineering, PHI.

Reference Books:
1. Smith, Hashemi and Prakash- Material Science and Engineering,TMH.
2. Shackelford-Introduction to Materials Science for Engineers, Pearson.
3. Fischer-Material Science for Engineering Students, Academic Press.
4. Philip and Bolton -Technology of Engineering materials, Butterworth-Heinamann.

CO-PO & PSO Correlation

Course Name : Engineering Metallurgy										
	Program Outcomes								PSO	
CO Number	1	2	3	4	5	6	7	8	1	2
CO1	2	2	-	-	-	2	-	1	2	2
CO2	1	2	2	2	-	3	3	3	1	2
CO3	3	1		-	-	2	-	-	1	2
CO4	3	3	3	-	-	2	-	2	2	2
CO5	3	3	3	-	2	3	-	2	3	3
CO6	2	2	3	-	-	3	-	3	3	3
CO7	-	-	-	3	-	3	3	3	-	2
CO8	-	-	-	3	-	3	3	3	-	2
CO9	3	3	3	-	-	2	-	-	2	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: **B.Tech.** **Semester: III**

Name of the Course: **Plant Maintenance and Safety** **Course Code: SOE-B-ME305**

Credits: 2 **No of Hours: 2 hours/week** **Max Marks: 50**

Course Description: Proper plant maintenance plays a significant role in reducing unscheduled downtime and improving safety. 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 Number	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 equipment's 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 equipment's. 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 firefighting, 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 equipment's

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. Industrial Safety, R.P. Blake, Prentice Hall of India, New Delhi

Reference 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

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	2	2	2	1	1	3	3
CO2	3	1	1	1	-	1	-	-	3	3
CO3	3	1	2	2	2	1	-	1	3	3
CO4	2	-	-	2	2	2	3	3	2	-
CO5	3	1	2	2	2	1	-	1	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 : B.Tech. **Semester: III Sem**
Name of the Course: Disaster Management **Course Code: SOE-B-CE305**
Credits : 1 **No of Hours: 1 hour/week** **Max Marks: 50**

Course Description
This course gives introduction to natural and environmental disasters, their behaviour and possible impacts. Principally aimed to introduce the students about various methods of mitigating damage during disasters.

Course Outcomes: students will be able to understand

CO Number	Course Outcome
CO1	Understand disaster, its nature and types.
CO2	understand disaster zoning and hazard assessment
CO3	know about the disaster mitigation and preparedness.
CO4	Demonstrate the use of construction technology for disaster management.
CO5	Identify the short term and long term relief measures.

Syllabus:

Unit -I:
Nature of disasters, natural and other disasters, earthquakes, floods, draught, cyclones, fire and other environmental disasters.

Unit-II:
Behavior of structures in disaster prone areas, disaster zoning, hazard assessment, Environmental Impact Assessment (EIA)

Unit -III:
Methods of mitigating damage during disasters, disaster preparedness.

Unit-IV:
Management systems during disasters, construction technology for mitigation of damage of structures.

Unit-V:
Short-term and long-term relief measures.

Text Books:

1. Earthquake Engineering damage assessment and structural design – S.F. Borg (August 1, 1988), World Scientific Publishing Co, 2nd Revised edition
2. Disasters and development – Cuny F, (October 13, 1983), Oxford University Press Publication.

Reference Books:

1. IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993.
2. Dynamics of Structures: Theory and Application to Earthquake Engineering– Anil K Chopra, (September 11, 2000), Pearson Education Publication, 2nd edition.

Assessment:

Assessment can vary from course to course and can include a combination of class work, tutorials, assignments, laboratory work, quizzes, surprise test, online test, project work and exams.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	2	2	2	1	1	3	3
CO2	3	1	1	1	-	1	-	-	3	3
CO3	3	1	2	2	2	1	-	1	3	3
CO4	2	-	-	2	2	2	3	3	2	-
CO5	3	1	2	2	2	1	-	1	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: **B.Tech.** **Semester: III Sem**
Name of the Course: **Thermo Fluids – I Lab** **Course Code: SOE-B-ME306**
Credits : 1 **No of Hours: 2 hours/week** **Max Marks: 50**

Course Description:

This lab course involves both study and experimentation. In the study part learners will get a detailed insight of the various low-pressure boilers along with their mountings and accessories. In the experimentation part learners will get hands-on experience with flow rate measuring devices such as venturi meter, orifice meter, pitot tube, and open channels.

COURSE OUTCOMES:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Understand the basic concept of temperature measuring through different approaches
CO2	Identify the key components and understand the low-pressure industrial boilers suitably
CO3	Understand and apply Bernoulli's theorem practically
CO4	Understand and use the basic pressure, velocity and flow rate measurement techniques
CO5	Demonstrate the ability to work in teams and present the experimental outcomes in form of report

List of Experiments:
(At least Ten experiments are to be performed by each student)

1. To study different types of temperature measurement techniques including Thermography approach.
2. To study Mountings & Accessories of a Boiler.
3. To study the Cochran Boiler and its Accessories and Mountings.
4. To study the Lancashire and its Accessories and Mountings.
5. To study the Babcock Wilcox and its Accessories and Mountings.
6. To determine Meta centric height of floating body.
7. To verify Bernoulli's theorem experimentally.
8. To measure the velocity of flow using Pitot tube.
9. To determine the coefficient of discharge of Venturi meter.
10. To determine the coefficient of discharge of Orifice meter.
11. To determine the impact of jet through nozzle.
12. To determine the coefficient of discharge through open channel flow over a triangular notch.

13. To determine the coefficient of discharge through open channel flow over a rectangular notch.

Equipment/Machines/Instruments/Tools/Software Required:

1. Boiler mountings.
2. Boiler accessories.
3. Cochran boiler.
4. Lancashire boiler.
5. Babcock and Wilcox boiler.
6. Apparatus for determination of meta centric height
7. Bernoulli's apparatus.
8. Impact of jet apparatus.
9. Venturimeter Apparatus.
10. Orifice meter Apparatus
11. Pipe friction apparatus
12. Orifice apparatus
13. Mouth Piece apparatus with provision for determination of hydraulic coefficient Cc, Cd & Cv
14. Vortex flow apparatus
15. Reynolds's apparatus
16. Complete setup for flow measurement using Pitot tube
17. Complete set for open channel apparatus

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	2	2	-	1	-	-	3	3
CO2	3	2	1	2	-	1	2	1	3	2
CO3	3	3	3	2	-	1	-	-	3	3
CO4	3	3	2	2	-	1	-	-	3	3
CO5	2	3	2	3	-	1	1	-	2	2

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

Programme : **B.Tech.** **Semester: III Sem**

Name of the Course: **Computer Aided Machine Drawing Lab**

Course Code: SOE-B-ME307

Credits : 2 **No of Hours: 4 hours/week** **Max Marks: 50**

Course Description: Computer Aided Machine drawing is used to communicate the necessary technical information required for manufacture and assembly of machine components. These drawings follow rules BIS and IS 1946. Hence the knowledge of the different standards is very essential. Students have to be familiar with industrial drafting practices and thorough understanding of production drawings to make themselves fit in industries.

The following topics have been covered to fulfill the course objectives and course outcomes. Classification of Machine Drawings, Principles of Drawings, Sectioning, Dimensioning, Limits, Fits and Tolerance, Symbols and Conventional Representation, Screw Fasteners, Key Joints, Coupling and its Types, Riveted Joints, Welded Joints, Structural Applications, Assembly Drawings, Production Drawings, Reproduction of Drawing, Introduction of Computer Aided Drafting, Introduction of Solid 3D Modeling

Course Outcomes:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Understand the application of industry standards and techniques applied in Machine Drawing.
CO2	Comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects.
CO3	Able to draw two-dimensional views.
CO4	apply sectional views to most practically represent engineered parts.
CO5	draw assemble and details drawing of important parts used in major mechanical engineering applications.

Syllabus:

The candidates will be required to make **minimum of 06 drawing sheets** using the software such as AutoCAD/Pro Engineer/Solid works on the following topics as per B.I.S. SP46-2003 for General Engg. Drawing. First angle method of Projection should be used.

1. One sheet consists of minimum 4 problems from Unit 1: Conventional representation & BIS Codes

2. One sheet consists of minimum 4 problems from unit 2: Geometric tolerance, surface roughness and surface roughness symbols

3. One sheet consists of minimum 4 problems from unit 3: sectional orthography views.

4. One sheet consists of assembly of details minimum 4 problems from unit 4 using Pro/Engineer software.

5. One sheet consists of details of assembly minimum 4 problems from unit 5 using Pro/ Engineer software.

6. One sheet consists of detail & assembly of unit 5 with fits and tolerances. using Pro/ Engineer software.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	-	2	-	-	-	1	3	1
CO2	3	1	2	-	2	-	2	1	3	2
CO3	3	-	2	-	-	-	-	1	3	2
CO4	3	2	1	-	2	2	1	2	2	3
CO5	3	2	1	-	2	-	1	2	3	2

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech.** **Semester: III Sem**

Name of the Course: **Mechanics of Materials Lab** **Course Code: SOE-B-ME308**

Credits: 1 **No of Hours: 02 hours/week** **Max Marks: 50**

Course Description:

The objective of the strength of materials lab is to demonstrate the basic principles in the area of strength and mechanics of materials and structural analysis to the undergraduate students through a series of experiments. In this lab the experiments are performed to measure the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility etc.

COURSE OUTCOMES:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	demonstrate the basic principles in the area of strength and mechanics of materials
CO2	Analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.
CO3	Utilize appropriate materials in design considering engineering properties, sustainability, cost and weight.
CO4	Measure the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility etc.
CO5	Perform engineering work in accordance with ethical and economic constraints related to the design of structures and machine parts

List of Experiments (minimum 10 numbers):

1. To perform the Tensile Test of Mild Steel on Computerized U.T.M and to Draw Stress–Strain Curve
2. To perform the Compression test on Bricks, Concrete blocks using Computerized U.T.M and to Draw Stress–Strain Curve
3. To perform the Shear test on ductile material using Computerized U.T.M and to Draw Stress–Strain Curve
4. To determine strength of wood on U.T.M (i) Along the Grain (ii) Across the Grain.
5. To determine Izod and Charpy Value of the given mild steel specimen by Impact Testing Machine

6. To estimate Spring Constant under Tension and Compression.
7. To perform Torsion Test on circular bar.
8. To determine modulus of rigidity for the material of open and closed Coiled Helical Spring Subjected to Axial Load by spring testing machine.
9. To study the Rockwell Hardness Testing Machine and to determine the Rockwell Hardness of the given material
10. To study the Brinell Hardness Machine and to determine the Brinell hardness of the given material
11. To study the Cupping Test Machine and to determine Erichsen value of Mild Steel sheet.
12. Solve minimum two numerical of Strength of Material using MATLAB.
13. Solve minimum two numerical of Strength of Material using ANSYS.

Equipment/Machines/Instruments/Tools/Software Required:

1. Universal Testing Machine
2. Impact Testing Machine
3. Fatigue Testing Machine
4. Spring Testing Machine
5. Torsion Testing Machine
6. Cupping Testing Machine
7. Rockwell Hardness Testing Machine
8. Brinell Hardness Machine
9. MATLAB Software
10. ANSYS Software

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	-	2	-	-	-	1	3	1
CO2	3	1	2	-	2	-	2	1	3	2
CO3	3	-	2	-	-	-	-	1	3	2
CO4	3	2	1	-	2	2	1	2	2	3
CO5	3	2	1	-	2	-	1	2	3	2

Note: 1: Low 2: Moderate 3: High

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering
B. Tech in Mechanical Engineering (Fourth Semester)

S.N	Subject Code	SUBJECT	Periods per week		Scheme of Examination and Marks					Credit
			L	T	P	PRE		ESE	Total Marks	
						Mid Sem	TA			
1	SOE-B-ME401	Machine Design	4	0	0	30	20	50	100	4
2	SOE-B-ME402	Thermo Fluids – II	4	0	0	30	20	50	100	4
3	SOE-B-ME403	Kinematics of Machines	4	0	0	30	20	50	100	4
4	SOE-B-ME404	Manufacturing Technology	3	0	0	30	20	50	100	3
5	SOE-B-ME405	Metrology and Mechanical Measurement (MMM)	4	0	0	30	20	50	100	4
6	SOE-B-CSE-411	Introduction to Data Science	2	0	0	15	10	25	50	2
7	SOE-B-ME406	Thermo Fluids – II Lab	0	0	2	0	30	20	50	1
8	SOE-B-ME407	Manufacturing Technology Lab	0	0	2	0	30	20	50	1
9	SOE-B-ME408	Metrology and Mechanical Measurement Lab	0	0	2	0	30	20	50	1
10	SOE-B-ME409	Professional Development	0	0	2	0	30	20	50	1
		TOTAL	**21**	**0**	**8**	**165**	**230**	**355**	**750**	**25**

L: Lecture T: Tutorial P: Practical ESE: End Semester Examination T.A: Teacher's Assessment.

PRE- Progressive Review Examination

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: IV**
Name of the Course: **Machine Design** **Course Code: SOE-B-ME401**
Credits: 4 **No of Hours :04/week** **Max Marks: 100**

Course Description: This course will integrate the knowledge of Statics, Dynamics, Strength of Materials and Engineering Materials into the design process of machine elements. Students will learn the fundamentals of the design process, and the design of some common machine elements will be the focus. The students will apply the concepts in the design of a simple machine.

Course Outcomes (COs)

CO Number	Course Outcome
CO1	Demonstrate knowledge on basic machine elements used in machine design.
CO2	To examine and identify role of material selection, manufacturing requirements, aesthetic and ergonomic needs in design of machine elements.
CO3	To formulate and analyze stresses and strains in machine elements subjected to static and fluctuating load conditions.
CO4	Design machine elements to perform functions in order to obtain desired objectives under various operating conditions.
CO5	Conduct a failure analysis for the design of mechanical components to select the suitable materials and manufacturing considerations.

Course Content:

Unit 1:
Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Design Standards, I.S. codes, Preferred Series and numbers. Material properties and their uses in design, Manufacturing considerations in design: tolerances, types of fits, selection of fits, Design considerations of casting and forging. Theories of failures, Factor of safety
Design against static Loads: Cotter joint, knuckle joint. Power Screw– Design of Screw Presses.

Unit 2:
Design against Fluctuating Loads, Variable stresses: reversed, repeated, fluctuating stresses Fatigue Failure- Static and fatigue stress concentration factors, Endurance limit estimation of endurance limit Design for finite and infinite life- Soderberg and Goodman design criteria, Fatigue design under combined stresses. Numerical problems.

Unit 3:
Design of shaft- power transmitting, power distribution, shafts under static and fatigue criteria. Keys–Types of Keys and their selection based on shafting condition. Couplings–Classification of coupling. Selection of Standard Bush Pin coupling.

Unit 4:
Design of springs- Helical compression, tension springs under static and variable loads. Design of Laminated Springs.
Bolted and Riveted Joints – eccentrically loaded bolted and riveted joints Welded Joints – Design of single transverse, double transverse parallel fillet, eccentrically Loaded welded joint

Unit 5:
Design of Belts –Flat and V belt with Pulley construction, timing belts and pulleys, Selection of Standard Roller chains.

Text Books:

1. Bhandari, V. B. Design of machine elements. Tata McGraw-Hill Education, 2010.
2. Shigley, Joseph E., Charles R. Mischke, and Richard G. Budynas. Mechanical engineering design. McGraw-Hill,, 2004.
3. Robert, L. Norton. "Machine Design An Integrated Approach." (2006).
4. V. Bhandari, Machine Design Data Book, McGraw Hill Education (2017)
5. Mahadevan K., Reddy K.B. Design Data Handbook for Mechanical Engineering in SI and Metric Units, CBS (2013) c
6. PSG Design Data Book, PSG College, Coimbatore (2012)

Reference Books:

1. Spottes, M.F.,Terry E. S., and Lee E.H. Design of machine elements. Vol. 2. Pearson Education India, 2004.
2. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	-	1	1	1	1	1	3	1
CO2	2	2	2	2	2	1	2	2	2	2
CO3	3	3	1	-	-	-	-	1	3	3
CO4	3	3	3	2	2	1	1	2	2	2
CO5	2	3	2	1	2	1	1	2	2	3

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: IV**

Name of the Course: **Thermo Fluids - II** **Course Code: SOE-B-ME402**

Credits: 4 **No of Hours:04 hours/week** **Max Marks: 100**

Course description:

This course is the second part of a newly-designed two course sequence and is made by combining the two traditional thermal disciplines - thermodynamics and fluid mechanics. In thermodynamics learners will be introduced to the performance analysis of various vapor and gas power thermodynamic cycles. In fluid mechanics learners will be introduced to the key concepts of laminar and turbulent flow along with it the working and performance analysis of various hydraulic machines.

COURSE OUTCOMES:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Draw and illustrate the property diagram for various phase change processes and solve basic problems related to vapor cycle using steam table/Mollier chart
CO2	To understand different gas power cycles and solve problems related to gas power cycles
CO3	Use appropriate equations and principles to solve pipe flow problems
CO4	Understand the working principles of various hydraulic machines viz. turbines, pumps and access their performance
CO5	Perform dimensional analysis and identify important dimensionless parameters

Syllabus:

Unit-I:

Properties of Pure substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, phase transformations, dryness fraction, Triple point, critical state, p-v, p-T, T-s, h-s diagrams, P-V-T surfaces, – Properties and processes in ideal vapor, use of steam tables and Mollier's diagram in determination of steam properties, energy interaction and entropy calculations.

Vapor Power Cycle: Simple steam power cycle, Rankine cycle; p-v, T-s and h-s diagrams, efficiency, steam rate, heat rate. Comparison of Rankine and Carnot cycles, mean temperature of heat addition, reheat cycle, ideal regenerative cycle, practical

regenerative cycle, Feed Water Heaters (FWH)- open FWH, characteristics of ideal working fluids, binary vapor cycle.

Unit-II:

Gas power cycles: An overview of reciprocating engine, Air standard cycle, Otto, Diesel, dual cycle - Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures, comparison of cycles. An overview (only p-v and T-s diagram) of Stirling, Ericson, Atkinson and Lenoir cycle.

Unit-III:

Laminar Flow: Reynold's experiment, flow of viscous fluids in circular pipe, shear stress and pressure gradient relationship, Velocity distribution, Hagen-Poiseuille Equation, flow of viscous fluids between two parallel plates (Counter flow) shear stress and pressure gradient relationship, Velocity distribution, Drop of pressure head.

Turbulent flow: Effect of turbulence, Expression for loss of head due to friction in pipes (Darcy-Weisbach equation), Expression for co-efficient of friction in terms of shear stress.

Flow through pipe: Loss of energy in pipes, Hydraulic gradient and total energy line, pipe in series and parallel, equivalent pipe power transmission through pipe, water hammer in pipes.

Unit- IV:

Impulse Turbine: Classification of turbine, impulse turbine, Pelton wheel, Construction working, work done, head efficiency and Design aspects, Governing of impulse turbine.

Reaction Turbine: Radial flow reaction turbine, Francis turbine: construction, working, work done, efficiency.

Axial flow reaction turbine: Propeller and Kaplan turbine, draft tube, specific speed, unit quantities, cavitation, degree of reaction, performance characteristics, surge tanks, governing of reaction turbine.

Unit-V:

Centrifugal Pumps: Classification of Pumps, Centrifugal pump, Construction, working, work done, heads, efficiencies, multistage centrifugal pump, pump in series and parallel, specific speed, characteristic, net positive suction head, cavitation.

Reciprocating Pumps: Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, air vessels.

Dimensional Analysis: Methods of dimensional analysis, Rayleigh's method, Buckingham's theorem, Limitations.

Model analysis: Dimensionless number and their significance, model laws, Reynolod's model law, Fraude's model law, Euler's model law, Type of models, scale effect in model, limitation of hydraulic similitude.

Text Books:

1. Thermodynamics- An Engineering Approach – Cengal & Boles – McGraw Hill.
2. Engineering Thermodynamics – P.K. Nag – TMH Publishers).

3. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar– Kataria & Sons – New Delhi.
4. A text of Fluid Mechanics – R. K. Rajput – S. Chand &Company Ltd., Delhi.

References Books:

1. Fundamental of engineering thermodynamics- R.Yadav ,CPH, Allahabad
2. Thermal Science & Engineering – D.S. Kumar – S.K. Kataria & Sons

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	-	1	-	1	3	2
CO2	3	2	3	-	-	1	-	1	3	1
CO3	2	2	2	-	-	2	-	-	3	1
CO4	3	2	2	-	-	1	-	1	3	1
CO5	3	1	1	-	-	-	-	-	2	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: **B. Tech** **Semester: IV**
Name of the Course: **Kinematics of Machines** **Course Code: SOE-B-ME403**
Credits: 4 **No of Hours: 04/week** **Max Marks: 100**

Course Description: The subject Kinematics of Machines is a very special course for Mechanical Engineers. This course tells us about the distinctive features of machines. It deals with the relative motions of different parts of a mechanism without taking into consideration the forces producing the motions. Thus, it is the study, from the geometric point of view, to know the displacement, velocity, and acceleration of a part of a mechanism.

Course Outcomes: At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains, and planar mechanisms
CO2	Analyze the planar mechanisms for position, velocity, and acceleration.
CO3	Construct and analyze cam profiles for a specified motion of the follower
CO4	Evaluate gear tooth geometry and select appropriate gears for the required applications. Analyze different types of gear trains.
CO5	Understand the application of friction in machine elements like bearings, clutches, brakes, and belt drives.

Syllabus:

Unit-I:
Fundamentals of Kinematics & Mechanisms
Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion, Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions.

Unit-II:
Kinematics of Linkage Mechanisms
Velocity and acceleration analysis of mechanisms, Velocities and accelerations by relative velocity method, Velocity analysis using instantaneous centre method, Velocities and accelerations by Analytical method, Klein's construction, Coriolis component of Acceleration.

Unit-III:
Kinematics of Cam Mechanisms
Classification of cams and followers, Nomenclature of a radial cam, Description of follower movement, Displacement diagrams, Uniform and modified uniform motion, Simple harmonic motion, Uniform acceleration motion and its modifications, Cycloidal

motion, Synthesis of cam profile by graphical approach, Considerations of pressure angle. Cams with specified contours: Circular arc cam & tangent cam.

Unit-IV:

Gears & Gear Trains

Types of gears, Gear terminology, fundamental law of toothed gearing, Gear tooth forms, Involute and Cycloid tooth profile, Length of path of Contact, Arc of Contact, Contact ratio, Interference and Undercutting of Involutes teeth, Minimum number of teeth on pinion to avoid interference. Simple, Compound, Reverted, and Epicyclic gear trains, computation of velocity ratio in gear trains by different methods.

Unit-V:

Friction in Machine Elements

Applications of friction, Pivot and collar friction, Thrust bearings, Friction clutches, Belt Drives - Ratio of tensions for flat belt & V-belt, Centrifugal tension, condition for maximum power transmission, Friction in brakes- Simple block or shoe brake, Band brake, Band and Block brakes, Internal expanding shoe brake, Absorption dynamometer, Transmission dynamometer.

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2005
3. Robert L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill, 2009.
4. Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961
5. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, Affiliated East-West Pvt.Ltd., New Delhi, 1988.
6. Rao.J.S. and Dukkipati R.V. “Mechanisms and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
7. John Hannah and Stephens R.C., “Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 2002.
9. Khurmi, R.S., “Theory of Machines”,14th Edition, S Chand Publications, 2005
10. Sadhu Singh: Theory of Machines, “Kinematics of Machine”, Third Edition, Pearson Education,2012.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	2	-	-	1	3	2
CO2	2	3	2	3	-	-	-	1	3	3
CO3	2	2	2	-	2	-	-	1	3	2
CO4	2	2	3	2	-	-	-	2	3	3
CO5	2	3	2	2	1	1	1	1	3	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 :	**B.Tech.**	**Semester :**	**IV Sem**
Name of the Course:	**Manufacturing Technology**	**Course Code:**	**SOE-B-ME404**
Credits :	**3**	**No of Hours: 03 hours/week**	**Max Marks: 50**

Course Description

The main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used. The course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.

Course Outcome

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

CO Number	Course Outcome
CO1	Graduates will gain a strong foundation in manufacturing process
CO2	Acquire knowledge and hands-on competence in applying the concepts of manufacturing process in the design and development of mechanical systems
CO3	Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular
CO4	Develop an ability to identify, analyze and solve technical problems related to machine tools
CO5	Work effectively with engineering and science teams as well as with multidisciplinary designs

Syllabus

Unit-I

Introduction to Manufacturing Processes: Importance of Manufacturing Process, classification, definition.

Metal Casting: Basic principle, Advantages and limitations, Applications, Steps involved in making a casting, casting terms, Sand mold making procedure, molding materials, molding sand composition, Patterns: Types of patterns, Materials used for patterns, Pattern allowances, Core: uses, core materials, types, Gating system: Elements of gating, Gating ratio and design of gating systems.

Solidification of casting: Concept, Solidification of pure metal and alloys, Runner & Risers: Types, function and design, Special casting processes: CO_2moulding, Shell molding, Centrifugal casting, Die casting, and Investment casting, Casting defects & remedies.

Unit-II

Metal Forming Process: Advantages of forming operations, Nature of plastic deformation, hot working and cold working

Rolling: Rolling fundamentals, Principle, Classification of rolled products, Theory of rolling, Types of Rolling mills and products, Roughing passes, Finishing passes, roll pass design for continuous mill, Forces in rolling and power requirements, Defects in rolled products and remedies. Industrial Case studies of rebar operation in plant rolling mill.

Unit-III

Forging: Basic forging operations, forging types: Smith, Drop, Press & Machine Forging, forging equipment's, roll forging, Rotary forging, Forging defects & remedies.

Extrusion: Principle, Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion, Impact extrusion, Hydrostatic extrusion, Seamless tubes, Extrusion defects and remedies.

Unit-IV

Sheet-Metal Operations: Classification, Spring back in metals, Press operations: Blanking, Piercing and other operations, Clearance and Shear in press operations, Forces and power requirement in press Operations, bending: Nomenclature, Types of bending dies, Bend allowance and force, Spinning, Stretch forming, Embossing and Coining. Industrial Case studies of plate operation in plant.

Plastics: Processing of Plastics: Injection molding, Blow molding, Compression molding, and Transfer molding

Unit-V

Metal Fabrication Process: Introduction to fabrication process, classification**.**

Welding: Principle, Classification of welding processes, types of welded joints, Welding terms, Filler materials, application of welding process, Gas welding: Flame types, forward and backward welding, Arc welding: AC & DC, Selection of welding current, Voltage, Welding electrodes: Types, Composition and specification, Metal arc welding (MAW), Submerged arc welding (SAW), Resistance welding; principle, types, Spot, seam & projection welding, Inert Gas welding: TIG & MIG welding, Thermit-welding, Friction welding, Laser welding, Soldering & Brazing, Welding defects: Causes and remedies.

TEXT BOOKS:

1. Manufacturing Technology, P.N. Rao, TMH.
2. Production Technology, Sharma P C, Chand Publishers.

REFERENCES:

1. Principles of Metal Castings, Rosenthal, Mc Graw Hill Professional.
2. Welding Engineering and Technology, RS Parmar, Khanna Publishers.
3. Manufacturing Engineering and Technology, Kalpakjian S, Pearson Education.
4. A Text Book of Production Technology – O.P. Khanna – Dhanpat Rai & Sons, New Delhi.
5. Manufacturing Science – A. Ghosh & A.K. Mallik – East West Press Pvt. Ltd., New Delhi
6. Production Technology – R.K. Jain – Khanna Publishers, New Delhi.

CO-PO & PSO Correlation

Course Name : Manufacturing Technology										
	Program Outcomes								**PSOs**	
CO Number	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	-	3	-	1	2	2
CO2	3	2	3	-	-	2	-	-	3	3
CO3	3	3	3	-	-	2	-	-	3	3
CO4	2	2	1	-	-	1	-	1	2	3
CO5	-	-	-	3	2	3	3	3	1	1

Programme : **B.Tech.** **Semester: III Sem**
Name of the Course: **Mechanical Measurements and Metrology**
Course Code: SOE-B-ME405
Credits : 4 **No of Hours: 4 hours/week** **Max Marks: 100**

Course Description:

The main objective of this course is to make students familiar with the mechanical measuring systems, and the standard measurement methods. It further aims to make them to understand the basic measurement systems in the real time engineering applications.

Course Outcomes:

After learning the course, the students should be able to:

CO Number	Course Outcome
CO1	Demonstrate linear, angular and taper measurement devices for measurement of various components.
CO2	describe basic concepts of mechanical measurement and errors in measurements.
CO3	discriminate capabilities of machining process by measuring surface finish of the component produced and evaluate quality of surface produced using various methods.
CO4	discriminate between various screws and gears by measuring their dimensions.
CO5	Demonstrate the methods of measurement for various quantities like temperature force, torque, power, displacement, velocity and acceleration.

Syllabus:

Unit- I:

Introduction to Metrology: Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement. System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars (Numericals), standardization.

Linear Measurement and angular measurements: Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauges (M87, M112). Measurement of angles- sine bar, sine center, angle gauges,

optical instruments for angular measurements, Auto collimator-applications for measuring straightness and squareness.

Unit- II:

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation (IS 919-1963), geometric tolerance, position-tolerances. Classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

Comparators: Functional requirements, classification, mechanical- Johnson Mikrokator, sigma comparators, dial indicator, electrical principles, LVDT, Pneumatic-back pressure gauges, solex comparators and optical comparators- Zeiss ultra-optimeter.

Unit- III:

Measurement of screw thread and gear: Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3- wire methods, best size wire. Screw thread gauges, Tool maker's microscope. Gear tooth terminology, tooth thickness measurement using constant chord method, addendum comparator method and base tangent method, measurement of pitch, concentricity, run out, and involute profile. Gear roll tester for composite error.

Advances in metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications. Basic concepts of Coordinate Measuring Machines-constructional features, applications.

Unit- IV:

Measurement systems and basic concepts of measurement methods: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-time delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.

Unit- V:

Force, Torque and Pressure Measurement: Direct methods and indirect method, force measuring inst. Torque measuring inst., Types of dynamometers, Absorption dynamometer, Prony brake and rope brake dynamometer, and power measuring instruments. Pressure measurement, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge.

Measurement of strain and temperature: Theory of strain gauges, types, electrical resistance strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors.

Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer.

TEXT BOOKS:

1. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Engineering Metrology, R.K. Jain, Khanna Publishers, Delhi, 2009

REFERENCE BOOKS:

1. Engineering Metrology and Measurements, Bentley, Pearson Education.
2. Theory and Design for Mechanical Measurements, III edition, Richard S Figliola, Donald E Beasley, WILEY India Publishers.
3. Engineering Metrology, Gupta I.C., Dhanpat Rai Publications.
4. Deoblin's Measurement system, Ernest Deoblin, Dhanesh manick, McGraw –Hill.
5. Engineering Metrology and Measurements, N.V. Raghavendra and L.Krishnamurthy, Oxford University Press.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	-	1	1	1	1	1	3	1
CO2	2	2	2	2	2	1	2	2	2	2
CO3	3	3	1	-	-	-	-	1	3	3
CO4	3	3	3	2	2	1	1	2	2	2
CO5	2	3	2	1	2	1	1	2	2	3

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech.** **Semester: III Sem**
Name of the Course: **Introduction to Data Science**
Course Code: SOE-B-CSE-411
Credits: 2 **No of Hours: 2 hours/week** **Max Marks: 50**

Couse Description:
Fundamental coursework on the standards and practices for collecting, organizing, managing, exploring, and using data. Topics include preparation, analysis, and visualization of data and creating analysis tools for larger data sets.

Course Outcomes
At end of this course, the students will be able to:

CO Number	Course Outcome
CO1	Demonstrate understanding of the mathematical foundations needed for data science.
CO2	Collect, explore, clean, munge and manipulate data.
CO3	Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
CO4	Build data science applications using Python based toolkits.

Course Contents:
Unit – I: Introduction

Introduction: Business Analytics, Data Analytics, Data Science, Business intelligence, Machine Learning, deep learning, Artificial Intelligence, Big Data, Natural Language Processing etc; Application area;

Unit – II: Python for Data Science

Data Structure, Pandas, Matplotlib, etc.; Mean, Variance and Standard Deviation; Exploratory Data Analysis

Unit – III: Probability and Statistics
Applied Probability : Sampling Distribution: Population and samples; Sampling theorem; Sampling distribution of the mean (σ known and unknown); Gaussian Distribution and Non Gaussian Distribution (Log-Normal, Plower Law, etc.) ;PDF, CDF, PMF; Plot: Q-Q Plot, etc.; Correlation vs Causation; Sampling distribution of variance; Tests of hypothesis, Confidence interval; Relation between tests and confidence interval.
Applied Statistics: Curve fitting: Method of least squares; linear regression; quadratic regression; multiple regressions; Correlation, Multiple linear regressions.

Unit- IV: Machine Learning using Python

Introduction, ML Fundamentals, Understanding Supervised and Unsupervised Learning Techniques, Clustering, Implementing Association rule mining, Understanding Process flow of Supervised, Learning Techniques, Decision Tree Classifier, Random Forest Classifier, What is Random Forests, Naive Bayes Classifier, Project Discussion, Problem Statement and Analysis, Linear Regression, Logistic Regression, Text Mining, Sentimental Analysis, Support Vector Machines, Deep Learning, Time Series Analysis.

Text Books

1. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media

Reference Books

1. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
2. Jain V.K., “Big Data and Hadoop”, Khanna Publishing House, Delhi.
3. Jeeva Jose, “Machine Learning”, Khanna Publishing House, Delhi.
4. Chopra Rajiv, “Machine Learning”, Khanna Publishing House, Delhi.
5. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org
6. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	-	1	1	1	1	1	3	1
CO2	2	2	2	2	2	1	2	2	2	2
CO3	3	3	1	-	-	-	-	1	3	3
CO4	3	3	3	2	2	1	1	2	2	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	**B.Tech.**	**Semester :**	**IV Sem**
Name of the Course:	**Thermo Fluids – II Lab**	**Course Code:**	**SOE-B-ME406**
Credits :	**1**	**No of Hours:02/week**	**Max Marks: 50**

Course Description:

This lab course introduces students to various thermal and fluid systems and their performance analysis.

COURSE OUTCOMES:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Confidently identify and select hydraulic turbines and pumps for different working conditions
CO2	Carry out performance analysis of hydraulic turbines and pumps
CO3	Understand the working of wind tunnels and evaluate the coefficients of drag and lift associated with differently shaped objects.
CO4	Compare the analytical and numerical results and develop a deeper understanding for fluid machinery and thermodynamic cycles
CO5	Demonstrate the ability to work in teams and present the experimental outcomes in form of report

List of Experiments:
(Minimum seven experiments and three studies)

1. Performance characteristics of Pelton wheel turbine.
2. Performance characteristics of Francis turbine.
3. Performance characteristics of Kaplan turbine.
4. Performance characteristics of variable speed centrifugal pump.
5. Performance characteristics of rated speed centrifugal pump.
6. Performance characteristics of multistage centrifugal pump.
7. Performance Characteristics of a reciprocating pump.
8. Study of Wind Tunnel (Open Circuit blower type)
9. Determination of Lift and drag force over an air foil.
10. Analysis of vapor power cycle using MATLAB programming,
11. Analysis of gas power cycle using MATLAB programming.
12. Study of Boiler Feed pump and Vacuum

Equipment/Machines/Instruments/Tools/Software Required:

1. Pelton Wheel Turbine Test Rig
2. Francis Turbine Test Rig

3. Kaplan Turbine Test Rig
4. Variable Speed Centrifugal Pump Test Rig
5. Rated Speed Centrifugal Pump Test Rig
6. Multi Stage Centrifugal Pump Test Rig
7. Reciprocating Pump Test Rig
8. Complete setup of Wind Tunnel (Open circuit blow type)
9. Airfoil with the provision of measurement of pressure distribution over the surface.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	2	-	2	1	1	3	3
CO2	3	2	1	2	-	2	-	1	3	2
CO3	3	2	2	2	-	2	-	-	3	3
CO4	3	3	2	2	-	2	-	-	3	3
CO5	2	3	2	3	-	1	1	-	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 :	**B.Tech.**	**Semester :**	**IV Sem**
Name of the Course:	**Manufacturing Technology Lab**	**Course Code:**	**SOE-B-ME407**
Credits :	**1**	**No of Hours:02/week**	**Max Marks: 50**

Course Description:

To impart knowledge to students to develop their technical skill sets for creating entities from raw material. To give "hands on" training and practice to students for use of various tools, devices, machines. To develop ability of students to understand, plan and implement various processes and operations to be performed on the raw material to create object of desired shape and size. To give exposure to inter disciplinary domains.

Course Outcomes:

After learning the course, the students should be able to:

CO Number	Course Outcome
CO1	Acquire knowledge and hands-on competence in applying the concepts of manufacturing process in the design and development of mechanical systems
CO2	Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects
CO3	Select appropriate Joining Processes to join Work piece
CO4	Work effectively with engineering and science teams as well as with multidisciplinary designs.
CO5	Skillfully use modern engineering tools and techniques for mechanical engineering design & analysis.

Experiments to be performed (Minimum Eight Experiments)

Foundry Shop	1. Making of a single/two-piece pattern 2. Making a green sand mould using single/multi-piece patterns 3. Moulding Melting and Casting
Welding Shop	4. Joining MS plates by arc welding (Butt Joint/Lap Joint) 5. Joining metal sheet by spot welding 6. Joining MS plates by MIG welding 7. Joining metal sheets by gas Welding 8. Joining metals by Soldering/Brazing
Mechanical Press working	9. Study of blanking, piercing operation, simple, compound and progressive press tool operations. 10. Study of bending, spinning and stretch forming.

Processing of Plastics	11. Study of injection moulding. 12. Study of blow moulding.

List of Equipment/Instruments/Machines Required:

1. Carpentry Lathe
2. Wood Saw Machine
3. Open Hearth
4. Manual Metal Arc Welding Machine/Equipment's
5. Metal/Manual Inert Gas Welding Machine/ Equipment's
6. Resistance/Spot Welding Machine/ Equipment's
7. Oxy-Acetylene Gas Welding Set-up
8. Soldering & Brazing Equipment's
9. Bench Drilling Machine

CO-PO & PSO Correlation

Course Name : Manufacturing Technology Lab										
	Program Outcomes								**PSOs**	
CO Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	3	2	3	-	-	2	-	-	3	3
CO2	3	3	2	-	-	2	-	1	2	2
CO3	3	2	1	-	-	1	-	2	2	2
CO4	-	-	-	3	2	3	3	3	1	1
CO5	3	3	3	-	-	2		2	2	3

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: B.Tech. **Semester: IV Sem**
Name of the Course: Metrology and Mechanical Measurement Lab
Course Code: SOE-B-ME408
Credits: 1 **No of Hours: 02/week** **Max Marks: 50**

Course Description: The Laboratory is a well-equipped laboratory which provides ideas on hands on experience with various measuring instruments to utilize in industries. on evaluating mechanical properties of a given specimen or structure. This laboratory is scheduled for 5th semester Mechanical engineering students.

Course Objectives:

1. Select appropriate instrument/s for specific measurement. Capability to handle different types of measurement signals and utilize this capability to obtain reliable measurement results.
2. Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
3. Familiarity with different types of measurement systems/devices for engineering measurements.
4. General knowledge and hands-on experience using transducers for measurement of force, strain, position, velocity, and temperature.
5. Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.
6. Development of team working skills, organization, and task management

Course Outcomes:

After learning the course, the students should be able to:

CO Number	Course Outcome
CO1	Understand principle, working of various measuring instruments.
CO2	Selection of proper instruments for measurement, handling of measuring instruments and Care and maintenance of instruments. Setting the instruments for zero error adjustment, calculation of least counts of instrument.
CO3	Proper alignment of the instrument with work piece. Measure the angle, surface finish using the instruments.
CO4	Use a variety of equipment and techniques to measure force, flow, pressure, temperature, speed, strain, rotational position.
CO5	Collection, recording and analysis of data

Measurement Lab To Be Performed (Minimum 08 Numbers)

1. To Measure Pressure Using Bourdon Pressure Gauge.
2. To Calibrate Pressure Gauge Using Dead Weight Pressure Gauge Tester.
3. To Measure Displacement Using LVDT
4. To Measure Temperature Using Thermister
5. To Measure Flow Rate Using Rotameter.
6. To Measure Angle Using Angular Sensor.
7. To Measure Torque Using Torque Transducer
8. To Measure Pressure Using Pressure Transducer.
9. To Measure Strain Using Strain Cantilever Beam.
10. To Measure Temperature Using RTD.
11. To Measure Temperature Using Thermo Couple.
12. To Measure Temperature Using Thermal Imager.
13. To measure Noise using Sound meter
14. To perform the following experiments using Data Acquisition System
    a. To measure Temperature by Themocouple
    b. To measure Temperature by Thermistor
    c. To measure Temperature by RTD.
    d. To measure Strain.
    e. Vibration Measurement

Metrology Lab to Be Performed (Minimum 6 Numbers)

1. Measurements of lengths, heights, diameter by Vernier Calipers, Vernier Height Gauge, Micrometers.
2. Measurement of various angles using Bevel Protractor, Sine Bar & Combination Set.
3. Determining the accuracy of Electrical and Optical Comparator.
4. Determine the Surface Flatness and Contour using Interferometer.
5. Determine the Effective Diameter of screw threads by using Two wire & Three wire methods.
6. Measurement of Gear Elements using Profile Projector and image analyzer.
7. Measurement of Tool Angles of a Single Point Cutting Tool by using Tool Makers Microscope.
8. Calibration of Vernier Caliper, Micrometer, Height Gauge, Depth Micrometer using Slip Gauges.
9. Measurement of Rail profile using various rail gauges.

List of Equipments/Machines Required

MEASUREMENT	METROLOGY
1. Data Acquisition System 2. Software compatible with DAS 3. Displacement Measurement Tutor Using (LVDT) 4. Pressure Measurement Tutor Using Pressure Transducer 5. Strain Measurement Tutor Using Strain Cantilever Beam 6. Torque Measurement Tutor Using Torque Transducer 7. Temperature Measurement Tutor Using RTD Sensor 8. Temperature Measurement Tutor Using Thermocouple 9. Temperature Measurement Tutor Using Thermister 10. Angular Measurement Tutor Using Angular Sensor 11. Rotameter Trainer Module 12. Dead Weight Pressure Gauge Tester 13. Bourdon Gauge Trainer 14. Image Analyzer	1. Vernier Calipers 2. Vernier Height Gauge 3. Depth Micrometers 4. Set of Slip Gauges 5. Interferometer 6. Tool Makers Microscope 7. Profile Projector 8. Bevel Protector 9. Sine Bar 10. Combination Set 11. Optical & Electrical Comparator 12. Optical Flats 13. Surface Plates 14. Dial Indicators 15. Snap and Ring Gauges (GO and NO-GO type)

CO-PO & PSO Correlation

Course Name : Metrology and Mechanical Measurement Lab										
	Program Outcomes								PSOs	
CO Number	1	2	3	4	5	6	7	8	1	2
CO1	3	2	3	-	-	2	-	-	3	3
CO2	3	3	2	-	-	2	-	1	2	2
CO3	3	2	1	-	-	1	-	2	2	2
CO4	-	-	-	3	2	3	3	3	1	1
CO5	3	3	3	-	-	2	-	2	2	3

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: B.Tech. **Semester: IV Sem**
Name of the Course: Professional Development **Course Code: SOE-B-ME409**
Credits: 1 **No of Hours: 02/week** **Max Marks: 50**

Course Description:

'Effective Speaking Skills' course is designed to teach students to apply theories and principles of effective interpersonal and public speaking. This course provides instruction and experience in preparation and delivery of speeches within a public setting and group discussion. Emphasis is on research, preparation, delivery, and evaluation of informative, persuasive, and special occasion public speaking. Upon completion, students should be able to prepare and deliver well-organized speeches and participate in group discussion with appropriate audiovisual support. Students should also demonstrate the speaking, listening, and interpersonal skills necessary to be effective communicators in academic settings, in the workplace, and in the community.

Course Objectives:

The main objective of the course is to improve the students' spoken English and enable them to acquire the art of public speaking. The course is heavily practice oriented and has been designed to develop the skills of speech through presenting papers, giving seminars, participating in group discussions and appearing at interviews, etc.

Course Outcomes:

CO Number	Course Outcome
CO1	Choose a topic and formulate the speech according to the purpose, audience, and time constraints
CO2	Employ vocal variety in rate, pitch, and intensity as suitable to the message, occasion, and audience
CO3	Use strategies and skills to manage communication anxiety
CO4	Present speeches using an extemporaneous style with effective transitions that, establish connectedness, movement from one idea to another, and clarify relationships
CO5	Use knowledge of digital presentation tools to create and make effective presentations
CO6	Participate in GD effectively
CO7	Face interviews confidently

Syllabus:

UNIT- 1: Speaking: An Overview

Speaking: An Overview, Listening Effectively, Non-Verbal Communication, Art of Persuasion.

UNIT- 2: Dynamics of Professional Speaking

Introduction, Combating Stage Fright, Describing Objects/Situations/People, Delivering Just-a-minute Sessions, Delivering Different Types of Speeches.

UNIT- 3: Professional Presentations

Planning of a Presentation, Designing of a Presentation, Preparing Power Point Slides for Presentations, Individual and Group Presentations, Making Presentation.

UNIT- 4: Group Discussions

Introduction, GD and Debate, Types of GD, Personality Traits to be evaluated, Dynamics of Group Behaviour, DOs and DON'Ts of GD.

UNIT –5: Job Interviews

Introduction, Process, Stages in Job Interviews, Types, Desirable Qualities, Preparation, Tips for Success

Text Books:

1. Soft Skills for Everyone: Jeff Butterfield, CENAGE LEARNING, 2014.
2. Communication Skills: Sanjay Kumar and Pushp Lata, Oxford University Press, 2011.
3. Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussion and Interviews: PushpLata and Sanjay Kumar, Prentice Hall of India, 2007.
4. The Art of Public Speaking: Dale Carnegie, Ocean Paperbacks, 2016.

Reference Books:

1. The Art of Public Speaking: Stephen E. Lucas, Third Edition, Singapore: McGraw-Hill, 1989.
2. How to Talk so People Listen: Sonya Hamlin, New York, Throson, 1993.
3. The Complete Guide to Public Speaking: Jeff Davidson, Manjul Books PVT. Bhopal, 2006.
4. Effective Speaking: Turk, Cristopher, Second Indian Reprint, Taylor and Francis Group, Delhi, 2010.

CO-PO & PSO Correlation:

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	-	-	-	3	-	1	-	-	-	1
CO2	-	-	-	2	-	-	-	-	-	2
CO3	-	-	-	2	2	1	-	-	-	2
CO4	-	-	-	2	2	2	-	-	-	1
CO5	-	-	-	2	1	-	-	-	1	1
CO6	-	-	-	2	-	1	-	-	-	1
CO7	-	-	-	2	-	-	-	-	1	1

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

Mechanical Engineering
(Detailed Syllabus of 5th Semester)
L: Lecture, T: Tutorial, P: Practical, C: Credit

SEMESTER V

Semester- V											
S. N	**Subject Code**	**Subject**	**Periods per week**			**Credit**	**Examination Scheme**				
							PRE			**ESE**	**TOTAL**
			L	**T**	**P**		**TA**	**MSE**	**TOTAL**		
1	SOE-B-ME501	Thermal Engineering	3	0	0	3	20	30	50	50	100
2	SOE-B-ME502	Internal Combustion Engine (I.C)	3	0	0	3	20	30	50	50	100
3	SOE-B-ME503	Dynamics of Machine (DOM)	3	0	0	3	20	30	50	50	100
4	SOE-B-ME504	Operation Research Technique	3	0	0	3	20	30	50	50	100
5	SOE-B-ME505	Mechatronics	3	0	0	3	20	30	50	50	100
6	SOE-B-ME506	Thermal Engineering Lab	0	0	4	2	30	0	30	20	50
7	SOE-B-ME507	I.C. Engine Lab	0	0	4	2	30	0	30	20	50
8	SOE-B-ME508	KOM & DOM Lab	0	0	4	2	30	0	30	20	50
9	SOE-B-ME509	Seminars on Industrial Training	0	0	1	1	25	0	25	25	50
10	SOE-B-ME510	Electric Vehicle Design and Development	1	0	2	2	15	15	30	20	50
TOTAL			**16**	**0**	**15**	**24**	230	165	395	355	750

PRE- Progressive Review Examination

TA- Teacher Assessment
MSE- Mid Semester Examination
ESE-End Semester Examination

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Thermal Engineering**	**Course Code:**	**SOE-B-ME501**
Credits :	**3**	**No of Hours :**	**03/week**
Max Marks:	**100**		

Course Description:

This course offers lecture and laboratory classes to impart teaching and learning. The course is designed to provide a detailed knowledge of thermal power plant components to the learners. This course covers the concepts, numerical problems, and working principles of the various major and minor components of the thermal power plant.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Describe the characteristics of compressible fluid and steam flow through nozzle.
CO2	Analyze the steam flow through the impulse and reaction steam turbine with the help of velocity diagrams.
CO3	Explain the turbine governing and able to examine the various efficiencies of steam turbine.
CO4	Apply knowledge of turbo machinery for understanding, formulating and solving engineering problems
CO5	Classify the boilers, condensers and cooling towers and able to solve the condenser design problems

Syllabus:

Unit-I: Compressible Fluids: Velocity of pressure waves in a fluid, Mach number, isentropic stagnation state, stagnation enthalpy, temperature, pressure, density, one dimensional steady isentropic flow, area velocity relationship, critical properties-choking in isentropic flow, dimensionless velocity.
Nozzle: Flow of steam through nozzle, throat area for maximum discharge, effect of back pressure on the performance of nozzle flow supersaturated Flow in nozzle.

Unit-2: Steam Turbine: Principle of operation of steam turbine, classification of steam turbine, impulse turbine, compounding of steam turbine, velocity diagram for impulse turbine, force on the blade and work done. Blade or diagram efficiency, axial thrust, gross stage efficiency, efficiency of multi-stage turbine.

Impulse Reaction Turbine: Velocity diagram, degree of reaction, impulse-reaction turbine with similar blade section and half degree of reaction. (Parson's turbine) height of reaction turbine blading, losses in steam turbine, internal losses, and external losses.

Unit-3: State Point Locus and Reheat Factor: Stage efficiency of impulse turbines, state point locus of an impulse turbine, state point locus for multistage turbine, reheat factor. Internal efficiency, overall efficiency, relative efficiency, governing of steam turbine, Throttle governing, nozzle governing, bypass governing, combination of throttle and nozzle, governing and combination of bypass and throttle governing, effect of governing on the performance of steam turbine.

Unit-4: Reciprocating Air Compressors: Classification of air compressors, working of single acting single cylinder reciprocating compressor, single acting reciprocating compressor with and without clearance- equation of work, volumetric efficiency. Multistage reciprocating air compressors, advantage of multistage compression, two stage air compressor-minimum work, indicator diagram, mean effective pressure and indicated power, compressor power, efficiencies, shaft power of the compressor.
Turbo Compressors: Introduction, classifications of centrifugal compressors – components, working, velocity diagrams, calculations of power and efficiencies. Slip factor, surging and choking, power, and efficiencies.
Axial Flow Compressor: Construction and working, velocity diagram, calculation of power and efficiencies. Degree of reaction, work done factor, stalling, comparison of centrifugal and axial flow compressor.

Unit-5: Boilers: Classification of boiler, difference between water tube and fire tube boiler, High pressure boiler- advantages, construction and working of Lamont boiler, function of various boiler mounting and accessories, performance of boiler**:** Evaporation rate, equivalent evaporation, factor of evaporation, boiler efficiency, boiler trial, and heat balance sheet of boiler.
Steam Condensers: The function of condenser, element of a water cooled condensing unit, types of condenser, advantages and disadvantages of various types of condenser, condenser vacuum, mass of circulating water required, source of air its effects and removal, vacuum efficiency, condenser efficiency.
Cooling towers: Cooling towers, classification and working principles, and performance calculations.

Text Books:

1. B.K. Sarkar, Thermal Engineering, Tata McGraw-Hill Publishers, 2007.
2. P.K. Nag, Engineering Thermodynamics, TMH Publishers.
3. R.K. Rajput, Thermal Engineering, S. Chand Publishers, 2000.
4. R. Yadav, Steam and Gas Turbine and Power Plant Engineering, Central Publishing House, Allahabad.
5. S.M. Yahya, Turbine, Compressors and Fan, TMH, Delhi.

References Books:

1. S. K. Kulshrestha, Thermal Engineering, Vikas Publishing House Pvt. Ltd, New Delhi.
2. Mahesh Rathore, Thermal Engineering, Tata McGraw Hill, Delhi.

3. V. Ganeshan, Gas Turbine, TMH, Delhi.
4. S.M. Yahya, Fundamental of Compressible Flow, TMH, Delhi.
5. S.K. Kulshrestha, Gas Dynamics with Application, Khanna Publishers .
6. P. Balachandran, Fundamentals of Compressible Fluid Dynamics, PHI, Delhi.

CO, PO & PSO Correlation

Course Name : Thermal Engineering										
	Program Outcomes								PSOs	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	2	-	1	-	-	2	-	-	3	1
CO2	-	1	-	-	-	1	-	-	1	-
CO3	2	-	-	-	-	3	-	-	1	-
CO4	3	2	2	-	-	1	-	-	2	1
CO5	2	-	1	-	-	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 :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Internal Combustion Engine**	**Course Code:**	**SOE-B-ME502**
Credits :	**3**	**No of Hours :**	**03/week**
Max Marks:	**100**		

Course Description: This course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Ability to display a basic understanding of engine design, function and performance
CO2	Acquire knowledge and hands-on competence in the design and development of various mechanical systems of an Internal Combustion Engine
CO3	Ability to work efficiently as a team member in the field of Automobile Engineering with multidisciplinary designing and analysis skills.
CO4	Ability to understand the relationships between the designing parameters of the internal combustion engine and its effect on engine performance.
CO5	Ability to understand the effect of various engine parameters and fuel characteristics on exhaust emissions to control it effectively

Syllabus:

Unit-I

Introduction: Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification and application of IC engines.

Fuel Air Cycles and Actual Cycles: Assumptions for fuel–air cycles, reasons for variation of specific heats of gases, change of internal energy and enthalpy during a process with variable specific heats, isentropic expansion with variable specific heats, effect of variable specific heats, dissociation, comparison of air standard and fuel air cycles, effect of operating variables, valve and port timing diagrams.

Unit-II

Combustion: Combustion equations, stoichiometric air fuel ratio, enthalpy of formation, adiabatic flame temperature, determination of calorific values of fuels – calorimeter -Bomb and Junkers gas calorimeter.

Combustion in SI and CI Engines: Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking,

control of knocking, combustion chambers for SI engines, stages of combustion in CI engines, factors affecting detonation, controlling detonation, combustion chamber for SI and CI engine.

Unit-III

Fuels and its supply system for SI and CI engine: Important qualities of IC engine fuels, rating of fuels**,** structure and effect of fuel structure on combustion, volatility of liquid fuels and its effects, carburetion, simple carburetor and its working, types of carburetors, types of injection systems in SI and CI engine, fuel pumps and injectors, types of nozzles, spray formation.

Unit-IV

Measurement and Testing of IC engines: Measurement of indicated power, brake power, fuel consumption and emission, Measurement of friction power by Willan's Line Method and Morse test, calculation of brake thermal efficiency, brake power and brake specific fuel consumption, heat balance sheet of IC Engines.

Unit-V

Ignition and Governing System: Battery and magneto ignition system, spark plug, firing order, quality, quantity & hit and miss governing.

Engine Lubrication and Cooling: Lubrication of engine components, lubrication system – wet sump and dry sump, crankcase ventilation, Types of cooling systems – liquid and air cooled, comparison of liquid and air cooled systems.

SI and Diesel Engine Emissions: Nature and extent of problem nitrogen oxides carbon monoxide hydrocarbons particulates emissions control strategies EURO (1-4) series & BHARAT series.

Text Books:

1. Ganesan V., Internal Combustion Engines, Fourth Edition, Tata McGraw-Hill, 2012.
2. John B Heywood, Internal Combustion Engine Fundamentals, Tata McGraw-Hill, 1988.
3. Heinz Heisler, Advanced Engine Technology, SAE International Publications, USA, 1998.

Reference Books:

1. Mathur, M.L., and Sharma, R.P., A Course in Internal Combustion Engines, Dhanpat Rai Publications Pvt. New Delhi-2.
2. Ramalingam. K.K., Internal Combustion Engine Fundamentals, Scitech Publications.
3. Pulkrabek, Willard W, Engineering Fundamentals of the Internal Combustion Engine, PHI Delhi.
4. Dr. R.K. Singhal, A Textbook of Internal Combustion Engine, Standard Book House, Delhi.
5. W.H. Crouse, and D.L. Anglin, Automotive Mechanics: Principles and Practices-, TMH –Delhi.
6. B. P. Pundir, IC Engines Combustion and Emission, Narosa publishing house.

Course Name : Internal Combustion Engines										
	Program Outcomes								PSOs	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	2	3	3	1	-	2	-	-	3	2
CO2	3	2	3	2	2	2	-	1	3	2
CO3	2	2	2	3	3	2	2	-	3	3
CO4	2	3	3	-	-	2	3	3	3	3
CO5	3	2	2	-	2	3	3	3	3	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Dynamics of Machines**	**Course Code:**	**SOE-B-ME503**
Credits :	**3**	**No of Hours :**	**3**
Max Marks:	**100**		

Course Description: The subject Dynamic of Machines is a very special course for Mechanical Engineers. It involves the calculation of forces impressed upon different parts of a mechanism. The forces can be either static or dynamic.

Course Outcomes:
At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Understand the force-motion relationship in components subjected to external forces, characterize and design flywheels
CO2	Analyze and design centrifugal governors
CO3	Analyze balancing problems in rotating and reciprocating machinery
CO4	Understand the gyroscopic effects in ships, airplanes, and road vehicles
CO5	Understand free and forced vibrations of single-degree freedom systems

Syllabus:

Unit-I:

Dynamic Force Analysis

Inertia force and Inertia torque, D Alembert's principle, dynamic Analysis in reciprocating engines, gas forces, inertia effect of connecting rod, bearing loads, crankshaft torque. Turning moment diagram for single and multi-cylinder internal combustion engine, coefficient of fluctuation of speed, coefficient of fluctuation of energy, flywheel for engines and punching presses.

Unit-II:

Governors

Characteristics of centrifugal governors, Gravity controlled governors, Porter and Proell. Spring controlled centrifugal governor: Hartnell governor & Hartung, performance parameter: sensitivity, stability, Isochronism, hunting, co-efficient of insensitiveness, controlling force, governor effort and power.

Unit-III:

Balancing

Balancing of rotating masses, static and dynamic balancing, determination of balancing masses in two plane balancing, balancing of internal combustion engines, balancing of in-line engines, firing order, balancing of V-twin and radial engines, forward and reverse crank method, balancing of rotors.

Unit-IV:

Gyroscope

Gyroscopic forces and couple, gyroscopic effect in airplanes, ship motion, and vehicles moving on a curved path.

Unit-V:

Mechanical Vibrations

One-dimensional, longitudinal, transverse, and torsional vibrations, natural frequency, Effect of damping on vibrations, Different types of damping. Forced vibration, forces, and displacement, transmissibility, vibration Isolation, vibration sensors: seismometer and accelerometers, whirling of shafts with a single rotor.

Text Books:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., Theory of Machines and Mechanisms, 3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, Theory of Machines, 3rd Edition, Tata McGraw-Hill, 2009.

References:

1. Thomas Bevan, Theory of Machines, 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2009.
4. Allen S. Hall Jr., Kinematics and Linkage Design, Prentice Hall, 1961.
5. Ghosh. A and Mallick, A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
6. Rao. J.S. and Dukkipati R.V., Mechanisms and Machine Theory, Wiley-Eastern Ltd., New Delhi, 1992.
7. John Hannah and Stephens R.C., Mechanics of Machines, Viva Low-Prices Student Edition,1999.
8. Ramamurthi. V, Mechanics of Machines, Narosa Publishing House, 2002.
9. Sadhu Singh, Theory of Machines, Kinematics of Machine, Third Edition, Pearson Education, 2012.

CO-PO & PSO Correlation

	Program Outcome												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	1	-	-	-	-	-	-	2	3	2
CO2	3	3	2	3	1	-	2	-	-	-	-	2	2	2
CO3	3	3	2	3	3	-	-	-	1	-	-	2	3	3
CO4	3	3	3	-	1	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	2	-	2	1	2	-	-	2	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 :	**B.Tech.**	**Semester :**	**V Sem**
Name of the Course:	**Operation Research Techniques**	**Course Code:**	**SOE-B-ME-504**
Credits :	**3**	**No of Hours :**	**3hrs/week**
Max Marks:	**100**		

Course Description:
This course helps in defining the problem existing in industries, then formulating a mathematical model of the problem, after that it helps in finding an optimal solution of the problem, and finally it will help in interpreting and implementing the found solution using various methods of operation research techniques.

COURSE OUTCOMES:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Identify the appropriate Operation research tools for an industrial problem and then formulate it in mathematical model.
CO2	Solve the various problems of industries using operation research techniques methods.
CO3	Illustrate the use of Operation Research tools in a wide range of applications in industries.
CO4	Analyze various OR models like LPP Inventory, Queuing, Replacement, Simulation, Decision, Game Theory etc. and apply them for optimization.

Syllabus:
Unit-I: Linear Models: Introduction to operations research, linear programming, mathematical formulation, graphical method, simplex method, duality, two – phase simplex method, transportation problems, northwest corner method, Vogel's approximation method, Modi method, assignment problems, applications.
Problem solving techniques using flowcharts and pseudocode, Introduction to Linux and basic commands

Unit-2: Sequencing and Networks: Sequencing, problem with n jobs and 2 machines, 3 machines and m machines. network models: basic concepts, construction of networks, project network, CPM and PERT, critical path scheduling, crashing of network.

Unit-3: Inventory Models: Inventory models, various costs and concepts, economic order quantity, deterministic inventory models, production models, stochastic inventory models, buffer stock.

Unit-4: Queuing Models: Queuing models, Poisson arrivals and Exponential service times, Single channel models and multi-channel models.
Simulation: Basic concepts, advantages and disadvantages, random number generation, Monte-Carlo Simulation, Simulation models.

Unit-5: Decision Models: Decision models, game theory, two-person zero sum game, graphic solution, property of dominance, algebraic solution.
Replacement models, items that deteriorate with time - when money value changes, items that fail completely, individual replacement and group replacement.

Text Books:

1. Hira & Gupta, Operation Research, S. Chand & Co..
2. S.D. Sharma, Operation Research, S. Chand & Com. New Delhi.
3. A M Natarajan, P Balasubramani, A Tamilarasi, Operations Research, Pearson Education Inc.
4. Maurice *Sasien*, Arthur *Yaspan* and Lawrence Friedman, *Operations Research*—methods and problems, John Wiley and Sons, 1967.

References Books:

1. Hamdy Taha, Operations Research: An Introduction, Pearson.
2. P Mariappan, Operations Research, Pearson.
3. H N wagner, Operations Research, Prentice hall.
4. Ronald Rardin, Optimization in Operations Research, Pearson Education Inc.
5. R. Paneerselvam, Operations Research, Prentice Hall of India Pvt. Ltd.
6. N D Vohra, Quantitative Techniques in Management, Tata McGraw-Hill.
7. Ackof Sasieni, Fundamentals of Operation Research, Dhanpat Rai & Sons.

CO-PO & PSO Correlation

Course Name : Operation Research Techniques										
	Program Outcomes								PSO	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	2	-	-	1	1	2	-	1	2	1
CO2	2	1	1	-	3	3	-	2	2	2
CO3	2	1	1	1	2	2	-	2	2	-
CO4	2	1	1	-	3	2	-	1	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: **B.Tech.** **Semester: V**
Name of the Course: **Mechatronics** **Course Code: SOE-B-ME505**
Credits: 3 **No of Hours :03/week** **Max. Marks:100**

Course Description: In the recent trend of automation in industry environment has changed rapidly from mechanical to electromechanical. Hence aim is to implement such a mechatronics system in industry to enhance the performance as well as cost, size & power. In this course, knowledge of systems such as microprocessor, microcontroller, Programmable logic controller, Electro-pneumatic & electro-hydraulics & other systems such as MATLAB & software's will be useful.

Course Outcomes:
After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Able to demonstrate the basic structure of mechatronics system, their process and applications
CO2	explain principles of operation/interfacing of microprocessor, microcontrollers, PLCs, in mechanical systems
CO3	evaluate the various types of hydraulic and pneumatic actuators used in mechatronics and they will be able to design and develop simple hydraulic and pneumatic automation circuits.
CO4	Discover the basics of a control system and explore its types, time domain analysis, and analyze the mathematical models of dynamics systems
CO5	Carry out frequency domain analysis to assess stability of a system

Syllabus:

Unit I
Introduction to Mechatronics: Mechatronics systems in factory, home and business applications, basic components of mechatronic systems, mechatronics design process, objectives.

Unit II
Overview of micro-processors and micro-controllers: Microprocessor: organization of 8085: architecture, internal register organization and pin configuration – instruction set of 8085 – addressing modes – instruction machine cycles with states and timing diagram - 8085 assembly language programming- examples.
Microcontrollers: functional block diagram and architecture, 14 instruction set and assembly language programming. interfacing of: hex-keyboards, LCD display, ADC, DAC and stepper motor.

Unit III

Pneumatic and Hydraulic actuation systems: Pneumatic and hydraulic systems. electro-pneumatic systems, electro-hydraulic systems. Development of circuits for industrial automation PLC in automation: basic structure, I/O processing. Ladder logic diagram, selection of PLC.

Unit IV

Introduction to control systems: Open loop and closed loop systems, mathematical modeling of control systems, concept of transfer function, block diagram algebra, process control systems, on-off control, p-i-d control. Control system components: servomotor, stepper motors.

Transient response analysis of first and second orders system, time domain specifications. Step response of second order system, classification of control systems according to 'type' of systems, steady state errors, static error constants, steady state analysis of different type of systems using step, ramp and parabolic inputs.

Stability analysis: introduction to concepts of stability, the Routh and Hurwitz stability criteria, relative stability analysis.

Unit V

Root locus concepts.: Frequency response analysis: frequency domain specifications, correlation between time and frequency response, introduction to polar plots, bode plots.

Text books:

1. Uchino, Kenji, and Jayne Giniewicz, eds., Micromechatronics, CRC Press, 2003.
2. Gaonkar, Ramesh S., Microprocessor architecture programming, and applications with the 8085. Prentice-Hall, Inc., 1995.
3. Nagrath, I. J., and Madan Gopal, Textbook of Control Systems Engineering (Vtu), New Age International, 2008.
4. Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, (1970).
5. Kenneth, J. Aiyala, The 8051 Microcontroller, Architecture, programming and applications (1991).
6. Fawcett, John R. Pneumatic, circuits and low cost automation, Brookfield Publishing Company, 1968.

Reference Books:

1. Horowitz, Paul, and W. Hill, Art of electronics 2nd edn. (1997).
2. Fundamentals of Pneumatics: Festo Series (2002)
3. Fundamentals of Electro-Pneumatics: Festo Series (2002)
4. H. M. T., Mechatronics, Tata McGraw Hill New Delhi (1968).
5. Pippenger, John J., Hydraulic valves and controls: selection and application, Marcel Dekker Inc, 1984.
6. Dukkipati, Rao V., Analysis and design of control systems using MATLAB, New Age International, 2006.

7. Shetty, Devdas, and Richard A. Kolk, Mechatronics System Design, SI Version. Cengage Learning, 2010.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	2	1	-	1	-	-	3	1
CO2	3	3	3	1	-	1	1	1	3	3
CO3	3	3	3	2	2	2	1	-	3	3
CO4	2	2	2	1	-	-	-	1	2	1
CO5	2	3	2	1	-	-	-	-	2	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 :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Thermal Engineering Lab**	**Course Code:**	**SOE-B-ME506**
Credits :	**2**	**No of Hours :**	**04/week**
Max Marks:	**50**		

Course Description:

This Lab course offers experimentations to impart teaching and learning. In this course learners will study and perform the experiments on thermal systems such as condenser, cooling tower, solar panels, and axial flow compressor. In the study part learners will get the insight of various boilers and their accessories & mountings. This course covers the study of important thermal power plant components and experimentation on some of them.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Experiment with surface and Jet steam condenser and examine the performance.
CO2	Experiment with axial and reciprocating air compressor and examine the performance.
CO3	Classify and explain the boilers and their accessories & mountings
CO4	Experiment with cooling tower and examine the performance.
CO5	Experiment with solar power plant and examine the performance characteristics.

List of Experiments (minimum nine experiments):

1. Performance and testing of surface steam condenser.
2. Performance and testing of steam jet condenser.
3. Performance and testing of axial flow air compressor.
4. Performance and testing of Reciprocating Compressor.
5. Study of convergent-divergent nozzles.
6. To determine the efficiency of the nozzle.
7. Performance testing of Cooling Tower.
8. To study Benson Boiler and its mountings and accessories.
9. To study La Mont Boiler and its mountings and accessories.
10. To study Velox Boiler and its mountings and accessories.
11. To calculate the different losses in Boiler and its efficiency (Case Study in Industry).
12. To analyses different parameters affecting condenser efficiency (Case study in Industry).

13. Performance analysis on Solar Power Plant Prototype (minimum three experiments).

Equipment/Machines/Instruments/Tools/Software Required:

1. Surface steam condenser.
2. Jet steam condenser.
3. Reciprocating compressor.
4. Axial flow air compressor.
5. Nozzle with complete setup.
6. Cooling Tower setup.
7. Model of Benson boiler.
8. Model of Velox boiler.
9. Model of La Mont boiler

CO, PO & PSO Correlation

Course Name : Thermal Engineering Lab										
	Program Outcomes								PSOs	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1:	2	-	-	1	-	3	-	1	2	2
CO2:	1	1	1	-	-	1	-	1	1	3
CO3:	2	-		-	-	2	-	2	1	2
CO4:	3	-	2	-	-	1	-	3	2	3
CO5:	2	-	1	-	-	2	-	-	1	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 :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Internal Combustion Engines Lab**	**Course Code:**	**SOE-B-ME507**
Credits :	**2**	**No of Hours :**	**04/week**
Max Marks:	**50**		

Course Description: Internal Combustion Engine Laboratory is a well-equipped laboratory which provides ideas on practice of handling IC engines and measuring the performance parameters. The main aim is to understand the working of various IC Engines, the heat distribution in Diesel & petrol Engines, the Ignition system in IC Engines and the valve timing in IC Engines.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Understand the practical operation of 2 stroke and 4 stroke I.C engines using valve timing diagram and its impact on engine performance
CO2	Analyze the performance of multi cylinder engines with the variation of various performances like load and speed
CO3	Determine the quality of Engine fuels by analyzing its calorific value.
CO4	Estimate the constituents of combustion products for emission characteristics related to public safety

List of Experiment:

1. Familiarization with Sectional light weight models of IC Engine, carburetor, sectional working model for 4-Stroke petrol engine.
2. Familiarization with Sectional working model for four stroke cycle diesel engine.
3. To conduct the Performance test of 4 stroke Petrol Engine.
4. To conduct a performance test on diesel engine to draw heat balance sheet for given load and speed.
5. To study and conduct Morse Test on four-cylinder four-stroke Petrol Engine.
6. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine by using gas analyzer.
7. Performance test on single cylinder 4 stroke variable compression ratio engine.
8. Study of fuel supply system of a Diesel Engine (Fuel pump and Injector).
9. Study of ignition system of IC engine.
10. Study of valve timing and port timing diagram.
11. Performance analysis of CNG Engine.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	3	3	2	2	-	2	3	2
CO2	3	2	3	-	-	3	2	3	3	3
CO3	2	2	3	-	2	2	3	3	2	2
CO4	2	2	2	-	-	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 :	**B.Tech.**	**Semester :**	**V Semester**
Name of the Course:	**Kinematics of Machine & Dynamics of Machine Lab**	**Course Code:**	**SOE-B-ME508**
Credits :	**2**	**No of Hours :**	**04/week**
Max Marks:	**50**		

Course Outcomes (COs)

Course Outcomes: At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	Explain the jump phenomenon and construct the displacement diagram for the motion of the cam follower system
CO2	Understand the working principles of brakes and dynamometers
CO3	Apply the principles of gyroscopic effects and stabilization on various transport vehicles and applications of various governors
CO4	Determine the vibration parameters of different systems
CO5	Apply the principles of balancing masses to various links, mechanisms, and engines.

List of Experiments: (At least ten experiments are to be performed by each student)

1. To determine the jump phenomena of cam follower apparatus.
2. To find out the percentage slip at fixed belt tension by varying load with slip & creep apparatus.
3. Study of Four bar mechanism and its inversions.
4. To verify the Coriolis component of acceleration with theoretical and practical results.
5. To measure the transmitted torque and holding torque in an epicyclic gear train.
6. To study rope brake dynamometer and calculation of torque and power.
7. To find natural frequency of vibration by universal vibration apparatus.
8. To measure the frequency of torsional vibrations of single rotor system with universal vibration apparatus.
9. To find out the radius of gyration of bi-filler suspension with universal vibration apparatus.
10. To find out the Gyroscopic couple and prove the gyroscopic law with Gyroscope apparatus.
11. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
12. To verify the static and dynamic balancing for different planes and masses by balancing apparatus.
13. To measure the vibration of a machine by using tri-axial accelerometer.
14. To measure the vibration of a machine by using tri-axial accelerometer.

15. To measure Sound pressure level of a running machine using Sound level meter.

List of Equipment/Instruments/Machines Required:

1. Cam analysis apparatus.
2. Coriolis component of acceleration apparatus.
3. Slip & Creep Measurement Apparatus in Belt Drive.
4. Epicyclic Gear Train and Holding Torque Apparatus.
5. Rope brake dynamometer apparatus (with all accessories).
6. Universal Vibration Apparatus.
7. Gyroscope apparatus.
8. Governor apparatus with differential attachments.
9. Static and dynamic balancing apparatus.
10. Single and Tri axial accelerometer with data acquisition system.
11. Sound level meter.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	2	-	-	1	3	2
CO2	2	3	2	3	-	-	-	1	3	3
CO3	2	2	2	-	2	-	-	1	3	2
CO4	2	2	3	2	2	-	-	2	3	3
CO5	2	3	2	2	2	-	-	1	3	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU

UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Semester: V **Branch: Mechanical Engineering**

Subject: Seminar on Industrial Training **Code: SOE-B-ME509**

.....

Course description:

As a part of the B.Tech ME curriculum, Industrial Training and seminar is a Practical course, which the students of ME should undergo in reputed Private / Public Sector / Government organization / companies as industrial training of minimum four weeks to be undergone by the student in the summer vacation of the V semester.

Course Outcomes (COs)

Course Outcomes: At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions
CO2	To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
CO3	To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society
CO4	To set the stage for future recruitment by potential employers.

Procedures:

1. Call up the company first before sending out the application letters.
2. Find out whether there is a vacancy for industrial trainees.
3. If the company has vacancies, you have to ask for the person in charge. The person in charge may be from the HR department, training department, or any other departments of the company.
4. Try to get the name of the person so that you can address the letter to the person in charge correctly in your application letter.
5. Choose a company and Send the application letter received from your departmental training in-charge to the company directly.
6. Wait for the company's response.
7. If you don't get a response from the company within about 2 weeks or so, give them a call and enquire on your application status.
8. It is your responsibility to contact and follow-up with the company of your choice.
9. If you are not getting the company for training, immediately contact your training in-charge.

Note:

1. Presentation will take place the following week after you complete your training. The presentation is evaluation by your class in-charge and a panel.
2. Report must be submitted during presentation. The report evaluation is done by your class in-charge.
3. A Viva voce comprising comprehensive questions based on your presentation and training undergone will be put forth after your presentation.

Grading:

The training is graded based on:
Presentation: 25%
Student's reports: 30%
Viva voce: 25%
Student's Attendance: 20%

Task:

1. Discuss with your company supervisor about any project or assignment/tasks.
2. Try to understand the systems in your work place - Organization, administrative or practical
3. Record all the work done or knowledge gained
   - Maintain logbook
   - Email to lecturer softcopy every week

Etiquette:

1. Dress properly
2. Behave well
3. Portray good image as a university student
4. Be punctual
5. Observe work ethics
6. Concern for safety

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	-	3	3	3	2	2	2	2
CO2	2	2	1	2	2	2	2	2	1	2
CO3	2	1	2	2	1	1	2	2	1	2
CO4	-	-	-	2	1	2	2	2	1	2

Programme: B.Tech. Mechanical Engg. **Semester: V Sem**
Name of the Course: Electric Vehicle Design and Development
Course Code: SOE-B-ME510
Credits: 2 **No of Hours: 3 H/ Week** **Max Marks: 50**

Course Description:

This course introduces the fundamentals of electric vehicles (EV) in engineering with specific applications for commercial vehicles. The course focuses on mechatronic system and component design of EV based on the requirements to power flow management, power conversion. The course discusses design of batteries and energy storages in electric vehicles.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome (CO)
CO1	Design of the complete motor vehicle, vehicle body engineering and select appropriate motor for Electric Vehicle applications.
CO2	Evaluation of the vehicle performance and reduced the different losses or resistances occurred during the driving of vehicle.
CO3	To explain concepts and theory of electric power transmission of the vehicle and select appropriate motor with converter for EV applications.
CO4	Able to explain the vehicle vibration reduction, different types of chargers, their structure and usage, battery indication system for EV applications and to understand the testing of electric vehicle.
CO5	Able to know about the dynamics testing of vehicle, retro-fitment, charging station and understanding of vehicle control system and electronic models based on the knowledge gained.

Syllabus:
Unit-I
Introduction: Brief history of electric vehicles and comparative evolution with respect to petroleum vehicles.
High level block diagram: Main parts of electric vehicles - motor, controller, battery, battery management system, and electric vehicle control unit.
Vehicle performance: Tractive force, Tractive force Vs Vehicle speed, resistance to motion of the vehicle – rolling and gradient resistance, power requirement for acceleration and grade ability, maximum acceleration for front wheel drive – Rear wheel drive – four-wheel drive Vehicles.

Unit-II
Transmission Systems: Study of propeller shaft and universal joint, live axle and differential. **Steering and front axles:** Steering geometry, steering requirements,

steering linkages and steering gears, over steer and under steer, cornering power, reversibility of steering gears, types of front axles their constructions, troubleshooting and remedies.
Wheels and tyres: requirements of wheels and tyres, constructional features, types of tyres, application to ride and stability, troubleshooting and remedies.
Lighting system: types of lamps, Energy demands of lighting system, construction and types of head lamps.
Different accessories used in vehicles: Electric Horn, wipers, power operated windows, etc.

Unit-III
Vehicle Body Design: Importance of body design, material for body constructions – styling forms – coach and bus body style, layouts of passenger cars, bus and truck bodies. aerodynamic drag – aerodynamic lifts, pitching moments, side force, yawing moments and rolling moments.
Chassis types and structure types: open semi integral pedal and integral bus structures. **Frames:** function and types, loads on frames, load distribution of structure.

Unit-IV
Vehicle vibration and dynamics: types of vibration, vibration control, effect of vibration on human body, driver's comfort and passenger comfort vehicle vibration with single degree of vibration.
Suspension systems: objects of suspension, basic requirements, types of Suspension, Spring and shock absorbers.

Unit-V
Battery Management System: Importance of battery management system, battery management system design, onboard chargers, cell balancing, battery life optimization, battery cooling systems Electric.
Vehicle Charging: AC DC Charging, charger protocols, charging standards and interfaces (type2, chademo), charging method effect on battery, charging characteristics of battery.
Electric Vehicle Control Unit: principal of operations, interfacing with many sensors, design protocols, power management calculations, design considerations (vehicle use cases), safety optimization, performance optimization.

Text Books
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Reference Books:
1. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, General Motors, USA, John Wiley & Sons, Inc., 2017.

2. Tom Denton, Electric and Hybrid Vehicles, Taylor & Francis, 2018.
3. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, Third Edition, New Delhi, 2011.
4. Ali Emadi, Handbook of Automotive Power Electronics and Drives, Taylor & Francis Group, First Edition, USA, 2005.

CO-PO & PSO Correlation

CO Number	Program Outcome (PO)								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	3	-	-	2	-	-	3	3
CO2	3	3	3	1	1	2	-	-	3	3
CO3	3	3	3	2	2	1	-	-	3	3
CO4	3	3	3	2	2	2	-	-	3	3
CO5	3	3	3	-	-	2	-	-	3	3

- 3- Highly correlated, 2 - Moderately correlated, 1 - Weakly correlated
- Blank - No correlation

Mechanical Engineering
(Detailed Syllabus of 6th Semester)
L: Lecture, T: Tutorial, P: Practical, C: Credit

SEMESTER VI

Semester- VI											
SN	**Subject Code**	**Subject**	**Periods per week**			**Credit**	**Examination Scheme**				
							PRE			**ESE**	**TOTAL**
			L	**T**	**P**		**TA**	**MSE**	**TOTAL**		
1	SOE-B-ME601	Heat & Mass Transfer	3	0	0	3	20	30	50	50	100
2	SOE-B-ME602	Machine Tool & Machining	3	0	0	3	20	30	50	50	100
3	SOE-B-ME603	Design of Machine Element	3	0	0	3	20	30	50	50	100
4	SOE-B-ME604	Energy Conversion System	3	0	0	3	20	30	50	50	100
5	SOE-B-ME605	Professional Elective- I (Annexure-I)	3	0	0	3	20	30	50	50	100
6	SOE-B-ME606	Heat and Mass Transfer Lab	0	0	4	2	30	0	30	20	50
7	SOE-B-ME607	Machine Tool and Machining Lab	0	0	4	2	30	0	30	20	50
8	SOE-B-ME608	MATLAB Programming	0	0	4	2	30	0	30	20	50
9	SOE-B-ME609	Professional Communication	0	0	1	1	25	0	25	25	50
10	SOE-B-ME610	Principles of Management	2	0	0	2	15	15	30	20	50
TOTAL			**17**	**0**	**13**	**24**	230	165	395	355	750

PRE- Progressive Review Examination, TA- Teacher Assessment, MSE-Mid Semester Examination; ESE-End Semester Examination

Annexure-I

Sr. No	Subject Code	Courses
1.	SOE-B-ME605 (1)	Gas Dynamics and Jet Propulsion
2.	SOE-B-ME605 (2)	Computational Fluid Dynamics
3.	SOE-B-ME605 (3)	Welding Technology
4.	SOE-B-ME605 (4)	Material Handling System and Equipment
5.	SOE-B-ME605 (5)	Additive Manufacturing
6.	SOE-B-ME605 (6)	Power Plant Engineering

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme:	**B.Tech.**	**Semester:**	**VI Sem**
Name of the Course:	**Heat & Mass Transfer**	**Course Code:**	**SOE-B-ME601**
Credits: 3	**No of Hours: 03/week**	**Max Marks:**	**100**

Course Description:
This course offers lecture and laboratory classes to impart teaching and learning. The course is designed to provide a detailed knowledge of heat and mass transfer. The course started with the fundamentals of heat transfer and progress with the detailed discussion on different modes of heat transfer. At the end of the course various engineering devices/components will be discussed with respect to heat transfer involved.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Illustrate and solve governing differential equations for steady one dimensional heat conduction.
CO2	Apply and solve governing equations for conduction and convection for different fin configurations and examine transient heat transfer.
CO3	Apply the concepts of fluid flow and convection heat transfer to analyze the thermal system.
CO4	Describe radiative interactions and properties of different kinds of surfaces and estimate radiative heat exchange between two or more.
CO5	Evaluate performance of heat exchangers using LMTD & effectiveness method and recognize basic mass transfer

Syllabus:

Unit-I: Fundamental: Modes of heat transfer, effect of temperature on thermal conductivity of different solids, liquids and gases, derivation of generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, General laws of heat transfer.
Conduction: Fourier's law, one dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient.

Unit-2: Transient heat conduction: lumped heat capacity analysis, time constant, transient heat conduction in solids with finite conduction and convective resistances.
Heat transfer from extended surface: Types of fin, heat flow through rectangular fin, solution for infinitely long fin, insulated tip, finite long and heat transfer from fin tip, efficiency and effectiveness of fin.

Unit-3: Convection: Newton's law of cooling, dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection continuity, momentum and energy equations,

thermal and hydrodynamic boundary layer, Blasius solution for laminar boundary layer, general solution of Von-Karman integral momentum equation.

Unit-4: Radiation: Absorptive, reflectivity and transmissivity, black, white and grey body, emissive power and emissivity, laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law, intensity of radiation and solid angle, Lambert's cosine law.
Radiation heat exchange between black bodies, shape factor, heat exchange between non-black bodies- infinite parallel planes and infinite long concentric cylinders.

Unit-5: Boiling and Condensation: Boiling of liquids, Pool boiling curve, different types of pool boiling, Film wise & drop wise condensation.
Heat exchanger: Classification, heat exchanger analysis, LMTD and ε-NTU method for parallel and counter flow exchanger, cross flow heat exchanger.
Introduction to Mass Transfer: Mass and mole concentrations, molecular diffusion, eddy diffusion, Molecular diffusion from an evaporating fluid surface, Introduction to mass transfer in laminar and turbulent convection Combined heat and mass transfer, the wet and dry bulb thermometer.

Text Books:

1. P.K. Nag, Heat & Mass Transfer, McGraw Hill.
2. Yunus Cengel, Heat and Mass Transfer: Fundamentals and Application, McGraw Hill.
3. Incropera and Dewitt, Fundamental of Heat and Mass Transfer, Wiley Publication.
4. Mills and Ganesan, Heat Transfer, Pearson Education.

References Books:

1. J P Holman, Heat Transfer, McGraw Hill.
2. R K Rajput, Heat and Mass Transfer, S. Chand Publication.
3. Dutta, Binay K, Heat Transfer: Principles and Applications, PHI Publication.

CO, PO & PSO Correlation

Course Name : Heat and Mass Transfer										
	Program Outcomes								PSOs	
Course Outcomes	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	-	2	-	-	3	-
CO2	-	1	-	-	-	2	-	-	1	1
CO3	2	-	-	-	-	2	-	-	3	2
CO4	2	2	2	-	-	2	-	-	2	-
CO5	2	-	1	-	-	2	-	-	2	-

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B. Tech** **Semester: VI**
Name of the Course: **Machine Tools & Machining** **Course Code: SOE-B-ME602**
Credits: 3 **No of Hours: 03/week** **Max Marks: 100**

Course Description: The subject trains the students in the metal cutting domain so as to equip them with adequate knowledge about the various processes like turning, shaping, planning, drilling, milling, and grinding. To emphasize the prominent theories, concepts, and constructional features of machines related to them. To provide an insight into the superfinishing operations of lapping and honing. To lay the groundwork for further studies in the manufacturing stream.

Course Outcomes:
Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Understand the working of lathe, shaper, and planer, comprehend the speed and feed mechanisms of machine tools
CO2	Understand the working of drilling, milling, and grinding machines, Comprehend the speed and feed mechanisms of machine tools
CO3	Develop relations for chip reduction coefficient, shear angle, shear strain, forces, power, specific energy, and temperature in orthogonal cutting
CO4	Understanding the machinability aspects, selection of cutting fluids, and tool materials to control tool wear and temperature
CO5	Understand the working principles, applications, and importance of unconventional machining processes

Syllabus:

Unit-I:
Machine Tools: Concept and definition of machining and machine tools, history of developments of machine tools, concept of producing geometrical surfaces by generatrix and directrix, kinematic systems and structures of conventional machine tools. Classification, specification, construction, working principle and application of following machine tools.
Lathe: operations-facing, turning, knurling, taper turning, thread cutting, drilling, boring, reaming, work holding devices & tools, mechanism and attachments for various operations, semi-automatic and automatic lathes.
Shaper: Operations – horizontal cutting, vertical cutting, angular cutting, irregular cutting, Quick return Mechanisms. Table feed mechanism, work holding devices. Planner. Electromechanical and hydraulic drives and control of above machine tools. Machine tool automation.

Unit-II:

Machine Tools: Classification, specification, Construction, working principle and application of following machine tools.

Milling: Milling operations – plain, face, slotting, gear cutting mechanisms and attachments for milling, indexing-simple, compound and differential.

Drilling: Drill nomenclature, other operations like counter boring, counter sinking, spot facing etc. Reaming: description of reamers.

Boring: Boring operations, boring tools. Electromechanical and hydraulic drives and control of above machine tools, machine tool automation.

Grinding: Processes, grinding wheels, characteristics-abrasive type, grain size, bonding material, structure, and grade, wheel specification and selection, wheel life, types of grinding operations, specification of grinding wheel, economics of grinding.

Surface finishing operations: Honing, lapping, super finishing, polishing, buffing, process parameters and attainable grades of surface finish.

Unit-III:

Machining

Cutting tools- types, requirements, specification and applications. Tool geometry, mechanism of chip formation, mechanics of machining, theories of metal cutting, types of chips, chip breakers, orthogonal and oblique cutting, stress and strain in the chip, velocity relations, power and energy requirement in metal cutting.

Unit-IV:

Machinability

Concept and evaluation of machinability, mechanism of tool failure, tool wear mechanism, tool life, tool life equation, machinability index, factors affecting machinability. Thermal Aspects in machining and cutting fluid: source of heat in metal cutting and its distributions, temp measurement in metal cutting, function of cutting fluid, types of cutting fluid, cutting temperature causes, effects, estimation, measurement and control.

Unit-V:

Advanced Machining Processes

Introduction; Chemical Machining; Electrochemical Machining: Pulsed, Electrochemical Machining; Electrochemical Grinding; Electrical-discharge Machining: Wire EDM, Electrical-discharge Grinding; Laser-beam Machining; Electron-beam Machining; Water-jet Machining; Abrasive-jet Machining; Hybrid Machining Systems

Text Books:

1. P.N. Rao-Manufacturing Technology (Vol. – I & II), Tata McGraw Hill Pub. Company, New Delhi.
2. P.C. Sharma-A Text Book of Production Technology (Manufacturing Processes), S. Chand and Company Ltd., New Delhi.
3. G.R. Nagpal-Machine Tool Engineering, Khanna Publishers, New Delhi.
4. B.S. Raghuvanshi- A course in workshop Technology (Vol- I & II), Dhanpat Rai & Sons, New Delhi.

Reference Books:

1. A. Ghosh & A.K. Mallik- Manufacturing Science, East West Press Pvt. Ltd., New Delhi.
2. S. Kalpakjian & S.R. Schmid-Manufacturing Engineering and Technology, Addision Wesley Longman, New Delhi.
3. R. K. Jain, Production Technology- Khanna Publishers, New Delhi.
4. O.P. Khanna- A Text Book of Production Technology (Vol. I & II), Dhanpat Rai & Sons, New Delhi.
5. Sen, Bhattacharya- Principle of Metal Cutting, New Central Book Agency, Calcutta.
6. Kibbe Richard R-Machine Tool Practices, PHI, New Delhi.
7. Donaldson, Cyril, George H. LeCain, V. C. Goold, and Joyjeet Ghose- Tool design, Tata McGraw-Hill Education, 2012.
8. Chapman- W. A. J. Workshop Technology Part 1-3, 1998.
9. Juneja, B. L- Fundamentals of metal cutting and machine tools, New Age International, 2003.
10. HMT- H. M. T. Production technology, Tata McGraw-Hill Education, 2001.

CO-PO&PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	3	2	2	-	1	2	2
CO2	3	2	2	3	2	2	-	1	2	2
CO3	3	3	2	3	2	2	-	1	3	2
CO4	3	3	2	2	2	2	2	1	3	2
CO5	3	2	2	2	-	2	1	1	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: **B.Tech.** **Semester: VI**
Name of the Course: **Design of Machine Elements** **Course Code: SOE-B-ME603**
Credits: 3 **No of Hours:03/week** **Max Marks: 100**

Course Description: The objectives of this course are to develop an ability to design a system, component, or process to meet desired needs within realistic constraints. The student should able to apply the detailed design procedure of the different types of machine elements and select appropriate theory of failure. The student will also able to develop integrated approach for design of mechanical systems.

Course Outcomes:

CO Number	Course Outcome
CO1	Apply knowledge of machine design for understanding, formulating and solving engineering problems.
CO2	Acquire knowledge and hands-on competence in applying the concepts in the design and development of mechanical systems.
CO3	Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
CO4	Identify, analysis, and solve mechanical engineering problems useful to the society.
CO5	Work effectively with engineering and science teams as well as with multidisciplinary designs.

Syllabus:

Unit- I
Spur Gears: gear drives, classification of gears, selection of type of gears, law of gearing, force analysis, gear tooth failures, selection of material, number of teeth, face width, beam strength of gear tooth, effective load on gear tooth, estimation of module based on wear strength, Lewis equation, gear design for maximum power transmitting capacity, gear lubrication.

Unit- II
Helical Gears: helical gears, terminology of helical gears, virtual number of teeth, tooth proportions, force analysis, beam strength of helical gears, effective load on gear tooth, and wear strength of helical gears. Bevel gears: bevel gears, terminology of bevel gears, force analysis, beam strength of bevel gears, wear strength of bevel gears, effective load on gear tooth.

Unit- III
Bearings: rolling contact bearings - types of ball and roller bearings, selection of bearing for radial and axial load, bearing life, mounting and lubrication, shaft scales – contact

type and clearance type. Journal bearings: types of lubrication, viscosity, hydrodynamic theory of lubrication, Sommerfeld number, heat balance, self-contained bearings, bearing materials.

Unit- IV

Design of Brakes and Clutch: Types of clutches-mechanical, hydraulic and elctro-magnetic. Design of various mechanical clutches like single plate, multiple plate, centrifugal clutch etc., Design of various mechanical brakes like block brake, band brake, internal expanding shoe brake etc.

Design of hydraulic circuits for mechanical systems such as for achieving different machine tool operations.

Unit- V

Design of Pumps: Introduction to centrifugal pump and positive displacement pump, such as gear pump, vane pump, etc., design of main components of centrifugal pump - motor selection, suction and delivery pipe, impeller, impeller shaft, volute casing. application of mechatronics, sensors and IOT concepts in system design of centrifugal pump.

Text Books:

1. Bhandari V. B., Design of machine elements, Tata McGraw-Hill Education, 2010.
2. Shigley, Joseph E., Charles R. Mischke, and Richard G. Budynas. Mechanical engineering design, McGraw-Hill, 2004.
3. Robert, L. Norton, Machine Design-An Integrated Approach 2006.

Recommended Data Books:

1. V. Bhandari, Machine Design Data Book, McGraw Hill Education (2017).
2. Mahadevan K., Reddy K.B., Design Data Handbook for Mechanical Engineering in SI and Metric Units, CBS (2013)
3. PSG Design Data Book, PSG College, Coimbatore (2012)

Reference Books:

1. Spottes, M.F., Terry E. S., and Lee E.H., Design of machine elements. Vol. 2. Pearson Education India, 2004.
2. Maitra, Gitin M., Handbook of gear design, Tata McGraw-Hill Education, 1994.
3. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
4. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
5. Patil, SP., Mechanical System Design, JAICO students Ed., 2014.
6. Sahu G.K., Pumps, New Age International, 2000.
7. Sharma & Agrawal, Machine Design, Katson, New Delhi.
8. R. Phelan, Principles of Mechanical Design, McGraw Hill, New Delhi.
9. Sundarajamoorthy & Shanmugum, Machine Design, Anuradha, Chennai.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	1	-	1	1	1	1	1	3	1
CO2	2	2	2	2	1	1	1	2	2	3
CO3	3	3	3	2	2	2	2	3	3	3
CO4	2	2	2	2	2	3	3	3	3	3
CO5	2	2	2	3	2	2	2	2	2	1

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: **B.Tech** **Semester : VI Semester**
Name of the Course: **Energy Conversion System** **Course Code: SOE-B-ME604**
Credits :3 **No of Hours: 03/week** **Max Marks: 100**

Course Description:
This course offers lecture classes to impart teaching and learning. The course is designed to provide a detailed knowledge of various conventional and non-conventional energy conversion technologies. This course covers the concepts, numerical problems, and working principles of the various renewable, nonrenewable, conventional, and nonconventional energy sources and its conversion technologies.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Demonstrate a basic understanding of Gas turbine engine and its performance parameters.
CO2	Classify the Jet and rocket engine design and able to explain the working principle & components of each kind.
CO3	Explain about the renewable energy sources and direct & indirect solar energy utilization.
CO4	Classify and explain the different methods of biomass and wind energy conversion technologies.
CO5	Compare different renewable energy resources and choose the most appropriate based on local conditions.

Syllabus:
Unit-I: Gas Turbines: Classification of gas turbine, simple open cycle gas turbine Ideal and actual cycle (Brayton Cycle) for gas turbine, optimum pressure ratio for maximum specific output in actual gas turbine regeneration, reheat and inter cooling and effect of these modification on efficiency and output, closed cycle gas turbine.
Unit-2: Propulsion Devices: Types of Jet engines, Ram jet, Pulse jet, Turbojet, Turbo propulsion, principle and operation, energy flow through Jet and variation of pressure and temperature, thrust equation, specific thrust and velocity of fluid, thermodynamics of turbojet, efficiency & performance, parameters affecting performance, after burn, injection of water & alcohol mixture.
Rocket Propulsion: Classifications, Types of rocket engines, liquid propellant rockets, efficiency, and performance.

Unit-3: Renewable Energy Resources: Introduction to world energy scenario, renewable energy resources, solar energy, earth sun angles, resolution, solar measurement, collection of solar energy, flat plate and focusing collector analysis, calculations and same design parameters, applications of solar energy.
Solar photovoltaic system: Photovoltaic effect, efficiency of solar cells, semiconductor materials for solar cells, solar photovoltaic system.

Unit-4: Bio Mass: Gasifiers, gobar gas plant, types of applications, biomass conversion technologies, biogas generation.
Wind Energy: Basic principles of wind energy conversion, wind energy estimation, site selection consideration, and basic components of wind energy conversion system, classification, advantages, & disadvantages of WECS.

Unit-5: Additional Renewable Energy Resources: Tidal energy and OTEC - principle, resources and availabilities, energy conversion technologies.
Fuels cell technology, principle of MHD power system, types of MHD system, advantages, and materials for MHD system.
Geothermal energy, nature of geothermal fields, geothermal sources, prime movers for geothermal energy.

Text Books:

1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996.
2. Kothari D.P., Renewable energy resources and emerging technologies, Prentice Hall of India Pvt. Ltd.
3. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers.
4. R. Yadav, Steam and Gas turbine, Central Publishing House, Allahabad.

References Books:

1. S.M. Yahya, Turbine compressors and Fans, TMH.
2. J.K. Jain, Gas Turbine Theory & Jet Propulsion, Khanna Publishers.
3. D.S. Chauhan, Non-Conventional Energy Sources, New Age International Pub.
4. Garg & Prakash, Solar Energy, TMH Pub.

CO, PO & PSO Correlation

Course Name : Energy Conversion System										
	Program Outcomes								PSOs	
Course Outcomes	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	1	2	-	1	3	1
CO2	-	1	2	-	-	1	-	1	1	1
CO3	2	-	-	-	-	3	-	2	1	-
CO4	3	-	2	-	-	1	-	2	2	-
CO5	2	-	1	1	-	2	-	-	1	2

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech** **Semester : VI Semester**

Name of the Course: **Gas Dynamics and Jet Propulsion (Professional Elective-I)**

Course Code: SOE-B-ME605 (1)

Credits :3 **No of Hours: 03/week** **Max Marks: 100**

Course Objectives: The main aim is to understand the basic difference between incompressible and compressible flow. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

Course Outcomes:

Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Outline governing equations of compressible fluid flow.
CO2	Analyze one dimensional compressible flow through variable area duct.
CO3	Apply governing equations to compressible flow through constant area duct with friction.
CO4	Apply governing equations to compressible flow through constant area duct with heat transfer.
CO5	Interpret propulsive systems for their working and application.

Syllabus:

Unit-I

Basic Concepts and Isentropic Flows: Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.

Unit-II

Flow through Ducts: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

Unit-III

Normal and Oblique Shocks: Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl's – Meyer relations – Applications.

Unit-IV

Jet Propulsion: Theory of jet propulsion – thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

Unit V

Space Propulsion: Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Text Books

1. Anderson, J.D.-Modern Compressible flow, 3rd Edition, McGraw Hill, 2003.
2. Yahya- S.M. Fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

Reference Books:

1. Balachandran P.- Fundamentals of Compressible Fluid Dynamics - PHI Learning India Private Ltd. – 2009.
2. Cohen H., Rogers G. E. and Saravanamuttoo- Gas Turbine Theory. Longman – 1980.
3. Sutton G. P.- Rocket Propulsion Elements, John Wiley, New York - 1986.
4. Shapiro A. H.-Dynamics and Thermodynamics of Compressible Fluid Flow - Vol.-I - John Wiley, New York – 1953.
5. Radhakrishnan E.-Gas Dynamics, Prentice-Hall of India Pvt. Ltd – 2004.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	1	2	-	1	3	1
CO2	-	1	2	-	-	1	-	1	1	1
CO3	2	-	-	-	-	3	-	2	1	-
CO4	3	-	2	-	-	1	-	2	2	-
CO5	2	-	1	1	-	2	-	-	1	2

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech** **Semester : VI Semester**

Name of the Course: **Computational Fluid Dynamics (Professional Elective-I)**

Course Code: SOE-B-ME605 (2)

Credits :3 **No of Hours: 03/week** **Max Marks: 100**

Course Objectives

Computational fluid dynamics is an important tool to investigate fluid flow problems in industry and academia. The course deals with the numerical solution of equations governing fluid flow and would be of interest to engineers and scientists—both aspiring and professional—with chemical/mechanical/civil/aerospace engineering applications.

Course Outcomes:

Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Apply mathematics and engineering fundamentals to recognize the type of fluid flow and heat transfer that occur in a particular physical system and to use the appropriate model equations to investigate the problem.
CO2	Solve governing equations using finite difference and finite volume technique.
CO3	Apply suitable turbulence model for the chosen real world engineering problems
CO4	Solve fluid flow and heat transfer problems using commercial CFD tools

Syllabus:

Unit-I

Introduction and Governing Equations: Introduction to analytical, numerical and computational methods, mathematical description of physical phenomena, physical significance for mathematical classifications of partial differential equations as elliptic, parabolic and hyperbolic, physical meaning of general partial differential equations, basic concepts Eulerian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, laws governing fluid motion - continuity, momentum Navier – stokes & energy equations, boundary conditions – classification.

Unit-II

Mathematical Preliminaries: Solution of simultaneous equations: system of direct and iterative methods; Jacobi and various Gauss-Seidel methods (PSOR, LSOR and ADI), Gauss-elimination, TDMA (Thomas), Gauss-Jordan, other direct and indirect methods.

Unit-III

Discretization and Finite Difference Method: Basic aspects of discretization – finite difference, finite volume, and finite element method, elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis, stability of elliptic and hyperbolic

equations, fundamentals of fluid flow modeling-conservative property, upwind scheme, transporting property, higher order up winding. Finite difference applications in heat transfer –conduction, convection.

Unit-IV

Finite Volume Method: The Finite Volume Method for convection-diffusion problems – introduction - steady one dimensional convection and diffusion.
The central differencing scheme - assessment of the central differencing scheme for Convection-diffusion problems, the upwind differencing scheme - assessment of the upwind differencing scheme, the hybrid differencing scheme - assessment of the hybrid differencing scheme, the power-law scheme, higher order differencing schemes for convection-diffusion problems - Quadratic upwind differencing scheme: the QUICK scheme.

Unit-V

Turbulence Modeling: Introduction, types of turbulence modeling, Reynolds Time Averaging, Reynolds Time Averaged conservation equations – Boussinesq approach, One equation k – ε model.

Text Books:

1. Versteeg & Malalasekera- Introduction to computational fluid dynamics: the finite volume method, Addison-Wesley.
2. J.D. Anderson, Jr.- Computational Fluid Dynamics The basics with applications, McGraw-Hill, Incs, 2000.

Reference Books:

1. S.V. Patankar- Numerical heat transfer and fluid flow, hemisphere publishing company,1980.
2. Malalashekhara and Versteeg- An introduction of computational fluid dynamics (finite volume method).
3. Sunderarajan M.K.- Computational Fluid Flow and Heat Transfer, 2nd Ed, Narosa Publishing.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	-	2	-	-	3	-
CO2	-	1	-	-	-	2	-	-	1	1
CO3	2	-	-	-	-	2	-	-	3	2
CO4	2	2	2	-	-	2	-	-	2	-
CO5	2	-	1	-	-	2	-	-	2	-

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech.** **Semester: VI Sem**
Name of the Course: **Welding Technology (Professional Elective-I)**
Course Code: SOE-B-ME605 (3)
Credits: 3 **No of Hours: 3/week** **Max Marks: 100**

Course Description:
After going through this course the student will be able to: to understand of basic concept of welding, to understand the theoretical aspects of welding technology in depth. To understand the basic metallurgy of the melted and heat-affected zone of a metal or alloy. To know the welding parameters and techniques to optimize the weldments properties. To check the weldments quality using various inspection and testing methods.

Course Outcomes:
Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Understand the theoretical aspects of welding technology in depth.
CO2	Describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy
CO3	Identify the cause of welding defects and avoid them
CO4	Choose or adjust welding parameters and techniques to optimize the weldments properties
CO5	Demonstrate their ability to check the weldments quality using various inspections and testing methods

Syllabus:
Unit-I
Introduction to Welding and Joining Processes: Introduction to consolidation processes, classification of welding processes, types of fusion welds and joints, design considerations, heat effects, weld ability and join ability. Welding terms and definitions, welding positions, elements and construction of welding symbols.

Unit-II
Welding Metallurgy: Fundamentals of physical metallurgy, solidification of weld metal: principle of solidification of weld metal, modes of solidification, effect of welding parameters on weld structure, 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. Metallurgical issue in weld joint: mechanisms, causes and remedy of cold cracking, solidification cracking.

Unit-III
Weld Joint Preparation and Temperature Control: Checks prior to weld joint preparation, joint preparation checks, aims of preheating, interpass heating, post weld

heating, heating processes, post heat treatments, insulation of heated joints, temperature distribution in welding.

Unit-IV

Cracks and Defects in Welds: Classification of weld cracks, nomenclature, location and orientation of weld cracks, factors contributing to weld cracking, specific weld cracks, classification of weld defects, general sources of weld defects, arc welding defects, resistance welding defects, defects in friction welding.

Unit-V

Weldments Inspection and Testing: Chemical, metallurgical, and mechanical testing of weldments: comparison of destructive and non-destructive tests forms of corrosion, testing for corrosion resistance. selection of NDT method, relationship of welding processes, discontinuities and inspection methods, visual inspection prior to, during and after welding, liquid penetrant test, magnetic particle and radiographic inspection, ultrasonic inspection, eddy current inspection, acoustic emissions, proof tests and leak tests, inspection of pressure vessels. Introduction to weld 4.0.

Text Books:

1. Parmer R. S., Welding Engineering and Technology, Khanna Publishers, 1997.
2. S.P. Tewari and S.A. Rizvi, Advanced Welding Technology, S.k. Kataria & Sons.

Reference Books:

1. J.T. Black, Ronald Kohser, DeGarmo's, Materials and processes in Manufacturing, 11th Edition, Wiley Publication.
2. Lancaster J F, Metallurgy of welding, Allen and Unwin Co.
3. K. E. Esterling, Introduction to Physical Metallurgy of Welding, Second Edition.
4. Welding Handbook, Volumes 1, 2 and 3, 9th edition, American Welding Society.
5. Larry J and Jeffus L, Welding Principles and Applications, 5th edition, Delmer Publications.
6. Hull., Non-Destructive Testing, ELBS Edition, 1991.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	-	2	-	-	3	-
CO2	-	1	-	-	-	2	-	-	1	1
CO3	2	-	-	-	-	2	-	-	3	2
CO4	2	2	2	-	-	2	-	-	2	-
CO5	2	-	1	-	-	2	-	-	2	-

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech** **Semester : VI Semester**
Name of the Course: **Material Handling Systems and Equipment's**
(Professional Elective-I) **Course Code: SOE-B-ME605 (4)**
Credits :3 **No of Hours: 03/week** **Max Marks: 100**

Course Description:
This course provides an introduction to the field of material handling and to introduce to the importance of proper material handling and storage techniques. To introduce to selection of material handling equipment. To introduce to design considerations of mechanical handling equipment and load lifting attachments.

Course Outcomes:
Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	able to gain a strong foundation in Material handling system.
CO2	able to identify material handling equipment requirements for a specific process and for various locations and working conditions
CO3	Understand the design requirement of material handling systems
CO4	able to understand the benefit of an efficient material handling system
CO5	able to recognize the importance of material storage equipment's.

Syllabus:
Unit–I
Elements of Material Handling System: importance, terminology, objectives and benefits of better material handling, principles and features of material handling system, interrelationships between material handling and plant layout, physical facilities and other or organizational functions, classification of material handling equipment.

Unit–II
Material handling Equipment's and Systems for Various Materials: storing equipments like pallets, bins, racks, decking, order picking, positioning equipments. hoisting equipments like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators. Conveying equipments like belt, chain, roller, wheel, trolley, tray conveyors, gravity and vibratory type conveyors, screw conveyors. mobile equipments like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks, order pickers.

Unit-III
Selection of Material Handling Equipment: factors affecting selection of material handling equipment, material handling equation, choices of material handling equipment, general procedure for selection, basic analytical techniques, selection of suitable types of material handling systems, functions and parameters, affecting service,

packing and storage material, selection of material handling equipment in green sand moulding foundry, sugar manufacturing industry.

Unit–IV

Design of Mechanical Handling Equipment: design of hoists, drives for hoisting, components and hoisting mechanisms, rail traveling components and mechanisms. Design of cranes, hand-propelled and overheat traveling cranes, traveling mechanisms of cantilever and monorail cranes, design considerations for structures of rotary and cranes with fixed radius, fixed post and overhead traveling cranes.

Unit–V

Systems and Equipment used for Material Storage, Safety and Training: need, environmental and human factors in material handling, safety regulations, objectives of storage, bulk material handling, gravity flow of solid through slides and chutes, storage in bins and hoppers, belt conveyors, bucket-elevators, screw conveyors, cabin vibratory mobile racks etc.

Text Books:

1. N. Rudenko-Material Handling Equipments, Peace Publishers, Moscow.
2. James M. Apple- Material Handling System Design, John-Wiley Publication, New York.

References:

1. Allegri T H-Materials Handling Principals and Practice, CBS Publication, New Delhi.
2. John R. Immer- Material Handling, McGraw Hill Co. Ltd., New York.
3. Material Handling in Machine shops, Machinery Publication Co. Ltd., London.
4. M. P. Nexandrn- Material Handling Equipment, MIR Publication, Moscow.
5. C. R. Cock and J. Mason- Bulk Solid Handling, Leonard Hill Publication Co. Ltd. USA.
6. Kulwiac R. A- Material Handling Hand Book, John Willy Publication, New York.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	-	2	-	-	3	-
CO2	-	1	-	-	-	2	-	-	1	1
CO3	2	-	-	-	-	2	-	-	3	2
CO4	2	2	2	-	-	2	-	-	2	-
CO5	2	-	1	-	-	2	-	-	2	-

Note: 1: Low 2: Moderate 3: High

Programme: **B.Tech** **Semester : VI Semester**

Name of the Course: **Additive Manufacturing Processes (Professional Elective-I)**

Course Code: SOE-B-ME605 (5)

Credits :3 **No of Hours: 03/week** **Max Marks: 100**

Course Description:

This course is designed to provide an overview of available AM processes and basic scientific understanding of this emerging technology. The main aim is to introduce students, the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques. To familiarize students with different processes in rapid prototyping systems. To teach students about mechanical properties and geometric issues relating to specific rapid prototyping applications. To explore different applications of Additive Manufacturing Processes.

Course Outcomes:

Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Understand the importance of Additive Manufacturing
CO2	Classify the different AM processes
CO3	Design for AM processes
CO4	Understand the applications of AM.
CO5	Differentiate the post processing processes

Syllabus:

Unit-I

Introduction to Additive Manufacturing (AM): Introduction to AM, AM evolution, distinction between AM and CNC machining, advantages of AM. AM process chain: Conceptualization, CAD, conversion to STL, transfer to AM, STL file manipulation, machine setup, build, removal and clean up, post processing. Classification of AM processes: liquid polymer system, discrete particle system, molten material systems, and solid sheet system.

Unit-II

Introduction to Rapid prototyping (RP): Need of RP in context of batch production. Basic principles of RP, Steps in RP, process chain in RP in integrated CAD- CAM environment, advantages of RP, medical applications.

Unit-III

Classification of different RP techniques: based on raw materials, layering technique (2-D or 3-D) and energy sources: Process technology, Stereo-lithography (SL), photo polymerization, liquid thermal polymerization, solid foil polymerization.

Unit-IV

AM Applications: Functional models, pattern for investment and vacuum casting, medical models, art models, engineering analysis models, rapid tooling, new materials development, bi-metallic parts, re-manufacturing. Application examples for aerospace, defense, automobile, bio-medical and general engineering industries.

Unit-V:

Post Processing of AM Parts: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM: Introduction, new types of products, employment and digiproneurship.

Text Books:

1. Chua Chee Kai, Leong Kah Fai- Rapid Prototyping: Principles and Applications, World Scientific, 2003.
2. Ian Gibson, David W. Rosen, Brent Stucker- Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2nd edition, 2010.

Reference Books:

1. Ali K. Kamrani, Emand Abouel Nasr- Rapid Prototyping: Theory and Practice, Springer, 2006.
2. D. T. Pham, S. S. Dimov- Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.
3. Andreas Gebhardt- Understanding Additive Manufacturing, Hanser Publishers, 2011.

CO, PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	-	-	-	2	-	-	3	-
CO2	-	1	-	-	-	2	-	-	1	1
CO3	2	-	-	-	-	2	-	-	3	2
CO4	2	2	2	-	-	2	-	-	2	-
CO5	2	-	1	-	-	2	-	-	2	-

Note: 1: Low 2: Moderate 3: High

Programme : **B.Tech.** **Semester : VI Sem**
Name of the Course: **Power Plant Engineering (Professional Elective-I)**
Course Code: **SOE-B-ME605 (6)**
Credits : **3** **No of Hours : 03/week** **Max Marks: 100**

Course Description: This Course provides a simple understanding of the power plant engineering. The course contains the details of General sources of energy and generation, steam power plants, hydro power plants, nuclear power plants, along with solar, and wind energy. The economics of power generation and the environmental aspect of power generation are also being addressed in this course.

Course Outcomes (COs)

Course Outcomes: At the end of the course, the student will be able to

CO Number	Course Outcome
CO1	Compare different energy resources and choose the most appropriate based on local conditions.
CO2	Understand working, principle and constructions of Thermal Power Plant
CO3	Understand working, principle and constructions of Hydroelectric Power Plant and Wind Energy Conversion System.
CO4	Understand working, principle and constructions of Nuclear Power Plant and its important elements
CO5	Evaluate economic feasibility and its implications on power generating units.

Syllabus:
Unit I:

Introduction: General sources of energy and generation of electricity, future trends in power industry, coordination of power from different sources. Introduction, working Principle and applications of Renewable Energy sources (Solar, Wind, Hydroelectric only) Prospects of Renewable Energy Sources.

Unit II:
Thermal Power Plant: General layout, site selection and working of thermal power plant, basic thermodynamic cycles, coal handling, coal storage, Preparation & feeding, combustion and combustion equipment's, ash handling and dust collection, cooling system, draught system.

Unit III:

Hydroelectric Power plant and Wind Energy: Hydrograph, flow duration and mass curves, site selection, General arrangement of Hydroelectric Power Plant and its

operation, Storage and pond age, Classification of Hydroelectric Power Plant, selection of prime movers, Governing of turbines, Cavitation's in turbines.

Wind Energy: Basic principles of wind energy conversion, wind energy estimation, site selection consideration. Basic components of wind energy conversion system, Types of wind mills, generating systems, energy storage, advantages & disadvantages of WECS. Applications of Wind energy.

Unit IV:

Nuclear Power Plant: Principle of release of nuclear energy, fusion and fission reactions, nuclear fuels used in reactors, elements of nuclear reactors, moderators, control rods, fuel rods, coolants. Types of reactors PWR, BWR, Sodium graphite reactor, fast breeder reactor, Homogenous reactor and gas cooled reactor, radiation hazard, and shielding, radioactive waste disposal.

Unit V:

Power Plant Economics: Cost of energy production, selection of plant, performance and operating characteristics of power plants and generating equipment's. Tariffs for electrical energy, environmental aspects of power generation. Load estimation, load duration curve, load factor, capacity factor, diversity factor and demand factor, effect of variable load on power plant, selection of number and size of units.

Text Books:

1. P.K. Nag, Power Plant Engineering, Tata McGraw-Hill Publications Company, New Delhi, India.
2. V.M. Domkundwar & S.C. Arora, A Course in Power Plant Engineering, Dhanpat Rai Publications Company, New Delhi, India.

Reference Books:

1. R.K. Rajput, Text Book of Power Plant Engineering, Laxmi Publications.
2. P.C. Sharma, Power Plant Engineering, S.K. Kataria & Sons.
3. G.R. Nagpal, Power Plant Engineering, Khanna Publishers.
4. R. Yadav, Steam and gas turbine and power plant engineering, CPH Allahabad.
5. Skrotizke and Vopar, Power Station Engineering Economics, Tata McGraw-Hill Education.
6. Joel Weisman & Ray Eckart, Modern Power Plant Engineering, Prentice hall International Inc Publications.
7. M.M.E.I.- Wakil, Power Plant Engineering, Mc Graw Hill Education (I) Pvt. Ltd.
8. Black & Veatch, Power Plant Engineering.

CO-PO/PSO Mapping

	Program Outcome								PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	3	-	2	2	1	-	-	-	3	1
CO2	3	2	2	-	2	1	2	2	2	3
CO3	3	2	-	-	2	1	-	-	3	1
CO4	3	2	2	-	2	-	-	1	2	3
CO5	2	2	3	-	-	2	-	2	3	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 :	**B.Tech.**	**Semester :**	**VI Semester**
Name of the Course:	**Heat and Mass Transfer Lab**	**Course Code:**	**SOE-B-ME606**
Credits :	**2**	**No of Hours :**	**4/week**
Max Marks:	**50**		

Course Description:

This Lab course offers experimentations to impart teaching and learning. In this course learners will study and perform the experiments on heat and mass transfer systems such as heat exchanger, fins and also study the heat transfer in steady and unsteady scenarios. This course makes learners to understand the heat transfer phenomenon in different modes of heat transfer such as conduction, convection and radiation.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Evaluate heat transfer through lagged pipe, Insulating powder and Drop and Film wise condensation.
CO2	Experiment with a given metal Rod for determination of thermal conductivity.
CO3	Measure the Heat transfer coefficient for Pin Fin, forced convection, Natural Convection, and parallel and counter flow heat exchanger and to Experiment on Transient heat conduction.
CO4	Test for Emissivity, Stefan Boltzmann Constant, and Critical Heat flux.
CO5	Asses the performance of Refrigeration and Air conditioning and to determine the overall heat transfer coefficient for a composite slab.

List of Experiments (minimum ten experiments):

1. To Determine Thermal Conductivity of Insulating Powders.
2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3. To Measure the thermal Conductivity of Liquid.
4. To determine the transfer Rate & Temperature Distribution for a Pin Fin.
5. To Measure the Emissivity of the Test plate Surface.
6. To Determine Stefan Boltzman Constant of Radiation Heat Transfer.
7. To Determine the Surface Heat Transfer Coefficient for Heated Vertical Cylinder in Natural Convection.
8. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.
9. To Determine Critical Heat Flux in Saturated Pool Boiling.
10. To Study Performance of Simple Heat Pipes.

11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
12. To Find the Heat Transfer Coefficient in Forced Convection in a tube.
13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.
14. To find out the thermal conductivity of given slab material.
15. To determine the individual thermal conductivity of different lagging in a lagged pipe.
16. To study the rates of heat transfer for different materials and geometries.
17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
18. Testing and performance of different heat insulators.

Equipment/Machines/Instruments/Tools/Software Required:

1. Thermal conductivity of insulating powder apparatus.
2. Thermal conductivity of metal bar apparatus.
3. Thermal conductivity of liquid apparatus.
4. Transfer rate and temperature distribution for a pin fin apparatus.
5. Emissivity of the test plate surface apparatus.
6. Stefen-Boltzman constant of radiation of heat transfer apparatus.
7. Surface heat transfer coefficient for heated vertical cylinder in natural convection apparatus.
8. Heat transfer coefficient in drop wise and film wise condensation apparatus.
9. Critical heat flux in saturated pool boiling apparatus.
10. Performance of different heat pipe apparatus.
11. Heat transfer rate through heat exchanger apparatus.
12. Heat transfer coefficient in forced convection of air in a tube apparatus.
13. Heat transfer through composite wall apparatus.
14. Thermal conductivity of insulating slab apparatus.
15. Heat transfer through lagged pipe apparatus.
16. Unsteady state heat transfer apparatus.
17. Testing and performance test rig for heat insulators.

CO, PO & PSO Correlation

Course Name : Heat & Mass Transfer Lab										
	Program Outcomes								PSOs	
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	2	-	-	1	-	2	-	1	2	2
CO2	1	1	1	-	-	1	-	3	1	2
CO3	2	-	-	-	-	2	-	2	1	2
CO4	2	-	2	-	-	3	-	2	2	2
CO5	2	-	1	-	-	2	-	-	1	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 : **B.Tech.** **Semester : VI Sem**
Name of the Course: **Machine Tools & Machining Lab**
Course Code: SOE-B ME607
Credits : 2 **No of Hours : 04/week** **Max Marks:50**

Course Description:
Machine tools and machining processes introduces the types of cutting tools; Selection of cutting speeds and feed; Simple machining operations on lathe, shaping, slotting, milling and grinding machines.

Course Outcomes (COs)
Course Outcomes: At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	To explain the various parts and operations of the lathe, shaper, milling, drilling, and grinding machines
CO2	Perform plain turning, step turning, knurling, threading, eccentric turning, chamfering, and facing operations on a lathe
CO3	Ability to interpret job drawing, application of processes, and operations to produce basic components from raw material
CO4	Machine gears on a milling machine
CO5	Estimate the chip reduction coefficient and shear angle on a shaping machine.

Laboratory Component: (the student should perform a minimum ten experiments)

Machine tools:
1. Operation of Taper turning and Thread cutting in a Lathe.
2. Operation of Slot cutting in Shaper.
3. Operation of Gear cutting in milling machine using indexing head.
4. Alignment testing of Lathe.
5. Operation of Drilling, boring and reaming of a hole.
6. Acceptance test of machine tool (radial drilling machine).
7. System compliance of machine tool (centre lathe).

Machining:
1. Study of turning tool of Lathe (Tool signature) and re sharpening of turning tool to specific geometry.
2. Study of twist drill and re sharpening of drilling tool to specific geometry.
3. Study of dressing of grinding wheel.
4. Measurement of cutting forces and surface finish in turning, drilling, milling and grinding.
5. Measurement of cutting temperature and tool life in turning.
6. Machine setting and operation for spur/helical gear teeth cutting in milling.

7. Inspection of screw threads.
8. Inspection of gear teeth.

List of Equipment/Instruments/Machines Required:

1. Lathe Machine.
2. Shaper Machine.
3. Radial Drilling Machine.
4. Bench drilling machine.
5. Universal Milling Machine.
6. Bench Grinding Machine.
7. Thermal Imager.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	3	2	2	1	1	2	2
CO2	2	2	2	3	2	2	1	1	2	2
CO3	3	2	2	3	2	2	1	2	3	2
CO4	2	2	2	3	2	2	1	1	3	2
CO5	2	2	2	3	2	2	1	1	2	2

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: B.Tech. **Semester: VI**
Name of the Course: MATLAB Programming Lab **Course Code: SOE-B-ME608**
Credits: 2 **No of Hours:04/week** **Max. Marks:50**

Course Description: The course provides a MATLAB computing environment. It is designed to give students a basic to advanced understanding of MATLAB, including popular toolboxes. Courses cover the basics of MATLAB, graphical representations and tips for designing and implementing MATLAB code, and advanced techniques for specialized areas. The main aims are to do simple calculations using MATLAB and able to carry out simple numerical computations and analyses using MATLAB.

Course Outcomes (COs)

Course Outcomes: At the end of the course, the student will be able to:

CO Number	Course Outcome
CO1	Able to use MATLAB effectively to analyze and visualize data
CO2	Apply a top-down, modular, and systematic approach to design, write, test, and debug sequential MATLAB programs to achieve computational objectives
CO3	Design and document computer programs and analyses in a careful and complete manner so as to effectively communicate results, to facilitate evaluation and debugging by another programmer, and to anticipate and resolve user errors
CO4	Create and control simple plot and user-interface graphics objects in MATLAB
CO5	Apply numeric techniques and computer simulations to solve mechanical engineering-related problems

List of Experiments: (Minimum assignment 10)

1. MATLAB Basics: Introduction, operation with arithmetic, logarithmic and trigonometric function.
2. Operations with arrays, polynomials, problem practice.
3. Script file, problem practice.
2. Function file, problem practice.
3. Programming: graphics, input / output.
4. Plotting of 2D and 3D curves, problem practice.
5. Graphical User Interface.
6. Symbolic mathematics & Laplace transforms.
7. Roots: programming for general method.
8. Linear regression, general linear least-squares problem practice.
9. Polynomial: introduction and evaluation.
10. Nonlinear regression, polynomial interpolation.
11. Splines and piecewise interpolation problem practice.

12. Numerical integration formulas, numerical integration of functions.
13. Numerical differentiation, problem practice.
14. Ordinary differential equation problem practice.
15. Problems on lumped and continuum models from solid and fluid mechanics.
16. Heat transfer problem practice.
17. Simulation of various mechanical related model.

Text/Reference Books:

1. Chapra S. C.- Applied Numerical Methods with MATLAB, TMH publication. 2004.
2. Dukkipati R. V.- MATLAB for Mechanical Engineers, New Age International Publishers. 2009.
3. Pratap R.-Getting Started with MATLAB 7, Oxford University Press. 2005.
2. Dukkipati R. V. & Srinivas J.- Engineering Mechanics Problem with MATLAB, New Age International Publishers. 2008.
3. Mishra K. K.I. K.-A Handbook on Numerical Technique Lab: MATLAB Based Experiments, International Publication. 2007.

CO-PO/PSO Mapping

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	2	1	-	-	-	-	3	2
CO2	2	2	-	-	-	-	-	-	2	-
CO3	2	2	2	2	-	-	-	-	2	1
CO4	3	3	3	2	2	1	1	1	3	3
CO5	3	3	3	2	2	1	1	1	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

Program:	**B Tech.**	**Semester :**	**VI Sem.**
Name of the Course:	**Principles of Management**	**Course Code:**	**SOE-B-ME 610**
Credits :	**2**	**No of Hours :**	**20**
Max Marks:	**50**		

Course Description:

This course introduces the basic principles of management like planning, organizing and controlling. The content includes human resource aspects like motivation, leading, communication. Decision making capability is expected to improve through the critical study of managerial issues and problems. The course also deals with the ethical aspects involved in managerial decision making.

COURSE OUTCOMES:

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

COs	Course Outcome
CO1	Understanding the principles and practices of management in a global context.
CO2	Planning and analyzing the opportunities and impacts from an integrated perspective prevailing in the business organizations.
CO3	Applying the fundamental theories and techniques in the modern businesses.
CO4	Developing robust approaches to manage the changing needs of organizations.

Syllabus

UNIT-I: Introduction to Management & Historical Development
Definition of Management; Science or Art; Management and Administration; Development of Management Thoughts; Contribution of Taylor and Fayol; Functions of Management; Managerial Roles; Levels of Management; Types of Business Organizations.

UNIT-II: Planning: Nature & Purpose
Steps Involved in Planning; Objectives and Objective Setting; Types of Plans; Process of Managing by Objectives; Strategies; Policies and Planning Premises; Forecasting; Decision Making.

UNIT-III: Organising & Human Resource Management
Nature and Purpose; Formal and Informal Organization; Organization – Chart, Structure and Process; Departmentation by Different Strategies; Line and Staff Authority; Benefits and Limitations of Decentralization; Delegation of Authority; Introduction to Human Resource Management.

UNIT-IV: Directing

Scope; Human Factors; Creativity and Innovation; Harmonizing Objectives; Leadership & Leadership Theories; Motivation – Hierarchy of needs, Motivation Theories, Motivational Techniques, Job Enrichment.

UNIT-V: Controlling & International Management

System and Process of Controlling; Requirement for Effective Control; Budgetary Control Technique; Information Technology in Controlling; Use of Computers in Handling the Information; Productivity; Problems and Management; Control of Overall Performance; Direct and Preventive Control; Reporting; Global Environment; Globalization and Liberalization; International Management & Global Theory of Management.

Text Books:

1. H. Koontz, H. Weihrich, and Ramachandra Aryasri A., Principles of Management, 1st Edition, Tata McGraw-Hill Publishing Company Ltd., 2006.
2. H. Koontz, and H. Weihrich, Essentials of Management, Tata McGraw-Hill Publishing Company Ltd., 2000.
3. Philip Kotler, Marketing Management, Prentice Hall of India Publications.
4. G V Davis and M H Oison, MIS Conceptual foundation, structure and development, Tata McGraw-Hill Publishing Company Ltd., 1999.
5. Sushil, Flexibility in Management, Vikas Publications,New Delhi.

Reference Books:

1. Stephen P Robbins, Fundamentals of Management: Essential Concepts and Applications, 5th Edition, Pearson Education, 2005.
2. R Sivarethinamohan and P Aranganathan, Principles of Management, 1st Edition, CBA/Tata McGraw-Hill Hill Publishing Company Ltd., 2005.
3. James A F Stoner, Edward Freeman, and Gilbert, Management, 6th Edition, Pearson Education, Prentice Hall of India Pvt. Ltd., 2007.
4. Durbin, Essentials of Management, 7th Edition, Cengage Learning India Pvt. Ltd.

CO-PO & PSO Correlation

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	2	2	2	2	3	2	3	3
CO2	3	3	3	2	2	3	1	2	3	3
CO3	3	3	3	2	2	2	1	2	3	3
CO4	2	3	2	2	2	2	1	2	2	2

Note: Correlation Matrix Values of: 1= Low, 2= Moderate, and 3= High.

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme: B.Tech. **Semester:** VI Sem
Name of the Course: Professional Communication **Course Code:** SOE-B-ME609
Credits: 1 **No of Hours:** 01/week **Max Marks:** 50

Course Description:
Employability is a course for engineering students, designed to develop the knowledge and skills necessary to prepare for the career development. Knowledge of the factors involved in these roles is vital for preparing students to make informed and competent decisions regarding career and family life. This course focuses on the development of the transferable skills students need in job and life situation tasks. These skills include: basic academic skills, thinking skills, personal qualities, use of resources, interpersonal skills and using information.

Course Outcome

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

CO Number	Course Outcome
CO1	explore their values and career choices through individual skill assessments
CO2	make realistic employment choices and to identify the steps necessary to achieve a goal
CO3	develop and practice self management skills for the work site
CO4	explore and practice basic communication skills
CO5	learn skills for discussing and resolving problems on the work site
CO6	assess and improve personal grooming
CO7	promote safety awareness including rules and procedures on the work site.

Syllabus

UNIT-I: Career Exploration
a. Career Clusters
b. Interest inventory-Career Cruising
c. Career Cruising – My Portfolio

UNIT-II: Finding a Job
a. Job Sources
b. Networking and Personal Contacts
c. Entrepreneurship

UNIT-III: Job Search Skills
a. Resume Writing
b. Letter of Application
c. Job applications d. Interviews e. Professional Dress

UNIT-IV: Employer/Employee Relationships

a. Communication skills b. Transferable work skills
c. Positive work skills
d. Conflict resolution
e. Workplace legal issues
f. Work ethic

UNIT-V. Small Business
a. Small business types
b. Entrepreneurship
c. Business plan

Recommended Text & Reference Books

1. Hariharan S., Sundararajan, S. N., and Shanmugapriya, S.P. Soft Skills, Mjp Publishers.
2. Alex, Soft Skills: Know Yourself and Know the World.
3. Beverly Jaeger, Making Work for the Highly Sensitive Person, McGraw-Hill Education.
4. Dipali Biswas, Enhancing Soft Skills; Shroff; First edition Publication.
5. M. S. Rao, Soft Skills – Enhancing Employability: Connecting Campus with Corporate, I K International Publishing House Pvt. Ltd.
6. Shalini Verma, Enhancing Employability @ Soft Skills, Pearson Education; First edition.
7. A J Balasubramanian and Dr J Sadakkadulla, Get your First Job: A companion for getting your first job – A Guide to Employability Skills and Career Planning, Amazon Asia-Pacific Holdings Private Limited.
8. Beverly Amer, Soft Skills at Work: Technology for Career Success, Course Technology Inc.
9. Sally J. Vonada and JoAnn Brunner, BEST: Basic Employability Skills Training: Volume 1, CreateSpace Independent Publishing Platform.
10. Kim Watty and Beverley Jackling, Personal Transferable Skills in Accounting Education RPD, Routledge; 1 edition.
11. Atul John Rego, How to develop a pleasing personality, Publisher: Better yourself books, Mumbai, 2006.

CO-PO & PSO Correlation:

Course Outcome	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	-	-	-	2	-	-	-	-	1	-
CO2	-	-	-		-	2	-	-	-	-
CO3	-	-	-	3	-	-	-	-	1	-
CO4	-	-	-	2	-	-	-	-	-	2
CO5	-	-	-	2	-	2	-	1	1	1
CO6	-	-	-	1	-	-	2	-	2	-
CO7	-	-	-	-	-	-	-	2	-	1

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

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering

B. Tech in Mechanical Engineering (VII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-ME708	Mechanical	Research Internship /Industry Internship	0	0	44	0	250	250	500	22
			TOTAL	**0**	**0**	**44**	**0**	**250**	**250**	**500**	**22**
OR											
1	SOE-B-ME701	Mechanical	Refrigeration & Air Conditioning System	3	0	0	30	20	50	100	3
2	SOE-B-ME702	Mechanical	Professional Elective- II (Annexure-II)	3	0	0	30	20	50	100	3
3	SOE-B-ME703	Mechanical	Robotics & Automation	3	0	0	30	20	50	100	2
4	SOE-B-ME704	Mechanical	Computer Aided Design and Manufacturing	3	0	0	30	20	50	100	2
5	SOE-B-ME705	Mechanical	Refrigeration and Air Conditioning Lab	0	0	4	0	30	20	50	2
6	SOE-B-ME706	Mechanical	Robotics and Automation Lab	0	0	2	0	15	10	25	1
7	SOE-B-ME707	Mechanical	CAD/CAM Lab	0	0	2	0	15	10	25	1
			TOTAL	**12**	**0**	**08**	**120**	**140**	**240**	**500**	**14**

L: Lecture T: Tutorial P: Practical ESE: End Semester Examination T.A: Teacher's Assessment. PRE- Progressive Review Examination

Option A: The Students who opted for an Internship in the 7th Semester will have to choose Subjects in the 8th semester.

Option B: The Students who opted for Subjects in the 7th Semester will have to opt internship in 8th semester.

Professional Elective- II **(Annexure-II)**

S.N	Subject Code	Courses
1.	SOE-B-ME702 (1)	Industrial Engg and Production Management
2.	SOE-B-ME702 (2)	Finite Element Method
3.	SOE-B-ME702 (3)	Production Planning and Control
4.	SOE-B-ME702 (4)	Automobile Engineering
5.	SOE-B-ME702 (5)	Solar Energy Technology
6.	SOE-B-ME702 (6)	Introduction to Stainless Steel
7.	SOE-B-ME702 (7)	Process Planning and Cost Estimation
8.	SOE-B-ME702 (8)	Total Quality Management
9	SOE-B-ME702 (9)	Innovation, Entrepreneurship and Leadership
10.	SOE-B-ME702 (10)	TQM and Reliability Engineering

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	B.Tech.	**Semester :**	VII Sem
Name of the: Course:	Research Internship /Industry Internship	**Course Code:**	SOE-B-ME708
Credits:	22	**No of Hours:**	44 hours per week
Max Marks:	500		

Course Description:

The main objectives of internship training are to expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry. It provide exposure to the current technological developments relevant to the subject area of training.

Course Outcomes:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control
CO2	Understand the psychology of the workers and their habits, attitudes and approach to problem solving.
CO3	Apply the Technical knowledge in real industrial situations.
CO4	Gain experience in writing Technical reports/projects
CO5	Expose students to the engineer's responsibilities and ethics

Internship Guidelines:

Step 1: Request Letter/ Email from the office of the university should go to industry to allot various slots of 3-6 month during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.
Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers.
Step 5: Students will submit training report after completion of internship.
Step 6: Training Certificate to be obtained from industry.
Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell

Evaluation Through Seminar Presentation/Viva-Voce:
The student will give a seminar based on his training report, before an expert committee constituted by the department as per norms of the institute.

The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	1	-	2	1	-	-	3	1
CO2	1	-	-	3	2	2	2	2	2	2
CO3	2	2	3	2	2	2	2	2	3	1
CO4	2	3	1	3	2	3	-	-	3	2
CO5	-	-	-	-	-	2	3	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Refrigeration & Air Conditioning System	**Course Code:**	SOE-B-ME701
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

This course is designed to provide a simple and basic understanding of the fundamentals of Refrigeration and Air-conditioning to the learners. In this course learners will be introduced to the different refrigeration cycles and key concepts of psychrometry and psychrometric processes needed for designing air-conditioning systems. In addition to it, the estimation of cooling/heating load for comfort air-conditioning is also addressed in this course.

Course Outcomes:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Explain the need of refrigeration systems, basic units of refrigeration, and different types of refrigeration systems
CO2	Identify the key components of vapour compression refrigeration system and access it's performance
CO3	Choose the appropriate air-refrigeration systems for aircraft, and vapour absorption refrigeration system for remote applications
CO4	Understand the properties, applications and environmental impact of various refrigerants
CO5	Understand the different psychrometric processes and estimate the cooling/heating load for a particular application considering human comfort and operating conditions

Syllabus

Unit-I

Introduction to Refrigeration: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Simple vapour Compression Refrigeration System, Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions, liquid vapour heat exchangers, actual refrigeration cycle. Introduction to Multiple Evaporator and compound compression systems.

Unit-II

Gas Cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative Heat Exchanger. Air cycle for aircraft. Necessity of cooling of aircraft, Basic cycle, boot strap, regenerative type air refrigeration cycle.

Unit-III

Vapour Absorption System: Simple vapour absorption system, Electrolux Refrigerator, Analysis of Ammonia absorption refrigeration system, Lithium Bromide Absorption Refrigeration System.

Refrigerants: Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants.

Refrigeration Equipment's: Compressor, condenser, evaporator, expansion devices – types & working.

Unit- IV

Psychrometry: Psychrometric properties, psychometric relations, psychrometric charts, psychrometric processes, cooling coils, By-pass factor and air washers. Human Comfort Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.

Unit-V

Cooling load calculations: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling, selection of air conditioning, apparatus for cooling and dehumidification, Air conditioning system, Central, split and window air conditioning system.

Text Books:

1. C. P. Arora, Refrigeration and Air Conditioning, TMH, Delhi.
2. Arora & Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai, Delhi.

Reference Books:

1. R.K.Rajput, Refrigeration& Air Conditioning, S.K. Kataria, Delhi.
2. P.L. Ballaney, Refrigeration and Air Conditioning, Khanna Pub. Delhi.
3. Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill, Delhi.
4. P. N. Ananthanarayanan, Basic Refrigeration and Air-Conditioning, TMH, Delhi.
5. Roy J. Dossat, Principles of Refrigeration, Pearson, Delhi.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	1	-	-	1	-	-	1	-
CO2	3	2	2	1	-	1	-	1	3	2
CO3	3	2	2	1	-	1	-	1	2	2
CO4	2	1	2	-	-	1	1	2	1	1
CO5	3	2	2	1	-	1	1	1	3	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Robotics & Automation	**Course Code:**	SOE-B-ME703
Credits :	2	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

This course introduces the fundamentals of Robotics and Automation to students. The course focuses on to the basic principles of Robotic technology, configurations and control of Robots. The course explains about the kinematic and dynamic constraints of robotic elements. In this course information about the sensors and transducers are embedded, which are intricate parts of any robotic system. Robotic functions and applications are the core part of the course.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Ability to understand basic concepts of robotics
CO2	To analyze Instrumentation systems and their applications
CO3	To know about the differential motion, add statics in robotics
CO4	To know about the various path planning techniques.
CO5	To know about the dynamics and control in robotics industries.
CO6	Knowledge of industrial automation by transfer lines and automated assembly lines.
CO7	Ability to design an automated system

Syllabus:

Unit-I

Introduction: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Sub-assemblies. Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers Proportional, Integral, Differential, ND controllers.

Unit-II

Kinematics of Robot Manipulator: Introduction, General Mathematical Preliminaries on Vectors & Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw (RPY) Transformation. D-H Representation &

Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation.

Unit-III

Trajectory Planning: Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories 4-3-4 & 3-5-3 Trajectories.

Unit-IV

Dynamics of Robotic Manipulators: Introduction, Preliminary Definitions, Generalized Robotic Coordinates, Jacobian for a Two Link Manipulator, Euler Equations, The Lagrangian Equations of motion. Application of Lagrange—Euler (LE) Dynamic Modeling of Robotic, Manipulators: Velocity of Joints, Kinetic Energy T of Arm, Potential Energy of Robotic Arm, The Lagrange L. Two Link Robotic Dynamics with Distributed Mass.

Unit-V

Robot Sensing and Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors. Industrial Applications: Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

Text Books:

3. Introduction to Robotics: J. Craig, Pearson
4. Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
5. Robotics Engineering: R. Klafter, PHI
6. Robotics: Subir K Saha , Mc Graw Hill
7. Industrial Robotics: M. P. Groover, Ashish Dutta, McGraw Hill.

Reference Books:

1. Robotics for Engineers YoramKoren, McGraw Hill International
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International
3. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI
4. Computer Based Industrial Control- Krishna Kant, EEE-PHI
5. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk
6. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	1	-	-	-	2	-	1	2	2
CO2	1	2	2	2	-	3	1	2	1	2
CO3	3	2	2	2	-	1	2	1	1	2
CO4	3	3	3	-	-	2	-	2	2	2
CO5	3	3	3	-	2	3	-	2	3	3
CO6	2	2	3	-	-	3	-	3	3	3
CO7	2	3	3	-	2	3	-	3	1	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Computer Aided Design and Manufacturing	**Course Code:**	SOE-B-ME704
Credits :	2	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

In this course, the student will be familiar with parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids. The student will get exposure to CAD tools for use in mechanical engineering design conceptualization, geometric modelling, communication, analysis and optimization. The knowledge is also imparted in recent advances in the Computer Aided Manufacturing.

Course Outcomes:

After Completion of the course Students will be able to: able

CO Number	Course Outcome
CO1	Recognize various types of Curves, surface and solid and their application as used in geometric modeling.
CO2	Understand the concept of parametric modeling which is the mainstay of most of the 3D modeling system
CO3	Plan and execute the production activity control, which actually deals with operations in the shop floor.
CO4	Generate and verify the tool path and NC programs for milling and drilling manufacturing processes.
CO5	Skillfully use modern engineering tools and techniques for mechanical engineering design, analysis and application.

Syllabus:

Unit-I

Computer Graphics: Introduction to Computer aided design, Computer Graphics Module, Transformations-Introduction, Formulation, Translation, Rotation, Scaling and Reflection. Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations. Projections: Orthographic and Isometric.

Unit-II

Modelling: Curves-Introduction, Analytic Curves - Line, Circle, Ellipse, Parabola, Hyperbola. Synthetic Curves - Hermite Cubic Spline, Bezier Curve, B-Spline Curve. Numericals on Line, Circle, Ellipse and Hermite Cubic Spline. Surfaces-Introduction, Surface Representation, Analytic Surfaces, Synthetic Surfaces, Hermite bicubic Surface, Bezier surfaces, B-spline Surfaces, Coons Surface [No analytical treatment]. Solids:

Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid Modeling, Feature Based Modeling, Parametric Modeling, Constraint Based Modeling, Mass, area, volume calculation.

Unit-III

Computer Aided Manufacturing: Introduction to Computer Aided Manufacturing. CNC Programming-CNC part programming adaptable to FANUC controller. Steps in developing CNC part program. CNC part programming for Lathe Machine – Threading & Grooving cycle (Canned cycle). CNC part programming for Milling Machine - Linear & circular interpolation, milling cutter, tool length compensation & cutter radius compensation. Pocketing, contouring & drilling, subroutine and Do loop using canned cycle.

Unit-IV

Group Technology: Introduction to group technology, part families, parts classification & coding, three parts classification & coding system, group technology machine cells, benefits and Limitation of group technology.
Computer integrated manufacturing (CIM) system Introduction of Computer Aided Process Planning, Flexible Manufacturing System, Types, Advantages, Limitations.

Unit-V

Advanced Manufacturing Method: Introduction to Rapid Prototyping, classification of RP Processes, working principle, models & specification process, application, advantages & disadvantages & case study of Stereo Lithography Apparatus (SLA) Laminated Object Manufacturing (LOM) Selective Laser Sintering (SLS) 3D Printing. Fused Deposition Modeling (FDM). Rapid Tooling and STL format.

Text Books:

1. Zeid, Ibrahim & Sivasubramanian, CAD/CAM Theory and Practice, TMH, Delhi.
2. P.N. Rao, CAM/CAD Principle & Applications, TMH, New Delhi.

Reference Books:

1. Milkell P. Groover, Emory W. Zimmer, CAD/CAM, Pearson Education, Delhi.
2. Lalitnarayan, Computer Aided Design & Manuacturing, PHI, Delhi.
3. N. Krishnamoorty, Introduction to Computer Graphics, TMH, Delhi.
4. T. Jeyapoovan, Robert Quesada, Computer Numeric Control, Pearson Education.
5. Surendra Kumar & A.K. Jha, CAD/CAM, Dhanpat Rai, New Delhi.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	1	2	-	-	2	-	2	2
CO2	3	3	2	2	-	-	2	-	2	2
CO3	-	2	2	2	2	1	-	1	2	2
CO4	1	3	2	3	1	1	-	-	3	3
CO5	2	3	3	1	-	-	-	-	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Refrigeration and Air Conditioning Lab	**Course Code:**	SOE-B-ME705
Credits :	2	**No of Hours:**	4 hours per week
Max Marks:	50		

Course Description:

This lab course introduces students to various refrigeration and air conditioning systems and their performance analysis.

Course Outcomes:

After completion of the course students will be able to:

CO Number	Course Outcome
CO1	Obtain the knowledge about the basic components of refrigeration system
CO2	Evaluate the performance of vapor compression refrigeration system
CO3	Evaluate the performance of vapor absorption refrigeration system
CO4	Analyze the air conditioning processes using principles of Psychrometry.
CO5	Evaluate cooling and heating loads in an air conditioning system.

List of Experiments:

(Minimum seven experiments are to be performed by each student)

1. To study Domestic Refrigerator.
2. To study the Hermetically Sealed Compressor.
3. To study Vapour Compression refrigeration system and determine the COP.
4. To Study the Mechanical Heat Pump and to determine the following: -
   a. Theoretical coefficient of Performance
   b. Actual Coefficient of Performance.
   c. Theoretical capacity of the plant
   d. Actual capacity of the plant
5. To study the Air and Water Heat Pump and to determine the following: -
   a. Theoretical coefficient of Performance of the system as a refrigerator and as a heat pump.
   b. Actual Coefficient of Performance of the system as a refrigerator and as a heat pump.
   c. Capacity of the system in tons as a refrigerator.
   d. Capacity of the system in kW as a heat pump under the following conditions of operation: -
      i. Water cooled condenser and water-cooled evaporator.
      ii. Water-cooled condenser and air-cooled evaporator.

iii. Air-cooled condenser and air-cooled evaporator.
iv. Air-cooled condenser and water-cooled evaporator.

6. To study the following processes on the Air Conditioning Test Rig.
   a. Sensible Heating
   b. Sensible Cooling
   c. Sensible Cooling/cooling dehumidification
   d. Humidification and cooling
7. To Find the Efficiency of Cooling Tower Test Rig.
8. To Study the Simple Vapor Absorption System.

Equipment/Machines/Instruments/Tools/Software Required:

1. Domestic Refrigerator
2. Cut Section of Hermitically Sealed Compressor
3. Vapor Compression Refrigeration Test Rig
4. Mechanical Heat Pump Test Rig
5. Air & Water Heat Pump Test Rig
6. Air Conditioning Test Rig
7. Simple Absorption System Test Rig
8. Cooling Tower Test Rig

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	-	2	2	-	2	-	-	1	-
CO2	3	2	1	2	-	2	-	1	2	2
CO3	3	2	1	2	-	2	-	1	2	2
CO4	2	2	2	2	-	2	-	-	2	1
CO5	3	2	1	2	-	2	-	1	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Robotics and Automation Lab	**Course Code:**	SOE-B-ME706
Credits :	1	**No of Hours:**	2 hours per week
Max Marks:	25		

Course Description:

This lab introduces the preliminary practical fundamentals of Robotics and Automation to students. The lab focuses on to the basic principles of Robotic technology, configurations and control of Robots. This lab demonstrates about the kinematic and dynamic constraints of robotic elements also it demonstrates the applications and functions of sensors and transducers which are intricate parts of any robotic system.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	To introduce different types of robotics and demonstrate them to identify different parts and components.
CO2	To write programming for simple operations.
CO3	Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots.
CO4	Knowledge of industrial automation by transfer lines and automated assembly lines.
CO5	Ability to design an automated system.

List of the Experiments (Minimum 10 experiments should be performed)

1. Demonstration of Cartesian/ cylindrical/ spherical robot.
2. Demonstration of Articulated/ SCARA robot.
3. Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software.
4. Design, modeling and analysis of two different types of grippers.
5. Study of sensor integration.
6. Two program for linear and non-linear path.
7. Study of robotic system design.
8. Setting robot for any one industrial application after industrial visit.
9. To lift the object and place 100 mm away in various directions.
10. To find the gripper movement from 0 to 50mm.
11. To determine 5 Axis Robotic Arm movement and its degree of rotation.
12. To determine the object distance from 30mm to 300mm.
13. To detect the objects with infrared ray detector.
14. To find the horizontal and vertical movement up to 180° in either side.
15. To detect the distance from 100 mm to 800 mm with infrared object detector.

List of equipment's

1. 6-Axis Educational Robot Trainer
2. 5-Axis SCORBOT Robot
3. Line Follower Robot
4. Hex Crawler Robot

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	2	-	3	1	2	3	2
CO2	3	2	2	2	-	2	2	1	2	2
CO3	3	3	3	-	2	3		1	3	3
CO4	3	2	2	2	-	3	1	2	3	2
CO5	3	2	2	2	-	2	2	1	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Computer Aided Design and Manufacturing Lab	**Course Code:**	SOE-B-ME707
Credits :	1	**No of Hours:**	2 hours per week
Max Marks:	25		

Course Description:

The CAD/CAM Lab is aimed at giving exposure to and enhancing the knowledge and skills of engineers involved in the operation use of CNC machines, CAD packages and for those who want to provide training to others in this area.

Course Outcomes:

After Completion of the course Students will be able to: able

CO Number	Course Outcome
CO1	Execute steps required for modeling 3D objects by using protrusion, cut, sweep, extrude commands.
CO2	Convert 3D solid models into 2D drawing-different views, sections.
CO3	Skills to program and operate CNC machines to machine simple components.
CO4	Use CAM software to generate NC code.
CO5	Ability to develop a product from conceptualization to reality.

Syllabus:

Total TEN Experiments are to be carried out. FIVE Experiments each from CAD and CAM.

A.CAD Experiments

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for Translation/rotation /scaling: Writing and validation of computer program.
3. Understanding and use of any 3-D Modeling Software commands.
4. Experiment: Solid modeling of a machine component using Advanced-modeling software.
5. Structural analysis experiment using FEM software.

B.CAM Experiments

1. To study the characteristic features of CNC machine.

2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. To study CAM software to generate NC code.
6. Design and fabricate the product using 3D printer.
7. Demonstration of CNC laser Cutting Machine.
8. Demonstration on 4-axis CNC Machine.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	3	2	1	-	1	1	1	2	3
CO2	3	3	2	-	-	1	1	1	3	2
CO3	3	3	2	2	-	2	2	2	2	2
CO4	3	3	2	2	-	2	2	2	2	2
CO5	2	3	3	2	2	2	1	1	3	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Industrial Engineering and Production Management	**Course Code:**	SOE-B-ME702 (1)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

This course describes the broad scope of areas in which industrial engineers are engaged, including areas that became part of industrial engineering (IE) in recent decades such as work measurement, work design, ergonomics, production and productivity, site selection and plant layout, supply chain management, and service engineering. These fields are becoming an important part of the IE profession, alongside the traditional areas of IE such as production & operations management, project management, quality management, work measurement, and operations research. Industrial engineers require a strong understanding and good knowledge in all of these fields in order to perform their tasks in the industry.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Get familiar with the basic aspects of Industrial engineering and production and productivity measurement.
CO2	Understand and apply the concept of Work study and Method-study in the industry
CO3	Understand the plant layout and apply the concept of Time study in the industry.
CO4	Understand and apply the concept of production system and production management, New product design and capacity planning in the industry.
CO5	Know the recent trends like project management, material requirement planning (MRP), manufacturing resources planning (MRP II), ERP and supply chain management.

Syllabus:

Unit-I

Introduction to Industrial Engineering: Definition, history and development of Industrial Engineering, Industrial Engineering Approach, Objectives, Functions & Techniques of Industrial Engineering. Place of Industrial Engineering Department in the organization, System approach.

Productivity: Concept and definition of Productivity, Production and Productivity, Benefits from Productivity, Productivity measures, Advantages and limitations of Productivity measures, Factors Influencing Productivity, Productivity Improvement Techniques.

Unit-II

Work-Study: Introduction, Importance & advantages of Work study, Work study procedure, work simplifications & Work study, Human considerations in Work study, Work study & management, Influences of methods and time study on production activities, concept of work content, reasons for excess work content, techniques to reduce work content, work study as a tool to improve productivity.

Method-Study: Introduction, Objectives, scope of Method-Study, steps Involved in Method-Study, selection of jobs for Method-Study, Recording techniques, micro motion study, critical examinations, development and selection of new methods, Principle of motion economy, Installation of the proposed methods.

Unit-III

Plant Location and Layout: Introduction, need for selecting a suitable location, Plant location problems. Definition, Objectives, principles of plant layout, Types of Manufacturing systems, Types of layouts, Tools and techniques of plant layout.

Work Measurement/Time Study: Definition, objectives and Techniques of Work Measurement. Time study equipment', Performance rating, Allowances, Computation of Standard time, Work sampling, Synthetic data, Predetermined Motion Time Analysis (PMTS).

Unit-IV

Production System: Introduction, Production and Production Management, Objectives, Functions and scope of Production Management, Production Management Frame work, Relationship of Production with other functional areas.

New Product Design: Introduction, Product Life-Cycle, product policy of an organization, selection of profitable product, product design process, product analysis.

Demand Forecasting: Introduction, Forecasting and prediction, need of Demand forecasting, Long term and short term forecast, Classification of forecasting methods, Judgmental techniques, Time Study Analysis, least square methods, Moving average method.

Unit-V

Project management and MRP: Introduction, Project Concept and Definition, Characteristics of projects, Project identifications, Sources of Projects ideas, Project management phases and project appraisal, Tools and Techniques of Project Management, material requirement planning (MRP), manufacturing resources planning (MRP II), enterprise resource planning (ERP).

Logistics: types and strategies, supply chain management, objectives and decision phases of supply chain, management roles and development in supply chain management.

Text Books:

1. Industrial Engineering and Management, O.P. Khanna, Dhanpat Rai Publications.
2. Production Management, Hajra, Choudhury, MP publishers, New Delhi.
3. Operations Management, Heizer, Pearson, New Delhi.
4. Elements of Production Planning and Control, Samuel Eilon, McMillan.

Reference Books:

1. Industrial Engineering & Management A new perspective- Philip E Hicks - Mcgraw Hill.
2. Company Essential of Management - H. Koonz and H. Weihrich – Mcgraw Hill
3. Marketing Management- Kotler Philip- Prentice Hall of India
4. Flexibilty in Management - Sushil, Vikas publication - New Delhi
5. Human Resource Management - Luthans Fred - McGraw Hill, Inc.
6. Financial Management - M.Y. Khan and P.K. Jain - Tata Mc-Graw Hill
7. Fundamentals of Business Organizations and Management -Y.K. Bhusan - S. Chand
8. Industrial Management - K.K. Ahuja - Khanna Publishers
9. Introduction of work study - ILO, Geneva - Universal Publishing Corporation, Bombay
10. Motion and Time Study - Ralph M. Bannes - John Wiley & Sons
11. Work Study and Ergonomics - H.S. Shan - Dhanpat Rai & Sons

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	2	3	2	-	-	-	1	3	1
CO2	2	3	2	-	2	-	2	1	3	2
CO3	3	-	3	-	-	-	-	-	3	1
CO4	2	-	1	3	3	2	-	-	2	3
CO5	2	3	2	-	-	3	-	-	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Finite Element Method	**Course Code:**	SOE-B-ME702 (2)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

This course introduces finite element methods for the analysis of solid, structural, fluid, field, and heat transfer problems. Steady-state, transient, and dynamic conditions are considered. Finite element methods and solution.

Course Objectives:

1. To explain the finite element method its fundamentals and general steps.
2. To understand the underlying theory, assumptions and modeling issues in FEM.
3. To study the formulation of elemental characteristics matrices.
4. To provide hands on experience using finite element software to model, analyze and design systems of mechanical engineering.

Course Outcomes:

After successful completion of the course the student should be able to

CO Number	Course Outcome
CO1	Formulate numerical model for a given system.
CO2	Obtain solution for given problems.
CO3	Solve mechanical engineering problems using FEA techniques.
CO4	Carry out FE analysis using commercial software

Syllabus

Unit-I

Fundamentals concepts of FEA

Introduction– Brief History of FEM, general fem procedure, applications of fem in various field, advantages and disadvantages of fem, difference between fem and fdm, consistent units system. approximate methods of solving differential equations (ritz method, galerkin method, least square method, collocation and subdomain method). Review of Solid Mechanics: Stress equilibrium equations, strain-displacement equations, stress-straintemperature relations, plane stress, plane strain and axisymmetric problems, strain energy, total potential energy. essential and natural boundary conditions Review of Matrix Algebra: (Vectors, Matrices, Symmetric banded matrix, determinants, inverses), banded skyline solutions. Introduction to solvers (sparse solver, iterative solver, pcg etc)

Unit-II

1D Elements

Introduction to different approaches used in FEA such as direct approach, Variational approach, weighted residual (Galerkin). Types of 1D element. Displacement function, Global and local coordinate systems, Order of element, primary and secondary variables, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring, bar, beam, truss and Plane frame. Transformation matrix for truss and plane frame, Assembly of global stiffness matrix and load vector, Properties of stiffness matrix, half bandwidth, Boundary conditions elimination method and penalty approach, Symmetric boundary conditions, Stress calculations.

Unit-III

2D Elements

Types of 2D elements, Formulation of elemental stiffness matrix and load vector for Plane stress/strain such as Linear Strain Rectangle (LSR), Constant Strain Triangles (CST), Pascal's triangle , primary and secondary variables, properties of shape functions. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), Overview of axi-symmetric elements

Unit-IV

Isoparametric Elements

Concept of isoparametric elements, Terms Isoparametric, super parametric and subparametric. Isoparmetric formulation of bar element. Coordinate mapping - Natural coordinates, Area coordinates (for triangular elements), higher order elements (Lagrangean and serendipity elements). Convergence requirements- patch test, Uniqueness of mapping - Jacobian matrix. Numerical integration – Newton Cotes quadrature, 2 and 3 point Gauss Quadrature, full and reduced integration. Sub-modeling, substructuring

Unit-V

Steady State Heat Transfer Problems and Dynamic Analysis:

Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution.

Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar and beam element. Undamped-free vibration- Eigenvalue problem, Evaluation of eigenvalues and eigenvectors (natural frequencies and mode shapes). Error Analysis in finite element methods (types of error estimates- Priori error estimates, posteriori error estimates etc.)

Text Books:

1. A First Course in the Finite Element Method, Daryl L. Logan
2. Concepts and Applications of Finite Element Analysis, R. D. Cook, et al., Wiley-India.
3. Finite Element Analysis, S. S. Bhavikatti, New Age International.

Reference Books:

1. An Introduction to the Finite element method, J. N. Reddy, Tata McGraw-Hill.
2. Finite Element Procedures, Bathe K. J., Prentice-Hall of India (P) Ltd., New Delhi.
3. The Finite Element Method for Solid and Structural Mechanics, Olek C Zienkiewicz, Robert L Taylor, Butterworth-Heinemann-6th Edition.
4. The Finite Element Method in Engineering, S. S. Rao, Elsevier.
5. Introduction to Finite Elements in Engineering, Chandrupatla T. R. and Belegunda A. D., Prentice Hall India.
6. Text book of Finite Element Analysis, Seshu P., PHI Learning Private Ltd. New Delhi, 2010.
7. Finite Element Analysis, Theory and Practice, Fagan M. J., Pearson Education Limited
8. Finite element methods for Engineers, U. S. Dixit, Cengage Learning.
9. Finite Element Method using MATLAB, Kwon Y. W., Bang H., CRC Press, 1997.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	2	2	-	-	3	3
CO2	3	3	3	-	2	2	-	-	3	3
CO3	2	3	3	2	2	2	-	-	3	3
CO4	2	3	3	2	2	2	-	-	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Production Planning and Control	**Course Code:**	SOE-B-ME702 (3)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

The course refers to two strategies that work cohesively throughout the manufacturing process. **Production planning** involves *what to produce, when to produce it, how much to produce,* and more. In this course the student will learn the basic concepts of *Production, Manufacturing processes, selection of apt system for optimizing inventory, Product management* to advanced planning and control techniques as such lot sizing**,** *EOQ method, Order size calculation, Break-even analysis, Assembly line balancing* and many more.

Course Outcomes:

After successful completion of the course the student should be able to

CO Number	Course Outcome
CO1	Understand the various components and functions of production planning and control.
CO2	Know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP)
CO3	Understand the concept and implementation of scheduling methods, line balancing, aggregate planning, chase planning.
CO4	Understand the importance of dispatch and role of Computer in dispatch activities in the industry.
CO5	Understand the lean approach in Production system.

Syllabus

Unit-I

Introduction

Definition, objectives and benefits of planning and control, functions of production planning and control. Elements of production control, Types of production job, batch and continuous. Organization of production planning and control department, internal organization of department.

Unit-II

Forecasting

Importance of forecasting, Types of forecasting and their uses, General principles of forecasting. Forecasting techniques- qualitative and quantities methods.

Inventory management: Function of inventories, relevant inventory costs – ABC analysis, VED analysis, EOQ models. Inventory Control systems – P- system and Q-system. Introduction to MRP, MRP-II, ERP & line of balancing (LOB).

Unit-III

Routing

Definition, routing procedure, route sheets, Bill of material, factors affecting on routing procedure.

Scheduling – definition, difference with loading. Scheduling policies – Techniques, standard scheduling methods, line balancing, aggregate planning, chase planning.

Unit-IV

Dispatching

Dispatching procedure, activities of dispatching, follow up – definition, types of follow up- applications of computer in production planning and control.

Unit-V

Lean production system

Just in Time production system, elements of waste. JIT purchasing Techniques for mistake proofing processes. Economics and technology of setup time reduction. Improving product flow, The transition to lean.

Text Books:

1. James. B. Dilworth, Operations management – Design, Planning and Control for manufacturing and services, McGraw Hill International edition, 2015.
2. Baffa and Rakesh Sarin, Modern Production and Operation management, Wiley & Sons publications, 2016.
3. Martin K. Starr and David W. Miller, Inventory Control Theory and Practice, Prentice Hall publications 2016.

Reference Books:

1. Samson Eilon, Elements of Production Planning and Control, Universal Book Corpn.1984
2. Elwood S. Buffa, and Rakesh K. Sarin, Modern Production/Operations Management, 8th Edition, John Wiley and Sons, 2000.
3. Melynk, Denzler, Operations management–A value driven approach, Irwin McGraw hill.
4. Norman Gaither, G. Frazier, Operations Management, 9th edition, Thomson learning IE, 2007.
5. Jain. K.C & L.N. Aggarwal, Production Planning Control and Industrial Management, Khanna Publishers, 1990.

6. Chary. S.N., Theory and Problems in Production & Operations Management, Tata McGraw Hill, 1995.
7. Upendra Kachru, Production and Operations Management – Text and cases, 1st Edition, Excel books 2007.
8. Kanishka Bedi, Production and Operations Management 2nd Edition, Oxford university press, 2007.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**
CO1	3	2	-	2	-	-	-	-	3	1
CO2	2	3	2	-	1	-	-	1	3	2
CO3	1	-	2	3	3	-	-	1	3	2
CO4	1	-	-	3	-	-	2	2	2	3
CO5	2	3	-	-	2	3	-	2	3	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Automobile Engineering	**Course Code:**	SOE-B-ME702 (4)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Descriptions:

Automobile engineering combines creative aesthetics with a practical understanding of *engineering. Designers* often interact with mechanical and industrial *engineers* to create *designs* feasible for production, and have knowledge of raw materials, *engineering* techniques and production processes.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Explain analytical design of the complete motor vehicle, Vehicle Body Engineering and current motor vehicle design.
CO2	Evaluate the vehicle performance and different losses or resistances occur during driving the vehicle.
CO3	Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
CO4	Design the different vehicles, and the components required.
CO5	Identify Modern technology and safety measures used in Automotive Vehicles.

Syllabus

Unit-I

Introduction: Classification of automobiles. Automobile power plant: constructional features of different types of engines used in Automobiles, their characteristics, study of various engine components and their materials. Vehicle performance: Tractive force, Tractive force Vs Vehicle speed, resistance to motion of the Vehicle – Rolling and gradient resistance, power requirement for acceleration and grade-ability, maximum acceleration for front wheel drive – Rear wheel drive – four-wheel drive vehicles, selection of suitable real axle and gear ratios.

Unit-II

Transmission Systems: Study of Propeller shaft and universal joint, live axle and differential Steering and front axles: Steering geometry, steering requirements, steering

linkages and Steering gears, over Steer and under Steer, cornering power, reversibility of Steering gears, types of front axles, their constructions. Selection of gear ratios and final drive ratio, numerical on 3- speed and 4- speed gearbox.

Unit-III

Suspension systems: objects of Suspension, basic requirements, types of Suspension, shock absorbers Wheels and Tyres: requirements of Wheels and Tyres, constructional features, types of Tyres, application to ride and stability.

Vehicle Body Design: importance of body design, material for body constructions – styling forms – coach and bus body style, layouts of passenger cars, bus and Truck bodies. Aerodynamic drag – aerodynamic lifts, pitching moments, side force, yawing moments and rolling moments. Basic dimensions: geometrical relations to driver seat, dimensions of foot and pedal control, passenger seats, vehicle dimensions and visibility. Chassis types and structure types: open semi integral pedal and integral Bus structures. Frames: function and types, loads on frames, load distribution of structure.

Unit-IV

Vehicle vibration and dynamics: types of vibration, vibration control, effect of vibration on human body, Driver's comfort and passenger's comfort vehicle vibration with single degree of vibration. Different accessories used in vehicles: Electric Horn, Wipers, Fuel pump, power operated windows, etc.

Unit-V

Recent trends in automobile: Electronic control module(ECM), Operating modes of ECM (Closed loop and Open Loop), inputs required and output signals from ECM, electronic spark control, air management system, ideal speed control. New developments in sensor technology. Solar operated vehicle.

Text Books:

1. "Automobile engineering" by Singh, Kirpal. Standard publishers, 1994.
2. "Automobile Mechanics" by Giri, N. K., 2013.
3. "A textbook on Automobile Engineering" by Banga, T. R., and Natthana Sinha, Khanna Publ., 1987.
4. "Fundamental of vehicle dynamics" by Thomas D. Gillespie.
5. "Automobile engineering" by Gupta, R. B., Satya Prakashan, 1993.

Reference Books:

1. "The Automobile" by Reyat H.S., S.Chand and Co., 2004.
2. "Vehicle body engineering. Business Books" by Pawlowski, Janusz, and Guy Tidbury. 1969.

3. "Computerized engine controls" by King, Dick H. Delmar Publishers Inc., 1990.
4. "Automotive mechanics" by Crouse, William H., and William Harry Crouse, Tata McGraw-Hill Education, 1982.
5. "Motor vehicle" by Garrett, Thomas Kenneth, Kenneth Newton, and William Steeds.. Butterworth-Heinemann, 2000.
6. "Design of machine Elements" by M. F. Spotts and T.E. Shoup, Seventh Edition, Pearson Education.
7. "An Introduction to Modern Vehicle Design" by Julian Happian – Smith, Butterworth Heinemann.
8. "Mechanical Engineering Design" by Joseph E. Shigley and Larry D. Mitchell, Fourth Edition, McGraw-Hill.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	-	-	-	2	2	3	2
CO2	2	1	3	1	-	2	2	2	3	3
CO3	3	2	2	-	-	-	2	2	3	3
CO4	2	3	3	3	3	3	1	1	3	3
CO5	1	3	3	2	2	2	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 :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Solar Energy Technology	**Course Code:**	SOE-B-ME702 (5)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Descriptions:

The course is intended to deliver comprehensive knowledge on renewable energy resources, solar radiation, solar radiation data analysis, fundamentals of the solar thermal and photovoltaic system along with the effective design and performance analysis of solar energy conversion devices.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	The characteristics and world distribution of solar radiation.
CO2	The solar radiation and measurement techniques.
CO3	The methods of calculation of solar radiation availability at a given location.
CO4	The fundamentals of thermal and direct conversion of solar energy to power.
CO5	Understand the fundamentals of solar flat plate collectors, concentrating solar collectors.

Syllabus

Unit-I

Energy Resources & Solar Radiation

World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance – Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Solar radiation on the earth surface, distribution of solar radiation. Depletion of solar radiation - Absorption, scattering. Beam radiation, diffuse and Global radiation. Measurement of solar radiation –Pyranometer, Pyrheliometer, Sunshine recorder.

Unit-II

Solar Radiation Geometry and Calculations

Solar radiation geometry - Earth-Sun angles – Solar angles. Calculation of angle of incidence - Surface facing due south, horizontal, inclined surface and vertical surface. Solar day length – Sun path diagram – Shadow determination. Estimation of Sunshine hours at different places in India. Calculation of total solar radiation on horizontal and tilted surfaces. Prediction of solar radiation availability.

Unit-III

Solar Electrical Energy Conversion

Solar photovoltaic energy conversion - Principles - Physics and operation of solar cells. Classification of solar PV systems, Solar cell energy conversion efficiency, I-V characteristics, effect of variation of solar insolation and temperature, losses. Solar PV power plants.

Unit-IV

Solar Flat Plate & Concentrating Collectors

Fundamentals of solar collectors as devices to convert solar energy to heat. Non-concentrating low temperature flat-plate and evacuated tube collectors. Collector performance - Useful energy gain, energy losses, efficiency. Use of selective coatings to enhance the collector efficiency. Concentrating collectors for middle and high temperature applications. Line-focusing and point-focusing concentrators: parabolic trough, parabolic dish, Fresnel lenses, compound parabolic concentrator. Sun tracking mechanisms.

Unit-V

Performance & Applications of Solar Concentrators

Concentrating collector performance - concentration ratio, useful energy gain, energy losses, efficiency. Solar collector design, testing, installation and operation. Application of non-concentrating collectors in low temperature solar thermal plants for space heating and cooling, drying, seawater desalination. Use of concentrating collectors for process heat production and power generation.

Text Books:

1. K.Sukhatme, Suhas P.Sukhatme., Solar energy: Principles of thermal collection and storage, Tata McGraw Hill publishing Co. Ltd, 8 edition, 2008.
2. R Sukhatme, Solar Energy – Principles of Thermal Collection and Storage, THM Delhi.

Reference Books:

1. R.K. Singhal, Non-Conventional Energy Resources: Alternative Energy Sources And Systems, Kataria, Delhi.
2. Foster R., Ghassemi M., Cota A., Solar Energy, CRC Press, 2010.
3. Duffie J.A., Beckman W.A. Solar Engineering of Thermal Processes, 3rd ed., Wiley, 2006.
4. De Vos, A., Thermodynamics of Solar Energy Conversion, Wiley- VCH, 2008.
5. Garg H.P., Prakash J., Solar Energy Fundamentals and Applications, Tata McGraw-Hill, 2005.
6. Kalogirou S., Solar Energy Engineering: Processes and Systems, Elsevier, 2009.
7. Artur V. Kilian., Solar Collectors: Energy Conservation, Design and Applications, Nova Science Publishers Incorporated, 2009.
8. Soteris. A. Kalogiru, Solar Energy Engineering: Processes and systems, 1st edition, Academic Press, 2009.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	1	1	2	-	-	2	1	2	1	-
CO2	3	3	2	-	-	2	-	1	2	1
CO3	2	2	2	-	1	2	-	2	2	1
CO4	3	2	2	1	1	2	-	-	3	2
CO5	3	2	2	1	1	2	-	-	3	2

Note: 1: Low 2: Moderate 3: High

Programme :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Introduction to Stainless Steel	**Course Code:**	SOE-B-ME702 (6)
Credits :	3	**No of Hours:**	3 hours per week

Max Marks: 100

Course Descriptions:

This course is an industry linked course. Department used to conduct this course in association with Jindal Stainless Steel (JSL), Hissar, Haryana. This course is relevant to the steel industry practices and lectures being delivered by the eminent Industrial Professionals of JSL, Hissar, Haryana. Students used to gain the knowledge through direct interactions with the steel professionals and also develop their skills in work ethics, communication and management aspects.

Course Outcomes:

After Completion of the course Students will be able to: able

CO Number	Course Outcome
CO1	Distinguish between various stainless steels
CO2	Have an increased level of awareness towards stainless steel and their applications
CO3	Have fundamental understanding of the phase transformations in ferrous alloys.
CO4	Apply their basic understanding in development of alloys with better properties.
CO5	Distinguish between various stainless steels

Syllabus:

This Course is solely designed by the JSL, Hissar, Haryana and delivered accordingly.

UNIT – 1

Stainless Steel (SS) making process: complete overview, advancements in technology, if any. Family tree of SS, major grades, functions of alloying elements and their impact on mechanical properties of SS, cost implications of alloy addition and using substitutes, phase transformations in Stainless Steel, secondary phase transformations, mechanism of phase transformation and its effect on properties of SS.

UNIT - 2

Stainless Steel fabrication: Hot rolling, cold rolling, shearing, cold roll forming (CRF), process mechanism, tools and equipment, issues faced during fabrication of stainless steel and their solutions, corrosion in stainless steel, galvanic corrosion, mechanism and prevention, pitting corrosion: mechanism and prevention, PREN, crack propagation mechanisms, inter-granular and trans-granular.

UNIT - 3

Welding of Stainless Steel: Sensitization/Weld decay: causes, mechanisms, remedies, high temperature sensitization, 475 embrittlement, α' phase transformation, distortion:

causes, mechanisms, remedies, effect of alloying elements on weldability of SS, Schaeffler De Long diagram interpretations: Cr, Ni and C equivalent.

UNIT - 4

Testing of Stainless Steel: PMI technique, other NDT methods, handling and storage of stainless steel, recommended procedures for storage.

UNIT – 5

Applications of stainless steel in various segments: current applications of SS grades, conversion of components into SS and reasons for the same.

Text Books:

1. Ghosh, Secondary Steelmaking – Principle & Applications, CRC Press – 2001.
2. Ahindra Ghosh and Amit Chatterjee, Ironmaking and Steelmaking Theory and Practice, Prentice-Hall of India Private Limited, 2008.
3. An Introduction to Modern Steel Making, R H Tupkary, Khanna Publication, India.

Reference Books:

1. Ghosh, Principles of Secondary Processing and Casting of liquid steel, Oxford & IBH Publication.
2. Fundamentals of steel making, E.T. Tukdogan.
3. Steel making, Kurdin, Mir Publishers.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	-	2	1	-	-	2	-	-	2	-
CO2	1	3	2	-	-	2	-	-	2	2
CO3	1	3	2	-	-	2	-	-	2	2
CO4	1	3	2	-	-	2	-	-	2	2
CO5	-	2	1	-	-	2	-	-	2	-

Note: 1: Low 2: Moderate 3: High

Programme :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Process Planning and Cost Estimation	**Course Code:**	SOE-B-ME702 (7)
Credits :	3	**No of Hours:**	3 hours per week

Max Marks: 100

Course Descriptions:

The course is intended to understand the basic concepts of process Planning and estimation and apply different methods of cost estimation in different manufacturing shops and learn the concepts of process planning and cost estimation in competitive manufacturing systems and organizations.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Select the process, equipment and tools for various industrial products.
CO2	Prepare process planning activity chart.
CO3	Explain the concept of cost estimation.
CO4	Compute the job order cost for different type of shop floor.
CO5	Calculate the machining time for various machining operations

Syllabus

UNIT I: Introduction to Process Planning

Aims and Objectives, Place of process planning in Manufacturing cycle, Drawing interpretation, Dimensional tolerance vs Production processes. Study of various process plans for a product from manufacturing industries.

UNIT II: Process Planning Steps

Design of a process plan – Selection of production processes, tools and process parameters- Positioning and work holding devices, Selection of inspection devices and tools, Documenting the process plan, Simple Case studies. Computer-Aided Process Planning (CAPP) – Benefits, Architecture and approaches. Preparation of process planning sheet for new product design.

UNIT III: Introduction to Cost Estimation

Importance, Types, Purpose, Components, Procedure, Classification of costs, Cost elements, Ladder of cost – Material cost Determination of direct material cost – Labour cost, Determination of direct labour cost- over heads – classification of overhead expenses Depreciation- Methods of depreciation – Allocation of overhead expenses, Break-even analysis. Study on elements of cost in a manufacturing sector and their analysis.

UNIT IV: Production Cost Estimation

Estimation of production cost for - Casting processes, Estimation in welding shop – Arc welding – Gas Welding –Flame cutting -Estimation of metal forming–Forging –Forging losses - Estimation in Foundry shop – Moulding – pattern making. Manufacturing cost estimation of welding processes. -Manufacturing cost estimation of foundry processes shop.

UNIT V: Estimation of Machining Time and Cost

Estimation of Machining time – Lathe operations, Drilling, Milling, Shaping and Planning, and Grinding, Cost estimation for machining processes Machining time and cost calculation of shaping process. Machining time and cost calculation of Welding process. Machining time and cost calculation of Milling process, Machining time and cost calculation of Drilling process.

Text Books:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002

Reference Books:

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	1	3	2	3	2	2	2	3	3
CO2	2	2	3	3	3	2	-	-	2	3
CO3	3	2	2	3	3	-	-	-	3	2
CO4	2	3	2	3	3	2	-	2	2	2
CO5	2	3	3	3	3	2	-	2	2	3

Note: 1: Low 2: Moderate 3: High

Programme :	B.Tech.	**Semester :**	VII Sem
Name of the Course:	Total Quality Management	**Course Code:**	SOE-B-ME702 (8)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Descriptions:

This course provides learners with an understanding of quality control and improvement systems. The course includes study of topics related to quality management approaches, design and implementation of quality-related procedures, and related technologies.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	To facilitate the understanding of Quality Management principles and process
CO2	To learn the basic concepts of quality and quality from organizational point of view.
CO3	To be aware of international/national Quality standards.
CO4	To evaluate the process capability of machines.
CO5	To understand and analyse design and sampling plans for given producer and consumer risk.

Syllabus

Unit-I

Introduction

Need for quality, Evolution of quality, Definitions of quality, Dimensions of product and service quality, Basic concepts of TQM, TQM Framework, Barriers to TQM, Quality statements, Customer focus, Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

Unit-II

Quality Management Principles

Leadership, Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal, Continuous process improvement, PDCA cycle, 5S, Kaizen, Supplier partnership, Partnering, Supplier selection, Supplier Rating.

Unit-III

Quality Control Process and Methods

The seven traditional tools of quality, New management tools, Six sigma, Concepts, Methodology, applications to manufacturing and service sectors, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, Types.

Unit-IV
Tools and Techniques of Quality Control
Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, TPM, Concepts, improvement needs, Performance measures.

Unit-V
Quality Systems and Assurance
Need for ISO 9000 - ISO 9001-2015, Quality System, Elements, Documentation, Quality Auditing, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

Text Books:

1. Dale H. Besterfiled, et at., Total quality Management, Third Edition, Pearson Education Asia, 2006.
2. O.P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications.
3. N.V.R Naidu, G. Rajendra, Total Quality Management, New Age international, First Edition, Jan 2006.
4. Martand Telsang, Industrial Engineering and Production Management, S. Chand publication.

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. V.S Bagad, Total Quality Management, Technical Publications, First Edition, Jan 2008.
3. S. Rajaram, Total Quality Management, Dreamtech Press, First Edition, Jan 2008.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	3	2	-	2	2	-	3	1
CO2	3	3	2	3	3	2	2	-	2	1
CO3	2	2	3	-	3	2	-	-	3	1
CO4	2	3	1	3	2	2	-	-	2	3
CO5	2	1	2	1	2	3	3	-	2	2

Note: 1: Low 2: Moderate 3: High

Programme : B.Tech. **Semester :** VII Sem

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Name of the Course:	Innovation, Entrepreneurship and Leadership	**Course Code:**	SOE-B-ME702 (9)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Descriptions:

This course aims to provide students with an understanding of the nature of enterprise and entrepreneurship and introduces the role of the entrepreneur, innovation and technology in the entrepreneurial process. It also outlines the theoretical foundations of the concept of Leadership through a thorough review of leadership theories and provides students with the opportunity to understand what it takes to influence and empower others.

Course Outcomes:

After Completion of the course Students will be able to: able

CO Number	Course Outcome
CO1	Discuss the attitudes, values, characteristics, behaviour, and processes associated with possessing an entrepreneurial mindset and engaging in successful appropriate entrepreneurial behaviour.
CO2	Starting innovative practices in their entrepreneurial activities.
CO3	Developing their skills on the traits that they want to carry forward
CO4	Understand the concept of leadership and leading.
CO5	Develop critical thinking and problem solving attitude.

Syllabus

Unit-I

Conceptualizing Innovation

Innovation- an abstract concept; creativity, innovation and imagination; types of innovation –classified According to products, processes or business organizations.

Unit-II

Entrepreneurial Skills

Entrepreneurship: who is an entrepreneur? Entrepreneurship- A state of Mind, Emergence of the entrepreneur; Role of Entrepreneur; A Doer, not a Dreamer- Characteristics of an entrepreneur; Factors affecting entrepreneurial growth – Social, cultural, personality factors, psychological and Social Factors. Impact of Entrepreneurship for sustainable development.

Types of Entrepreneurs: Difference between entrepreneur and entrepreneurship, Difference between entrepreneur and intrapreneur, Common Entrepreneurial

competencies/Traits; Entrepreneurship stimulants, Obstacles inhibiting Entrepreneurship; Types of entrepreneurs, Functions of an entrepreneur.

Unit-III

Analyzing Strengths, Weaknesses, Opportunities, and Threats

Identification of Business Opportunities: Introduction, Sources of Business of Product Ideas, Steps in Identification of Business opportunity and its SWOT Analysis.

Developing Entrepreneurial project

Techno-Economic Feasibility of the project: Introduction, Techno-Economic feasibility of the Project, Feasibility Report, Considerations while preparing a Feasibility Report, Proforma of Feasibility Report, Role of Institutions and entrepreneurship.

Unit-IV

Introduction to Leadership Studies Overview and approaches to Leadership Studies Theories in leadership Definition and understanding of key terms: leadership, leading, leader, difference between manager and leader, difference between hero and leader etc.

Unit-V

Issues in Leadership Basic issues in leading like role of emotions and passions, problems in decision making, ethics and values etc. Why good leaders fail? Is ethical leading successful? Contemporary leadership and leaders etc.

Text Books:

1. Competing through Innovation-Bellon & Whittington, Prentice Hall of India.
2. A Guide to Entrepreneurship – David Oates- JAICO Publishing House.
3. Entrepreneurship Management and Development – Ajith Kumar, HPH
4. Manikutty, S. and S.P. Singh. Essence of Leadership: Explorations from Literature. Delhi: Macmillan, 2010.

Reference Books:

1. Entrepreneurship- Rober D Hisrich, Peters, Shepherd- TMH
2. Entrepreneurship in Action- Coulter, Prentice Hall of India
3. Fundamentals of entrepreneurship- Mohanty, PHI
4. Patterns of Entrepreneurship- Jack M Kaplan, Wiley, student Edition MS skills.
5. Antonakis, J., A.T. Ciancioloand R.J. Sternberg. The Nature of Leadership. California: Sage, 2004
6. Bennis, Warren G. On Becoming a Leader. Cambridge, Massachusetts: Perseus, 2003
7. Goleman, D. “What Makes a Leader?” Harvard Business Review 11 (1998): 93-102.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	-	2	2	2	2	3	3	3
CO2	2	2	3	2	3	2	2	2	2	3
CO3	2	2	3	2	-	-	-	-	3	2
CO4	3	2	-	2	2	2	2	2	3	2
CO5	-	3	3	2	2	2	2	2	2	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 :	B.Tech	**Semester :**	VII Sem
Name of the Course:	TQM and Reliability Engineering	**Course Code:**	SOE-B-ME702 (10)
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Descriptions:

This course focuses on advanced tools of TQM to measure and evaluate the quality of products and gain the experience on system reliability analysis and design. The student will able to apply knowledge to a practical operational problem or research project.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	Identify and explain the basic concepts of Quality Management
CO2	Identify and explain the basic concepts of Total Quality Management (TQM) & Total Productive Maintenance (TPM).
CO3	Differentiate between product quality characteristics and service quality characteristics.
CO4	Understand the basic elements of reliability engineering and its tools.
CO5	Understand the basic elements of intellectual property and its implications, patent, copyright, industrial design and trademark.

Syllabus

Unit-I

Introduction Quality Management

Indian Companies Monopolize the Deming Awards in 2003, Quality Management –A conceptual frame work, Strategic Quality Management, Benchmarking.

Unit-II

Total Quality Management (TQM)

The foundation of Total Quality Management, Components of quality, the total quality management approach, Innovation, design and improvement, Product quality characteristic and service quality characteristics, Quality parameters and specific dimensions of quality Jaran's Contribution to TQM, Crosby's contribution to TQM, Ishikawa's contribution to TQM, Comparing the Quality Gurus, Kaizen, Total Productive Maintenance (TPM).

Unit-III:

Service quality management and Cost of Quality

Products and services, Classification of services, Service Quality, Measuring Service Quality, Prevention costs, Appraisal Costs, Internal and External failure costs, Cost of quality models.

Unit-IV

Reliability Engineering

Introduction, Need, Basic Elements of Reliability, Measurement of Reliability, cost of Reliability, Maintenance & Reliability, Maintainability, MTBF, MTTR, Maintenance action Rate, Failure Mode Effect & Criticality Analysis (FMECA). Hazard Analysis, System Reliability – Series, Parallel and Mix Problem Reliability Concepts: Reliability in terms of Hazard rate and failure density, Conditional probability and multiplication rules

Unit-V

Intellectual Properties System

Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark.

Text Books:

1. Krishnamurthy, K.S., A First Course in Quality Engineering. Prentice Hall, 2006.
2. Dale H. Besterfield et al, Total Quality Management, Third edition, Pearson Education (First Indian Reprints 2004).
3. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
4. Anand Sharma, Statistics for Management, Himalaya Publishing House, Second Revised edition, 2008.
5. Srivatsava TN, Shailaja Rego, Statistics for Management, Tata McGraw Hill, 2008.

Reference Books:

1. Poornima Charantimath, Total Quality Management, Pearson Education Asia.
2. Tapan Bose, Total Quality Management, Pearson Education Asia.
3. Srinath L.S., Reliability Engineering Affiliated East West Press.
4. James R. Evans and William M. Lindsay, The Management and Control of Quality, 6th Edition, South-Western (Thomson Learning).
5. Oakland, J.S. TQM-Text with Cases, Butterworth – Heinemann Ltd. Oxford, 3rd Edition.
6. Suganthi, L and Anand Samuel, Total Quality Management, PHI Learning Pvt. Ltd.
7. Janakiraman, B and Gopal, R.K. Total Quality Management- Text and Cases, PHI Learning Pvt. Ltd.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	2	3	3	2	-	2	2	-	3	1
CO2	3	3	2	3	3	2	2	-	2	1
CO3	2	2	3	-	3	2	-	-	3	1
CO4	2	3	1	3	2	2	-	-	2	3
CO5	2	1	2	1	2	3	3	-	2	2

Note: 1: Low 2: Moderate 3: High

Department of Mechanical Engineering
Scheme of Teaching and Examination, B. Tech in Mechanical Engineering

B. Tech in Mechanical Engineering (VIII- Semester)

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE		ESE	Total Marks	
							Mid Sem	TA			
1	SOE-B-ME701	Mechanical	Refrigeration & Air Conditioning System	3	0	0	30	20	50	100	3
2	SOE-B-ME702	Mechanical	Professional Elective-II (Annexure-II)	3	0	0	30	20	50	100	3
3	SOE-B-ME703	Mechanical	Robotics & Automation	3	0	0	30	20	50	100	2
4	SOE-B-ME704	Mechanical	Computer Aided Design and Manufacturing	3	0	0	30	20	50	100	2
5	SOE-B-ME705	Mechanical	Refrigeration and Air Conditioning Lab	0	0	4	0	30	20	50	2
6	SOE-B-ME706	Mechanical	Robotics and Automation Lab	0	0	2	0	15	10	25	1
7	SOE-B-ME707	Mechanical	CAD/CAM Lab	0	0	2	0	15	10	25	1
8	SOE-B-ME801	Mechanical	Major Project	0	0	20	0	150	100	250	10
			TOTAL	**12**	**0**	**28**	**120**	**290**	**340**	**750**	**24**
OR											
1	SOE-B-ME708	Mechanical	Research Internship / Industry Internship	0	0	44	0	250	250	500	22
2	SOE-B-ME801	Mechanical	Major Project	0	0	20	0	150	100	250	10
			TOTAL	**0**	**0**	**64**	**0**	**400**	**350**	**750**	**32**

Option Chosen	Credit in VII-Sem	Credit in VIII-Sem	Total Credit
Option A	22	24	**46**
Option B	14	32	**46**

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	B.Tech.	**Semester :**	VIII Sem
Name of the Course:	Major Project	**Course Code:**	SOE-B-ME801
Credits :	3	**No of Hours:**	3 hours per week
Max Marks:	100		

Course Description:

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. Each project group will submit project synopsis by the end of eighth semester. Project evaluation committee consisting of three or four faculty members specialized in the various fields shall study the feasibility of each project work before giving consent.

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	gain in-depth knowledge and use adequate methods in the major subject/field of study.
CO2	create, analyze and critically evaluate different technical/research solutions
CO3	clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings
CO4	identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration
CO5	apply principles of ethics and standards, skill of presentation and communication techniques.

Contents

Project work is of duration of one semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than four members is

expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project batches are expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the seventh semester.

Student shall study the topic of project work and define problem statement. The student shall evolve design and/or do experimental study and/or fabricate engineered device to obtain solution to the identified problem. The student shall prepare a report and shall present a seminar on the basis of work done at the end of semester.

CO-PO/PSO Mapping

CO Number	Program Outcome								PSO	
	1	2	3	4	5	6	7	8	1	2
CO1	3	2	2	2	-	2	2	2	3	2
CO2	3	2	1	1	1	1	1	2	2	3
CO3	1	2	1	3	2	-	-	1	1	3
CO4	1	1	1	-	1	-	3	2	1	2
CO5	-	1	-	3	2	-	3	1	1	3

Note: 1: Low 2: Moderate 3: High