Kolhapur Institute of Technology's College of Engineering, Kolhapur

Curriculum (Syllabus)

for

S.Y.B.TECH
Mechanical Engineering Programme
(Under Graduate Programme)
From Academic Year 2022-2023

Title of the Course: ENGINEERING MATHEMATICS-III	L	T	P	Credits
Course Code: UMEC0301	3	1	---	4

Course Pre-Requisite: Basic terminologies of differential equations, vector algebra, concepts of probability, basic results of derivative and integration.

Course Description: This Course contains linear differential equations, vector calculus, Laplace transform, probability distributions, Fourier series and applications of partial differential equations.

Course Objectives:

1. To develop abstract, logical and critical thinking and the ability to reflect critically upon their work.
2. To study various mathematical tools like differential equations, integral transforms, vector calculus, probability and partial differential equations to devise engineering solutions for given situations.
3. The student must be able to formulate a mathematical model of a real life and engineering problem, solve and interpret the solution in real world.

Course Outcomes:

COs	After the completion of this course the student will be able to	Bloom's Cognitive level	Descriptor
CO1	Understand various terminologies in differential equations, probability and properties of Laplace transform	II	Understanding
CO2	Solve LDE with constants coefficients, problems of Laplace transform and Laplace equation numerically by Gauss – Siedel method.	III	Applying
CO3	Apply the knowledge of probability distributions, Laplace transform method to solve differential equations and express the given function as Fourier series over the given interval.	III	Applying
CO4	Analyze and interpret the solutions obtained of problems on Oscillation of a spring, wave and heat equations and evaluate vector integrals.	IV	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three units)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three units) covered after MSE.

Course Contents:

Unit 1: Linear Differential Equations with Constant Coefficients and Its Applications 1.1 Definition, general form, complete solution 1.2 Rules for finding complementary function 1.3 Rules for finding particular integral 1.4 Application: Mass – spring Mechanical system 1.4.1 Free oscillations 1.4.2 Damped Oscillations 1.4.3 Forced oscillations without damping.	8 **Hrs.**
Unit 2: Vector Integration 2.1 The line integral, surface integral, volume integral 2.2 Gauss's divergence theorem 2.3 Stoke's theorem 2.4 Green theorem (without proof)	8 **Hrs.**
Unit 3: Laplace Transform 3.1 Definition, transforms of elementary functions, properties of Laplace transform 3.2 Transforms of derivative and integral 3.3 Inverse Laplace transform 3.4 Inverse Laplace transforms by using partial fractions and convolution theorem. 3.5 Solution of linear differential equations with constant coefficients by Laplace transform method.	8 **Hrs.**
Unit 4: Probability Distributions 4.1 Introduction to Probability 4.2 Random variable 4.3 Probability mass function and probability density function 4.4 Binomial distribution 4.5 Poisson distribution 4.6 Normal distribution	6 **Hrs.**
Unit 5: Fourier Series 5.1 Definition, Euler's formulae, Dirichlet's conditions. 5.2 Functions having points of discontinuity 5.3 Change of interval 5.4 Expansion of odd and even periodic functions 5.5 Half range Fourier series	6 **Hrs.**
Unit 6: Application of Partial Differential Equations 6.1 Introduction to partial differential equations 6.2 The method of separation of variables. 6.2 The Wave Equation. 6.2.1Fourier series solution of wave equation. 6.3 One dimensional heat flow equation 6.4 The Laplace equation in two dimensional heat flow (Steady State). 6.5 Numerical solutions of Laplace equation using Gauss – Seidel iterative method	6 **Hrs.**

Textbooks:

SN	Title	Edition	Author/s	Publisher
1.	Higher Engineering Mathematics	**42**	Dr. B. S. Grewal	Khanna Publishers, Delhi

2.	A Text Book of Applied Mathematics Vol. II & III	**6**	P. N. Wartikar & J. N. Wartikar	Pune Vidyarthi Griha Prakashan, Pune		**Reprint 2007**

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Advanced Engineering Mathematics	**10**	Erwin Kreyszig	John Wiley & Sons	**2011**
2.	Advanced Engineering Mathematics	**21**	H. K. Dass	S. Chand & Company Pvt. Ltd, New Delhi	**2014**
3.	A text book of Engineering Mathematics		N. P. Bali, Iyengar	Laxmi Publications (P) Ltd., New Delhi	
4.	Engineering Mathematics		Ravish R Singh and Mukul Bhatt	McGraw Hill Education (India) Private Limited, Chennai.	**2017**

Unit wise Measurable Learning Outcomes:

Unit 1: Linear Differential Equations with Constant Coefficients and Its Applications

Students will be able to

a) Solve linear differential equations with constant coefficients.
b) Obtain the solution of problems on free oscillation, damped oscillation and forced vibrations.

Unit 2: Vector Differential Calculus

Students will be able to

a) Evaluate line integral, surface integral, and volume integral.
b) Apply Green theorem to evaluate line integral.
c) Apply Stokes theorem to evaluate surface integral.
d) Apply Gauss Divergence theorem to evaluate surface integral.

Unit 3: Laplace Transform

Students will be able to

a) Compute Laplace transform by using definition
b) Recall properties of Laplace transform and use to compute transforms of given functions.
c) Use Laplace transforms method to solve linear differential equations.

Unit 4: Probability Distributions

Students will be able to

a) Verify the function as probability mass and density function.
b) Use probability distributions in solving physical and engineering problems.

Unit 5 : Fourier Series

Students will be able to

a) Define Fourier series, Euler's formulae.
b) Develop Fourier series in an interval.
c) Expand function as the half range sine or half range cosine series.

Unit 6: Application of Partial Differential Equations

Students will be able to

a) Solve wave equation
b) Solve one dimensional heat equation
c) Compute numerical solution to two dimensional heat equations

Title of the Course: APPLIED THERMODYNAMICS Course Code: UMEC0302	L	T	P	Credit
	3	-		3

Course Pre-Requisite: Basic Physics, Chemistry, Basic Mechanical Engg

Course Description: Basic Concepts in Thermodynamics, Forms of energy, Properties of pure substances, Phase diagram and Phase transition, First law of Thermodynamics and applications, Second Law of Thermodynamics and Exergy.

Course Objectives:

1. Understand various types of energies and its applications in thermodynamic systems
2. Applying thermodynamic concepts to thermodynamic systems
3. Know various laws of thermodynamics and applications to thermodynamic system
4. Application of ideal gas processes to thermodynamic systems
5. Study steam properties, Use of steam tables and Mollier charts with numerical applications
6. Understand and analyze (numerical analysis) various types of air standard cycles

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain fundamental knowledge of Thermodynamics	II	Understanding
CO2	Apply knowledge of thermodynamics cycles to understand the working of Thermodynamic systems.	III	Applying
CO3	Analyze performance parameters of Thermodynamic systems	IV	Analyzing

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Review of Laws of Thermodynamics Review of First Law, Second Law, Clausius theorem, Entropy, Clausius inequality, Entropy as a property of system, Entropy of pure substance. T-s and h-s planes, Entropy change in reversible and irreversible processes, Increase of entropy principle, Calculation of entropy changes of gases and vapors.	**7 Hrs.**
Unit 2: Available Energy, Availability and Irreversibility: Available Energy, Available referred to cycle, Quality of Energy, Reversible work in Open and Closed system, Useful work, Dead state, Availability, Irreversibility and Second Law efficiency.	**7 Hrs.**
Unit 3: Properties of Pure Substances	**6 Hrs.**

Pure substance, Phase change processes, Property diagram for phase change process (T-v, p-T, p-V diagram, p-v-T surface), Triple point of water, Properties of steam, Deviation of real gases from Ideal gases, Equations of state: Vander Waal, Beattie-Bridgeman, Virial and Diterici's equations.(Descriptive treatment)	
Unit 4: Gas Power Cycles: Air Standard cycles: Assumptions, the Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Combustion Cycle and Brayton Cycle. Comparison of Otto, Diesel and Dual Combustion Cycles. Expression for air standard efficiency and mean effective pressure for Otto, Diesel and Dual Combustion cycle.	**6 Hrs.**
Unit 5: Vapour Power Cycles: Carnot cycle using steam, Limitations of Carnot cycle Rankine cycle, Representation on T-s and h-s planes, Thermal efficiency, Specific steam consumption. Work ratio, Effect of steam supply pressure and temperature, Effect of condenser pressure on the performance. (Numerical Treatment), Reheat and regenerative steam power cycles, Use of steam table and Mollier chart.	**8Hrs.**
Unit 6: Reciprocating Air Compressors: Application of compressed air, classification of compressor, Reciprocating compressors, construction , Work input, Necessity of cooling , Isothermal efficiency, Heat rejected, Effect of clearance volume, Volumetric efficiency, Necessity of multistaging, construction, Optimum intermediate pressure for minimum work required, After cooler, Free air delivered, air flow measurement, Capacity control.	**6 Hrs.**
Textbooks: 1. Thermodynamics: An Engineering Approach, 3rd Edition, Yunus A Çengel and Michael, Boles, Tata McGraw Hill. 2. Basic and Applied Thermodynamics, 2nd Edition, Nag P. K., Tata McGraw-Hill.	
References: 1. Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley. 2. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering 3. Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall. 4. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.	

Title of the Course: Object Oriented Programming	**L**	**T**	**P**	**Credit**
Course Code: UMEC0303	**3**	**-**	**-**	**3**

Course Pre-Requisite: Knowledge of Computers and Programming using any computer language.

Course Description:

This course exposes students with various object oriented concepts like, classes, objects, inheritance and operator overloading etc. This course encourages students to design and solve real life graphical problems like drawing line, rectangle and circle using object oriented programming language.

Course Objectives:

1. To understand the concepts of Object Oriented Programming.
2. To make students aware about various Object Oriented Concepts.
3. To give hands on exposure to develop Computer graphics applications based on concepts of Object Oriented approach.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom"s Cognitive level	Descriptor
CO1	**Define** object oriented concepts, principles and techniques.	1	Remembering
CO2	**Compare** between object oriented programming and procedural programming.	2	Understanding
CO3	**Apply** various object oriented features to solve real life problems using C++ language.	3	Application
CO4	**Design** and **Develop** small computer graphics application to solve real timeproblems.	3, 6	Application ,Create

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three units)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- Introduction Principles of OOPS, Object oriented Programming Paradigm, Basic Concepts of Object- Oriented Programming, Benefits of OOP, Applications of OOP, A simple C++ Program, Structure of C++ Program, Tokens, expressions and Control Structure.	(07 Hrs)
Unit 2:- Functions in C++, Introduction, The Main function, Function Prototyping, Call by Reference, Return by reference, Inline functions, Function Overloading, Friend and Virtual function, Library functions., Introduction to Arrays.	(07 Hrs)
Unit 3:- Classes and Objects - Introduction, Specifying a Class, Defining member functions, A C++ Program with Class, Nesting of member functions, Objects as a function arguments, constructors and destructors.	(06 Hrs)

Unit 4 :- Operator Overloading and Inheritance- Introduction, Defining Operator overloading, Overloading Unary Operators, Overloading Binary Operators, Inheritance- Introduction, Defining Derived Classes, Single Inheritance, Making a private member Inheritable, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance.	(08 Hrs)
Unit 5:- Pointers, Virtual Functions and Polymorphism- Introduction, Pointers, Pointers to objects, Pointers to derived classes, Virtual function, Pure Virtual function.	(06 Hrs)
Unit 6:-Introduction and background of Computer Graphics, Graphic primitives: Points, Lines and Rectangle, Line drawing Algorithms, DDA Algorithm, Analytic curves: Circle Transformation and its Types.	(06 Hrs)

Textbooks:

1. C++: The Complete Reference, Herbert Schildt, McGraw Hill Education,4th Edition
2. C++ Black Book, Steven Holzner, Coriolis Group,U.S.; Pap/Cdr edition
3. Object oriented programming with C++, E. Balagurusamy, Tata McGraw Hill Education , 3rd Edition
4. Let us C++" ,Yashwant Kanitkar ,BPB Publication
5. "Object-Oriented Programming in C++", Rajesh K Shukla, Wiley India
6. Classic Data structures by Samantha, PHI Learning Pvt.Ltd, 2nd Edition.

References:

1. "Professional C++", Solterwiely India.
2. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.
3. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.PvtLtd.,Second Edition
4. An introduction to Data structures and algorithms, J.A.Storer,Springer.

Title of the Course: Electrical and Electronics Engineering	**L**	**T**	**P**	**Credit**
Course Code: UMEC0304	**3**	**-**	**-**	**3**

Course Pre-Requisite: Knowledge of basic electrical and electronic systems

Course Description:
This course exposes students to various electrical and electronic components to assist them in future to develop control systems.

Course Objectives:
1. To understand the concepts of Electric circuits.
2. To make students aware about various Transducers and sensors.
3. To make students aware about various analog devices
4. To make students understand the concepts of signal conditioning circuits and actuators

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom"s Cognitive level	Descriptor
CO1	**Apply** the knowledge of Electrical laws to **analyze** the simple circuits	IV	Analyze
CO2	**Explain** the working principle, construction, operation and features of sensors and transducers.	II	Understand
CO3	**Explain** the use of different analog devices used in instrumentation.	II	Understand
CO4	**Explain** the different signal conditioning circuits and actuators.	II	Understand

CO-PO Mapping:

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

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three units)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- **Electric Circuits:** DC Circuits- Types of sources, Ohm's law, Kirchhoff's Laws, Simple problems on Ohms law & Kirchhoff's law, mesh current & node voltage method, Current and voltage source transformation, series and parallel circuits.	(05 Hrs)

AC Circuits- Basic circuit elements (R, L, C), Behavior of R, L and C when connected to AC source (V – I Relationship), Series parallel combination of R, L & C (Simple numerical on RL, RC, RLC circuit)	
Unit 2:- **Transducers & Sensors (MODULE -1):** Transducers – Definition & Classification of transducers, Difference between sensor and transducer. Performance terminologies of sensors. Measurement of strain – definition of stress & strain, operation of resistance strain gauge, construction of metal foil strain gauge, Strain Gauge Circuits Measurement of Force and Torque - Force measurement using load cell, Types of load cells: column type and beam type, Measurement of torque using torque cell Temperature Measurement- Thermistor, Thermocouple- thermocouple types and their ranges. Resistance thermometer (RTD) Displacement measurement- Linear variable differential transformer (LVDT) Rotary motion measurement using optical rotary encoder	(08 Hrs)
Unit 3:- **Transducers & Sensors (MODULE -2):** Pressure measurement - Definition of pressure and its units, Absolute, differential and gauge pressure Absolute pressure measurement using bourdon tube gauge Flow Measurement-Difference between mass flow rate and volumetric flow rate, Volumetric flow rate measurement using electromagnetic flow meter, turbine type flow meter and hot wire anemometer Measurement of magnetic field - Hall effect and hall effect transducer Level measurement – float type, capacitive and ultrasonic level measurement Rotational velocity / speed measurement	(08 Hrs)
Unit 4 :- **Analog Devices (MODULE 1):** Semi conductor theory:- Intrinsic and Extrinsic Semiconductors - N type and P type materials -majority and minority carriers - Semi conductor diode - PN junction - V I characteristics of PN Junction diode Rectifiers: Working and Waveforms of Half wave - Full wave - Bridge rectifiers (without filters) – Differences.	(06 Hrs)
Unit 5**:- Analog Devices (MODULE 2):** Special Diodes: Working principle and V I characteristics of Zener diode - Applications of Zener diode - Regulator (series and shunt) - LED - LCD – Opto coupler. Transistor: Working Principle of NPN and PNP transistor - Transistor as a switch - Transistor working as an amplifier- common base - common collector- common emitter configuration - input and output characteristics. FETs, MOSFETs and IGBT.	(06 Hrs)
Unit 6:- **Signal Conditioning & Actuation:** Signal Conditioning Circuits - Introduction, Functions of Signal Conditioning circuits, Operational Amplifier and its characteristic parameters - Block diagram and features of OPAMP Circuit Symbols and Terminals. OP-AMP basic Circuits-Open loop and closed loop configuration of op-amp, its comparison. Virtual ground concept. Open loop configuration, Close loop configuration: Inverting, non- inverting, differential amplifier, unity gain amplifier (voltage follower), inverter (sign changer), Adders, Subtractor, Integrator, Differentiator. Concept of comparator: zero crossing detector, Schmitt trigger, window detector, Phase detector, active peak detector, peak to peak detector Classification of filters, Concept of passive & active filters Actuators - AC and DC motors introduction, Servomotors—AC and DC, Stepper	(08 Hrs)

motor and Synchros, Linear actuators. (Only working principle & applications)	

Reference Books :

Electrical & Electronic Measurement & instrumentation – A. K. Sawhney, Dhanapat Rai and Co (19th edition)
Op-Amps and linear IC's – Ramakant Gaikwad, Prentice- Hall India
Modern Electronic instrumentation and measurent techniques –cooper Helfrick, Prentice Hall
Electronic Instrumentation – H.S.Kalsi – Tata McGraw Hill
Electrical Technology- Volume 1 & 2 by B.L.Thereja, S.Chand Publication
Fundamentals of Electrical Engineering – 4th Edition, Ashfaq Husain, Dhanapat Rai & Company
Mechatronics 3/e - W. Bolton (Addison Wesley) ISBN 81-7758-284-4
Mechatronics Principles, Concepts & Applications – N.P.Mahalik (TMH) ISBN 0-07- 048374
Automated Manufacturing Systems: Sensors, Actuators – S. Brain Morriss (McGraw Hill) ISBN 0-07-113999-0

`Title of the Course: Machine Tools Course Code: UMEC0305	L	T	P	Credit
	3	--	--	3

Course Pre-Requisite: Knowledge of basic mechanical engineering

Course Description: This course aims to impart knowledge of machine tools and various operations performed on to it, using different cutting tools.

Course Objectives:

1) To understand the various conventional and basic machine tools and manufacturing processes carried out on these machines for different applications.
2) To gain the basic knowledge about machine tools and its construction and principles of working.
3) To make student aware of tool geometry, tool signature, and mechanics of chip formation, types chip, tool wear, surface finish and need of cutting fluids, machininabilty of the material helps in selection of tool material.
4) To study of various features and capabilities of various machine tool types, parts, accessories attachments, and operations performed and time required, assists in selection of proper machine tool for a particular application.
5) To study of advances in machine tools and finishing processes helps to take decision for selection of proper machine tool for batch and large size machining applications.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Explain the fundamentals & basic concepts of metal removal process.	2	Understanding
CO2	Identify & Select the required machine tools for machining process.	3	Applying
CO3	Compare various machining processes for metal removal.	4	Analyzing
CO4	Estimate cycle time for given machining operations	5	Evaluating

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Introduction to Theory of Metal Cutting Overview of machining processes, Classification of Machine tools, Mechanics of machining, Principles, Machining Parameters, forces in machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear, Tool signature, Types of chips, Surface Finish, Cutting fluids, machinability, Selection of tool materials.	**6 Hrs**
Unit 2: : Lathe, Capstan and Turret Lathe, Shaper & Planer Machine Working Principle, Specification, Principal Parts, Accessories, Attachments, Concept of speed, feed, depth of cut, and Machining time calculation for lathe machine. Operations, Introduction to Capstan and Turret Lathe, principle parts & applications of shaper & planer machine, Quick return Mechanism used in shaper & planer machine.	**7 Hrs**
Unit 3: Drilling, Boring & Milling Machines Drilling machine specification, Construction, working, Operations performed on drilling Machines, Machining time calculation for drilling machine, Specification, Classification, Construction & working of boring machine, boring machine applications, classification of milling machines, construction and working of column and knee type milling machine, operations performed on milling machine, study of standard accessories, gear cutting on milling machine.	**7 Hrs**
Unit 4: Grinding Machines & Gear manufacturing process Introduction, types of grinding, classification of grinding machines, principle of grinding operations, grinding wheel, bonds and bonding processes, grit, grade and structures of wheel, wheel shapes and sizes, standard marking system for grinding wheel, dressing & truing of grinding wheel, applications of grinding machine, Principle of Gear Shaping & Gear hobbing, Gear finishing processes, Gear shaving, Gear Burnishing, Gear rolling process.	**7 Hrs**
Unit 5: CNC Machines NC machine, Difference between NC&CNC machine tools, CNC types, constructional details, special features, machining centre, Vertical and Horizontal Machining Centre, Recirculating ball screw, Feedback devices, fundamentals of part programming, tooling used for CNC machines, Automatic tool changer (ATC), Automatic pallet changer (APC).	**7 Hrs**
Unit 6: Non Conventional Machine tools Need of non conventional machining, Advantage, Limitations and applications, Abrasive Jet Machining, Electrical Discharge Machining, Electro- chemical Machining, Laser beam Machining, Ultrasonic Machining, Water Jet Machining, Plasma arc machining.	**6 Hrs**

Textbooks:

- Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.
- B.S. Raghuwanshi, "Workshop Technology", Dhanpatrai Publication, 9th Edition, 1999.
- Rao, P.N., Manufacturing Technology–Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi, 2000.
- Hajra Chowdary, S.K., and Hajra Chowdary, A.K., Elements of Workshop Technology, Vol. II, Asia Publishing House, Bombay, 2003.
- Kalpakjian, S. and Steven R. Schmid, Manufacturing, Engineering & Technology, Pearson
- Production Technology by HMT, Tata McGraw-Hill, 2002
- Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol II , Dhanpat Rai & Sons, 1992.
- Fundamentals of metal cutting and Machine Tools, B.L. Juneja, G.S. Sekhon and Nitin Seth, New Age International Publishers 2nd Edition, 2003
- All about Machine Tools, Heinrich Gerling, New Age International Publishers revised 2nd Edition, 2006
- Fundamental of Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor & Francis, Third Edition.
- Workshop Technology Vol. II by Bawa H. S. (TMH)

Reference Books:

1. Manufacturing Science – Amitabha Ghosh and Mallik, Affiliated East West press, 2010, 2nd edition.
2. Modern machining Process – Pandey and Shah, Tata Mc Graw Hill – 2009.
3. Manufacturing processes for Engineering Materials by Serope kalpakijian and Steven R.Schimid pearson education 2009, 5th edition.
4. Materials and Processes in Manufacturing by E.Paul DeGarmo, J T Black, Ronald A Kohser, 8th Edition, Prentice Hall of India Private limited, 2004.

Title of the Course: Environmental Studies (Audit Course – I)	**L**	**T**	**P**	**Credits**
Course Code:UMEA0361	**2**	**-**	**-**	**0**

Course Pre-Requisite: Students shall have knowledge of:

- Science
- Technology

Course Description: The objective of the course is imparting fundamental knowledge and awareness of Environmental science among students and importance of conservation of environment.

Course Objectives:

At the end of the course students will be able to

1. Study scope and importance of natural resources, ecosystems, biodiversity for creating awareness and their conservation in multiple disciplines.
2. Learn various types of pollution, their impacts and control measures for minimizing pollutionand sustainable development.
3. Understand social issues related environment, environmental ethics and human rights towards environment.
4. Study various laws and regulations related to environment and its applicability in society and industries

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Describe natural resources, importance of ecosystem and conservation of biodiversity with respect to multiple disciplines	2	Understanding
CO2	Explain causes, effects, solutions for various pollution problems and its minimization strategies.	2	Understanding
CO3	Discuss environmental ethics and their implementation for betterment of environment and human life.	4	Analyzing
CO4	Differentiate between requirements of laws and regulations for environmental conservation and applicability of legislationsin society and industries.	4	Analyzing

CO-PO Mapping:

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

Assessment Scheme:

ESE: Assessment is based on 100%

Assessment Component	**Marks**
ESE	100

Course Contents:

Unit 1: Nature of Environmental Studies Definition, scope and importance, Multidisciplinary nature of environmental studies, Need for public awareness.	4 **Hrs.**

Unit 2: Natural Resources and Associated Problems a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. b) Waterresources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. c) Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources. d) Food resources: World foodproblem, changes caused by agriculture effect of modern agriculture, fertilizer-pesticide problems. e) Energy resources: Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. f) Land resources: Solar energy, Biomass energy, Nuclear energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources.	4 **Hrs.**
Unit 3: Ecosystems Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristics features, structure and function of the following ecosystem :- a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	4 **Hrs.**
Unit 4:Biodiversity and its conservation Introduction- Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptiveuse, productive use, social, ethical, aesthetic and option values. India as a mega- diversity nation, Western Ghat as a biodiversity region. Hot-spot of biodiversity. Threats to biodiversity habitat loss, poaching of wildlife, manwildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	4 **Hrs.**
Unit 5:Environmental Pollution Definition: Causes, effects and control measures of: Air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution, Thermal pollution,	4 **Hrs.**
Unit 6: Social Issues and the Environment Disaster management: floods, earthquake, cyclone, tsunami and landslides. Urban problems related to energy Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issue and possible solutions. Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	4 **Hrs.**
Unit 7:Environmental Protection From Unsustainable to Sustainable development. Environmental Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Population Growth and Human Health, Human Rights	4 **Hrs.**

Textbooks:

1. Environmental Studies by Dr. P.D.Raut (Shivaji University, Kolhapur)

Reference Books:

1. Miller T.G. Jr., Environmental Science. Wadsworth Publications Co.(TB).
2. Odum, E.P.1971, Fundamentals of Ecology, W.B.Saunders Co. USA,574p
3. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines,Compliances and Standards, vol. I and II, Environmental Media (R)

Title of the Course: THERMAL ENGINEERING LAB Course Code: UMEC0306	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Basic Mechanical Engineering, Physics

Course Description: Basic Concepts in Thermodynamics, Working of Steam generator and Condenser, Working Principle of Reciprocating compressor, Working Principle of Gas Turbine

Course Objectives:

1. To Understand types and working of Steam Boilers, steam condensers and steam turbines.
2. To Demonstrate working of air compressors.
3. To Determine Thermo physical properties of Lubricating oil and Grease
4. To estimate efficiency of Reciprocating Compressor

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain the working of Thermal Equipments	II	Understanding
CO2	Experiment with apparatus for Thermal properties of Lubricants	III	Applying
CO3	Analysze performance of thermal system	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															
CO2			2										2			
CO3		2											2			

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No.1: Test On Carbon Residue Apparatus **Aim and Objectives:** To determine the percentages of carbon residue after evaporation of oil. **Outcomes:** Students are able to determine percentages of carbon residue after evaporation of oil.	CO2	2 Hrs
Experiment No.2: Determination of Flash and Fire Point of Lubricating Oil **Aim and Objectives:** Determination of flash and fire point of given lubricating oil. **Outcomes:** Students are able to determine flash and fire point of given lubricating oil.	CO2	2 Hrs
Experiment No.3: Test on Dropping point apparatus **Aim and Objectives:** To determine the dropping point of lubricating grease. **Outcomes:** Students are able to determine dropping point of lubricating grease.	CO2	2 Hrs

Experiment No.4: Test on Aniline Point apparatus Aim and Objectives: To determine the aniline point of given lubricating oil. **Outcomes**: Students are able to determine aniline point of given lubricating oil.	CO2	2 Hrs.
Experiment No. 5: Trial on Reciprocating Compressor **Aim and Objectives:** To determine thermal and volumetric efficiency of reciprocating compressor. **Outcomes:** Students are able to determine thermal and volumetric efficiency of Reciprocating Compressors.	CO1	2 Hrs
Experiment No.6: Study and demonstration of Steam condensers **Aim and Objectives:** To Classify and explain working of Steam Condenser and calculation of performance parameters of condenser. **Outcomes:** Students are able to Classify and explain working of various steam Condenser and determine performance parameters.	CO1	2 Hrs.
Experiment No. 7: Study and Demonstration of Steam Boilers **Aim and Objectives:** To Classify and explain working of Steam Boilers **Outcomes:** Students are able to Classify and explain working of various Steam Boilers.	CO1	2 Hrs.
Experiment No.8: Study and demonstration of Boiler mounting and Accessories **Aim and Objectives:** To Classify and explain working of Boilers Mounting and accessories **Outcomes:** Students are able to Classify and explain working of various Boilers mountings and accessories.	CO1	2 Hrs
Experiment No. 9: Study and demonstration of steam turbines **Aim and Objectives:** To study and demonstrate the working principle of steam turbine **Outcomes:** The students will be able to understand and demonstrate the working principles of steam turbines.	CO1	2 Hrs.
Experiment No. 10: Study and demonstration of Centrifugal and Axial Compressor **Aim and Objectives:** To determine overall efficiency of Centrifugal blower **Outcomes:** The students will be able to understand the performance of Centrifugal compressor.	CO2	2 Hrs
Experiment No. 11: Industrial visit to steam power plant. **Aim and Objectives:** To Classify and explain working of Steam Boilers, mounting and accessories. **Outcomes:** Students are able to Classify and explain working of various steam Boilers, mounting and accessories.	CO1	2 Hrs.

Textbooks:

1.Thermodynamics: An Engineering Approach, 3rd Edition, Yunus Çengel and Michael, Boles, Tata McGraw Hill.

2.Basic and Applied Thermodynamics, 2nd Edition, Nag P. K., Tata McGraw-Hill.

References:

1.Fundamentals of Thermodynamics, 5th Edition, Richard E. Songtag, Claus Borgnakke and Gordon J. Van Wylen, John Wiley and Sons, Inc.

2. Thermodynamics, 4th Edition, J.P. Holman, McGraw-Hill.

3. Engineering Thermodynamics, 2nd Edition, Jones J.B. and Hawkins G.A., John Wyley and Sons.

4. Fundamentals of Engineering Thermodynamics, Moran M.S. and Shapiro H.N., John Wyley and Sons, 1988.

5. Thermodynamics, 5th Edition, K. Wark, McGraw-Hill.

	Experiment wise Measurable students Learning Outcomes: At the end of each experiment the students will be able to 1. Determine Percentage of Carbon Residue in Lubricating Oil. 2. Determine Flash and Fire point of Lubricating oil 3. Determine Dropping point of Lubricating oil 4. Determine Aniline point of Lubricating oil 5. Determine Efficiency of Reciprocating Compressor. 6. Demonstrate working of Steam Condensers 7. Demonstrate working of Steam Boilers 8. Demonstrate working of Boiler mountings and accessories. 9. Study and demonstration of steam turbines 10. Study and demonstration of Centrifugal and Axial Compressor 11. Industrial visit to steam power plant

Title of the Course: Object Oriented Programming Lab **Course Code: UMEC0307**	**L**	**T**	**P**	**Credit**
	-	**-**	**2**	**1**

Course Pre-Requisite: Knowledge of Computers and Programming using any computer language.

Course Description:

This course exposes students to the concepts of Object Oriented Programming (OOP). It helps students to choose proper OOP concepts to solve different problems. Upon completion, students should be able to write efficient, reusable programs for a given problem using OOP concepts.

Course Objectives:

1. To understand the concepts of Object Oriented Programming.
2. To make students aware about various Object Oriented Concepts.
3. To give hands on exposure to develop Computer graphics applications based on concepts of Object Oriented approach.

Course Learning Outcomes:

CO	**After the completion of the course the student should beable to**	Bloom's Cognitive level	Descriptor
CO1	**Define** object oriented concepts, principles and techniques.	1	Remembering
CO2	**Compare** between object oriented programming and procedural programming.	2	Understanding
CO3	**Apply** various object oriented features to solve real life problems using C++ language.	3	Application
CO4	**Design** and **Develop** small computer graphics application to solve real timeproblems.	3, 6	Application, Create

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

Assessment	Marks
ISE	25
ESE	25

ISE is based on practical performed and submission during Lab.
ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1 :- Programs on Functions in C++	**2 Hrs.**
Experiment No. 2: --- Programs on control structures.	**2 Hrs.**
Experiment No. 3 :- Programs on arrays of objects.	**2 Hrs.**
Experiment No. 4 :- Programs on inline function & friend function.	**2 Hrs.**
Experiment No. 5 :- Programs on function overloading & Operator Overloading.	**2 Hrs.**
Experiment No. 6 :- Programs on Constructor and destructor.	**2 Hrs.**

Experiment No. 7 :- Programs on Inheritance (Single, Multilevel)	**2 Hrs.**
Experiment No. 8 :- Programs on Inheritance (Multiple, Hierarchical)	**2 Hrs.**
Experiment No. 9 :- Programs on Polymorphism.	**2 Hrs.**
Experiment No. 10 :- Programs on drawing a line using DDA algorithm.	**2 Hrs.**
Experiment No. 11 :- Program on drawing a rectangle.	**2 Hrs.**
Experiment No. 12 :- Program on drawing a circle.	**2 Hrs.**

Textbooks:

1. Object oriented programming with C++, E. Balagurusamy, Tata McGraw Hill Education ,3rdEdition
2. Let us C++" ,Yashwant Kanitkar ,BPB Publication
3. "Object-Oriented Programming in C++", Rajesh K Shukla, Wiley India
4. Classic Data structures by Samantha, PHI Learning Pvt.Ltd, 2nd Edition.

References:

1. "Professional C++", Solterwiely India.
2. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.
3. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.PvtLtd.,Second Edition
4. An introduction to Data structures and algorithms, J.A.Storer,Springer.

Title of the Course: CAD/CAM Laboratory	L	T	P	Credit
Course Code: UMEC0308	-	-	2	1

Course Pre-Requisite: Knowledge of Machine drawing, isometric & orthographic projection and CNC machines is essential.

Course Description: Under this course the student will be introduced to the principles of parametric design using computer aided design software. Students will construct 3 models and surfaces. Topics will include sketching, constraining, solid modeling, surface modeling, Drafting and Assembly modeling and kinematics, Students will also learn Manual part programming and CAM.

Course Objectives:

1. To Construct 3D solid Models of parts using CAD software and measure its physical properties.
2. To Construct surface models of parts using CAD software
3. To build 3D assemblies using CAD software taking into consideration appropriate assembly approach
4. To Build 2D projections from 3D models and assemblies
5. To Develop the CNC part program by using manual programming and CAM software.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Construct 3D solid and surface Models of parts using CAD software and measure its physical properties.	3	Construct
CO2	Build 3D assemblies with appropriate assembly approach and 2D projections using CAD software.	3	Build
CO3	Develop the CNC manual part program for 2D Profile.	3	Develop

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PS01	PS02	PS03
CO1	2		1		3					1		1	2		
CO2	2		1		3					1		1	2		
CO3	1		1		2					1		1	2		

Assessments :

Teacher Assessment:

Assessment	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

1: Introduction to CAD: Concept of CAD/CAM/CAE Need for implementing CAD, Application and benefits of CAD, Hardware Requirements, Different	2 **Hrs.**

Software packages used for 3D Modeling.	
2: Sketching & Solid Modeling: 2D sketching of elements like line, circle, arc, spline etc. Dimensioning these elements, Geometrical constraints **Solid Modeling:** Concept of Feature based and parametric modeling Basic and advanced modeling features. Import and export of 3D solid models between two different software packages. Physical properties like volume, surface area, center of gravity etc of solid model.	8 **Hrs.**
3: Basic Surface Modeling: Concept of parametric surface modeling. Basic modeling features. **Assembly Modeling**: Concept of Bottom up and top down approach, Building two composite assemblies of components (consisting at least five components) along with all relevant details, Exploded Views using assembly features in any suitable 3D modeling software.	**8 Hrs**
4: Generation of 2D Drawings: Generation of Orthographic views of individual components required for shop floor [working drawings] from 3D model which will include all relevant views like front, side, top, bottom views, sectional views, dimensioning, dimensional and geometrical tolerances etc. Generation of title block in sheet. Orthographic views of assembly drawings, generation of Bill of Materials (BOM). Plotting of drawings.	2 **Hrs.**
5. Computer Aided Manufacturing: **Part Programming:** Introduction to manual part programming, use of G and M codes to generate manual part program, Introduction to data exchange formats, Demonstration of integration of CAD/CAM software to generate tool path using suitable software.	4 **Hrs.**

Text Books:

1) "CAD/CAM- Principals and Applications", P.N. Rao, Tata McGraw Hill, 2nd Edition.
2. "CAD/CAM/CAE",N.K. Chougule, SciTech Publication, Revised Edition.
3. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007 4.
Radhakrishnan P, SubramanyanS.andRaju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.

References:

1. Various 3D modeling Software Manuals.
2. CNC Programming manual.
3. "Machine Drawing", N. D. Bhatt and V.M. Panchal, Charoter Publications
4. "Mastering CAD CAM",Ibrahim Zeid, Tata McGraw-Hill, Special Indian Edition, (2007).
5. "Machine Drawing", N. Siddheshwar, P. Kannaiah, V V S Sastry, Tata McGraw Hill Publications, 2nd Edition.
6. "CAM/CAM – Theory and Practice",Ibrahim Zeid, R. Sivasubramaniam, Tata McGraw Hill,2nd Edition.
7. "CAD/CAM – Concepts and applications", Chennakesava R. Alavala – Prentice Hall of India

Experiment wise Measurable students Learning Outcomes:

1. Students shall be able to explain the computer aided design process by taking into account current CAD practices
2. Students shall be able to build/Construct Build 2D sketches fulfilling appropriate dimensional and geometrical constraints using CAD software
3. Students shall be able to to design 3D solid Models and surface models of parts using CAD software.
4. Students shall be able to Construct 2D projections from 3D models and assemblies.

5. Students shall be able to Develop 3D assemblies using CAD software taking into consideration appropriate assembly approach.
6. Students Shall be able to develop CNC manual part program.

Title of the Course: Machine Drawing Lab Course Code: UMEC0309	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: - 1. Fundamentals of Engineering Drawing
2. Basic knowledge of 2-D drafting using software

Course Description: Machine Drawing is used to communicate the necessary technical information required for manufacture and assembly of machine components. Students will be aware of the different standards. Students will to be familiar with production drawings to make themselves fit in industries. This course enables students to create 2D model, Assembly, Bill of material and drafting of any mechanical components.

Course Objectives:
1. To make the student familiar with Indian Standards for drawing.
2. To use different limits, fits and tolerances on assembly drawings.
3. To provide sound knowledge of detail and assembly procedure.
4.To build/Construct Build 2D sketches fulfilling appropriate dimensional and geometrical constraints using CAD software
approach

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Make use of BIS conventions and free hand sketches for drawing simple machine components in machine drawing	III	Applying
CO2	Interpret the geometrical dimensioning and tolerance used in industrial drawing	III	Applying
CO3	Develop the Interpretation curves for two mating parts	III	Applying
CO4	Construct the detail part and assembly drawing	III	Applying

CO-PO Mapping:

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

Assessments:
Teacher Assessment: Sheetsfor In Semester Evaluation (ISE).

Assessment	Marks
ISE	25

ISE are based on sheets/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Sheet No. 1: ---Study of Conventions **Aim and Objectives:** To draw BIS conventions on A3 Sized Sheet **Outcomes:** Student will be familiar with Standards for drawing **Theoretical Background:** Significance and importance of various BIS Conventions, ANSI and ASTM as per standards, Drawings sheet sizes and layout, Dimensioning Techniques, Conventional representation of Engineering materials, BIS conventions for sectioning, conventional representation of screw threads and threaded parts, Internal and external threads, springs, gears and gearings, conventional representation of common	**3Hrs.**

machine elements (splined shaft, serrated shaft, Knurling, bearings *etc.*). Symbolic representation of Welds, Rivets and riveted joints as per BIS conventions.	
Sheet No. 2: ---Sketching of machine components **Aim and Objectives:** To draw free hand sketching on A3 Sized Sheet **Outcomes:** Free hand sketching is used so as to enable the students to quickly present, in graphical form, an idea which is related to particular problem, understand the application of the machine component. **Theoretical Background:** Free Hand drawing on Nuts, bolts, studs, washers. Types of keys: Parallel, sunk, woodruff, saddle, feather etc. Types of couplings: flexible and Rigid couplings.	**3Hrs.**
Sheet No. 3: ---Sketching of machine components **Aim and Objectives:** To draw free hand sketching on A3 Sized Sheet **Outcomes:** Free hand sketching is used so as to enable the students to quickly present, in graphical form, an idea which is related to particular problem, understand the application of the machine component. **Theoretical Background:**Types of joints: Pin and cotter, Types of bearings: Simple, Solid, bushed, Plummer block, footstep bearing, antifriction (SKF bearing catalogue reading) Pipe Joints and fittings: Different types of pipe Joints like Expansion joints, piping layouts, valves, pipe fittings like sockets, nipples, plugs, bends, Tees, elbows, crosses, etc. Power transmission elements: Flat belt, V belt, gears, chains, ropes, sprockets	**3 Hrs.**
Sheet No. 4: --Interpenetration of Solids **Aim and Objectives:** To draw Interpenetration of solids A3 Sized Sheet **Outcomes:** Students will be able to develop the Interpretation curves for two mating parts **Theoretical Background:** Intersection of surfaces and solids: - Intersection of prisms, cylinders, cone with prism & cylinder, pyramid with prism, and vice versa both solids in simple position. (Prisms and Pyramids limited up to rectangular base)	**3 Hrs.**
Sheet No. 5: --- Geometrical Dimensioning and Tolerances **Aim and Objectives:** To show GD&T and surface roughness symbols on drawing using drafting software on A3 Sized Sheet. **Outcomes:** Students will be able to understand and make use of GD&Tfor representing it ondrawing. **Theoretical Background:** Significance of limit systems, terminology, Dimensional Tolerances, types of fits, Recommendations and selections, Geometric Tolerances, Nomenclature, Rules, Symbols, form and position, (ASME Y 14.5)Representation of geometric tolerances on drawing, giving Tolerances for individual dimensions on a detail drawing. Roughness Grades, Representation of surface roughness on drawing (Machining symbol), Relation between surface finish & Manufacturing processes.	**4 Hrs.**
Sheet No. 6: ---Detailed to Assembly drawing. **Aim and Objectives:** To draw theassembly using drafting software on A3 Sized Sheet or sketching on A3 Sized Sheet **Outcomes:** Students will be able to understand and draw the assembly of Machine. **Theoretical Background:** Assembly drawings (Machine tool parts, Engine parts, Valves, Jigs and Fixtures, Fabricated assembly) study and preparation of bill of materials. Entering limits, fits, tolerances and surface finish symbol and manufacturing notes on assembly drawing	**2 Hrs.**
Sheet No. 7: --- Assembly to detailed drawing **Aim and Objectives:** To draw details using drafting software on A3 Sized Sheet or sketching on A3 Sized Sheet. **Outcomes:** Students will be able to understand and draw the detailsof Machine. **Theoretical Background:** Part drawings (Machine tool parts, Engine parts, Valves, Jigs and Fixtures, Fabricated assembly) study and preparation of bill of materials. Entering limits, fits, tolerances and surface finish symbols and manufacturing notes on detailed	**2 Hrs.**

drawing	
Sheet No. 8: ---Industrial case study on Machine drawing. **Aim and Objectives:** A group of 4 students have to visit an industry to collect the Industrial drawing and interpret the drawing. **Outcomes:**Students will understand in brief about the material needed to manufacture the part to be used, where it seats in assembly, what GD&T and tolerances are required to fit it in the assembly, how is the impact of other parts on this part, how to prepare final drawing of the part, how drawing checks are done and how drawings are released for production. Students will develop the skill of interpreting and reading the industrial drawing	**4 Hrs.**

Textbooks:

1. K. L. Narayana, Dr. P. Kannaiah, and K. Venkata Reddy, "Machine Drawing", New Age International Publishers, New Delhi
2. N. D. Bhatt & V. M. Panchal, "Machine Drawing by", Charotar Pub, Anand, Gujarat
3. P. S. Gill, "A Textbook of Machine Drawing", S. K. Kataria& sons, New Delhi
4. N. D. Junnarkar, "Machine Drawing", Pearson Education
5. R.K. Dhavan, "Machine Drawing", S. Chand and Company, New Delhi
6. N.Sidheshwar, P.Kannaiah and V.V.S.Sastry, "Machine Drawing"McGraw Hill,2001.

References:

1. IS Code: SP 46 – 1988, Standard Drawing Practices for Engineering Institutes
2. "Design Data", Faculty of Mechanical Engineering, PSG College of Tech, Coimbatore
3. IS: 2709-Guide for Selection of Fits, B.I.S. Publications
4. IS:919-Recommendation for Limits and Fits for Engineering, B.I.S. Publications
5. IS: 8000-Part I, II. III. TV, Geometrical Tolerancing of Technical Drawings –B.I.S. Publications
6. I.S.:696 Code of practice for general engineering drawings. BIS Publication.
7. I.S.:2709 Guide for selection of fits. BIS Publication.

Measurable students Learning Outcomes:

1. To get familiar with Bureau of Indian Standards drawing conventions.
2.To be able to draw proportionate free hand sketches of standards machine components.
3. Understanding penetration curves of solids.
4. Ability to use standard drafting software for showing limits, fits and tolerances and surface roughness symbols with respect to assembly drawings and detail drawings.
5. To be able to prepare detail drawings from given assembly drawings and vice a versa.
6.Students shall be able to read the industrial drawing

Title of the Course: Sensors and Actuators LabCourseCode:UMEC0310	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: AppliedMechanics,EngineeringPhysics, Basics of Sensors and transducers

Course Description: This course deals with the demonstration of different measuring devicesandsystemsand the conductofvariousexperimentsonthesame.Italsodealswith the testingandcalibrationofvarious measuringsystems.

CourseObjectives:

1. To demonstratedifferent components of mechatronics/measurement systems such as sensors, actuators and signal conditioning devices.
2. To make use of appropriate sensor/transducer for given engineering application.

CourseLearningOutcomes:

CO	Afterthecompletionofthecourse,thestudentshouldbeable to	Bloom'sCognitive level	Descriptor
CO1	Identify different typesofsensorsandtransducers.	3	Applying
CO2	Make use of breadboard and different signal conditioning circuits.	3	Applying
CO3	Demonstrate the working principal and applications of different electrical actuators.	2	Understanding

CO-POMapping:

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

Assessments:

TeacherAssessment:

OnecomponentofInSemesterEvaluation(ISE).

ISEisbasedonpractical performanceand Internal oral.

CourseContents: Any <u>ten</u> experiments out of the following list of the experiments are to be conducted, use of simulation software for experimental validation are encouraged:

ExperimentNo.1: ---AssignmentonMeasurementsystemsandbasicconceptsof measurement methods.	02 Hrs.
ExperimentNo.2: ---StudyofdifferenttypesofSensorsandTransducers.	02 Hrs.
Experiment No. 3: --- Measurement and monitoring of flows of the fluid using flow sensors.	02 Hrs.
Experiment No. 4: --- Measurement of distance using non-contact type laser distance sensor.	02 Hrs.
Experiment No. 5: --- Measurement and calibration of temperatures using PT100 temperature sensor.	02 Hrs.
Experiment No. 6: --- To studyDetection and Measurement of fluid levels using level sensor unit.	02 Hrs.

Experiment No. 7: --- To studyDetection and recognition of 2D/3D objects using object detection/recognition sensors.	02 Hrs.
Experiment No. 8: --- To studyDetection of exact positions of the objects using photoelectric sensors.	02 Hrs.
Experiment No. 9: --- To studyencoders to measure angular or linear distance movement.	02 Hrs.
Experiment No. 10: --- Angular speed measurement using, Photo-electricpickup and magneticpickup.	02 Hrs.
ExperimentNo.11: ---Testingof MechanicalpressuregaugeusingDead weightpressuregaugetester.	02 Hrs.
ExperimentNo.12: ---MeasurementofdisplacementusingLVDT.	02 Hrs.
ExperimentNo.13: ---Forceandtorquemeasurementusingstraingauges.	02 Hrs.
ExperimentNo.14: --To study the Universal Logic Gates using breadboard	02 Hrs.
ExperimentNo.15: --To study the Inverting and Non-Inverting OP-AMP.	02 Hrs.
ExperimentNo.16: --To study of astable/monostable/bistablemultivibrator using IC555.	02 Hrs.
ExperimentNo.17: --Assignment on electric actuators used in the mechatronic systems.	02 Hrs.
ExperimentNo.18: --Measurement and control of a speed of the DC motor.	02 Hrs.
ExperimentNo.19: --Demonstration of Design of smart wireless control system using Arduino Board through any suitable simulation applications.	02 Hrs.

Textbooks:

1. MechanicalMeasurement–Beckwithand Buck,PrenticeHallofIndia,NewDelhi.
2. Mechatronics",W. Bolton, Pearson Education , 4th Edition
3. Mechanical Measurement– Beckwith and Buck, Prentice Hall of India, New Delhi.
4. Mechatronics",Mahalik, TATA McGraw Hill, (2006) Reprint

References:

1. "Mechatronics: Integrated Mechanical Electronic System", Ramchandran , Willey India,1st Edition.
2. MeasurementSystems–DoebelinEmesto,McGrawHillPublishingCo.NewYork.

Title of the Course: Workshop Practice II Course Code: UMEC0311	L	T	P	Credit
	--	--	2	1
Course Pre-Requisite: Machine Drawing Interpretation, Use of workshop equipments, Safety measures.				
Course Description: This course is designed to provide the students with hands on knowledge and the practical learning experience on various machine tools and operations on it.				
Course Objectives: To practice basic metal cutting processes and acquire elementary skills.				

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Demonstrate the components and accessories of various machine tools.	2	Understanding
CO2	Identify & Find the suitable machining process for a given components.	3	Applying
CO3	Make use of part programming principles to develop a program in CNC machining.	3	Applying
CO4	Perform jobs with composite machining operations on suitable machining tools.	6	Creating

CO-PO Mapping:

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

Assessments :
Teacher Assessment:

Assessment	Marks
ISE	50
ESE(POE)	50

ISE: Assessment is based on 100% lab work.
ESE (POE): Assessment is based on 100% job performed and oral conducted. Time duration for job work is 4 hours.

Course Contents:	
Demonstration of Lathe machine to understand constructional details, various mechanism, accessories, attachments & different operations.	2 hrs
Reading the component Drawing, selecting and preparing operation sequence	2 hrs
Demonstration of Surface grinder , Cylindrical grinder followed by assignment	2 hrs
Demonstration of adjusting stroke on shaper/ Planer Machine followed by assignment	2 hrs
Demonstration of Turning Centre followed by assignment	2 hrs

Job 1: Manufacturing of component on lathe, Milling and Drilling Machine. This Job consists of operations such as turning, facing, grooving, Taper turning, Threading, Knurling, centre drilling, straddle milling etc.	12 hrs
Job 2: Demonstration of CNC machine, Completion of Job containing part programming	4 hrs
Industrial visit to study various manufacturing activities.	2 hrs
Note:- • Student must maintain work diary/operation sheet showing regular progress in the semester. • Dimensional accuracy is of prime importance. • The practical oral examination (POE) shall include manufacturing of one assigned job followed by an oral examination. The examination duration- 4 Hours. Textbooks: 1. "Elements of Workshop Technology vol. II", S.K.Hajra Choudhury and A.K. Hajra Choudhury , Media promoters and Publishers Pvt.Ltd,New Delhi,13th Edition,2012. 2. "Workshop Technology vol. II", W. A. J. Chapman, Viva Books Pvt.Ltd,New Delhi,1st Edition,2001. 3. Workshop Technology Vol. I , II and III by W.A.J. Chapman, (ELBS) 4. Workshop Technology Vol. II by Bawa H. S. (TMH) 5. A Course on Workshop Technology – Vol. 1 by B. S. Raghuvanshi; (Dhanpat Rai & Co.) 6. Workshop Technology Vol. III – Chapman (ELBS). 7. "Production technology", R. K. Jain, Khanna Publishers, Delhi, 15th Edition,2000.	

Title of the Course: FLUID MECHANICS AND HYDRAULIC MACHINES	**L**	**T**	**P**	**Credit**
Course Code: UMEC0401	**3**	**-**	**-**	**3**

Course Pre-Requisite: Fundamental Units and Dimensions, Differential and Integral Calculus, Basic Laws of Mechanics and Thermodynamics.

Course Description: This is one of the fundamental courses in thermal engineering. The course deals with fluid properties, fluid statics, dynamics and basics of hydraulic machines. The knowledge of this course is essential for design of turbines, pumps, compressors etc,. Also the course is essential pre-requisite for Heat and Mass Transfer and Computational Fluid Dynamics courses in Mechanical Engineering.

Course Learning Objectives:

CLO1: To prepare students of Mechanical Engineering to excel in fundamentals of Fluid Mechanics and Hydraulic Machines to succeed in careers in industry, technical professions or entrepreneurship.

CLO2: To provide students with a solid foundation in Fluid Mechanics and Hydraulic Machinery fundamentals required to solve engineering problems in thermal engineering and also to pursue higher studies.

CLO3: To train students with good scientific and engineering breadth in the areas of Fluid Mechanics and Hydraulic Machines, so as to comprehend, analyze, design and create novel products and solutions for the real life problems.

CLO4: To train students for self education and lifelong learning and acquire the necessary knowledge and skills in the area of Fluid Mechanics and Hydraulic Machines to participate and succeed in competitive examinations like GRE, GATE and IES.

Course Learning Outcomes:

CO	**After successful completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Explain the fundamental concepts of Fluid Mechanics and Hydraulic Machines.	II	Understanding
CO2	Solve problems in Fluid Mechanics and Hydraulic Machines based on the acquired knowledge and techniques.	III	Applying
CO3	Develop expression for parameters used in Fluid Mechanics and Hydraulic Machines.	III	Applying
CO4	Analyze the performance of components and devices based on the information gained in Fluid Mechanics and Hydraulic Machines.	IV	Analyzing

CO-PO,PSO Mapping:

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

1:Low 2:Medium 3: High

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Components	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	Hours
Unit 1: Fluid Properties and Statics: **Fluid Properties:** Definition of fluid, Fluid as a continuum. Viscosity, Types of Fluid, Compressibility, Surface tension, Capillarity and Vapour pressure. **Fluid Statics:** Pascal's law, Hydrostatic law, Hydrostatic forces on submerged bodies. Buoyancy and Stability. Pressure measurement.	**06**
Unit 2: Kinematics and Dynamics of Fluid Flow: **Fluid Kinematics**: Types of Flow and Flow Lines, Stream and velocity potential Function. Continuity Equation in Cartesian Coordinates System, Velocity and Acceleration of fluid particles. **Fluid Dynamics:** Equation of Motion, Bernoulli's equation, discharge measurement, Momentum Equation, Application of Momentum Equation. Need and Applications of CFD.	**07**
Unit 3: Flow through pipes: Laminar flow through circular pipe and parallel plates, Losses of energy, Darcy's Equation, Chezy's Equation, Major and Minor Losses, Flow Through Series and Parallel Pipes. Branching of pipes and equivalent Pipes, Siphon Pipe.	**07**
Unit 4: Boundary Layer Theory and Dimensional Analysis: **Boundary Layer Theory:** Laminar, Turbulent boundary layer, momentum and energy thickness, Boundary layer Separation and Control. **Dimensional analysis:** Buckingham's theorem, model laws and model testing.	**06**
Unit 5: Forces on Immersed Bodies and Compressible Fluid Flow: **Forces on Immersed Bodies:** Expression for Drag and Lift forces on stationary body like streamlined bodies, bluff bodies. Drag and lift forces on sphere and cylinder. Magnus effect. **Compressible Fluid Flow:** Basics of Compressible flow, Energy equation of compressible flows, Mach Cone and Mach number. Stagnation properties. Area velocity relationship in compressible flow.	**07**
Unit 6: Hydraulic Machines: **Water Turbines:** Classification, Angular-momentum principle (Euler's Equation). Pelton wheel, Francis, Kaplan Turbine: construction, principle of working, velocity diagrams. Daft tubes: types and analysis. Selection of turbines. **Centrifugal Pumps:** Classification, principle of working, types of heads, velocity triangles, cavitation, NPSH, minimum starting speed, priming of pumps, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps. Selection of Pumps.	**07**

Text books:

1. Fluid Mechanics-Fundamentals and Applications, **Yunus Cengel , John Cimbala ,** McGraw Hill Education, 4th Edition.
2. Fluid Mechanics, **Frank M White,** McGraw Hill Education India Private Limited, 8th Edition.
3. Introduction to Fluid Mechanics, **Robert W. Fox , Alan T. McDonald , John W. Mitchell,** Wiley Publication, 10th Edition.
4. Introduction to Fluid Mechanics and Fluid Machines, **S K Som , Gautam Biswas , Suman Chakraborty**, Mc Graw Hill India, 3rd Edition.

References:

1. Fluid Mechanics and Hydraulic Machines-Problems and Solution, **K. Subramanya**, McGraw Hill Education, 2nd Edition,.
2. A Textbook of Fluid Mechanics and Hydraulic Machines, **R.K. Bansal,** Laxmi Publications, 10th Edition.
3. Hydraulics and Fluid Mechanics Including Hydraulics Machines, **Dr. P.N. Modi and S.M. Seth,** Standard Book House,22nd Edition.

Unit wise Measurable students Learning Outcomes:

1. Graduates will be able to demonstrate fundamental of Fluid properties and Fluid statics.

2. Graduates will be able to develop expressions and solve problems in fluid kinematics and fluid dynamics.

3. Graduates will be able to analyze and solve problems in fluid flow through pipes.

4. Graduates will be able to demonstrate the knowledge of boundary layer and dimensional analysis.

5. Graduates will be able to analyze and solve problems on Drag and lift forces generated on different bodies and demonstrate the knowledge of compressible fluid flow.
6. Graduates will be able to analyze and solve problems on water turbines and centrifugal pums.

Title of the Course: Analysis of Mechanical Elements **Course Code: UMEC0402**	**L**	**T**	**P**	**Credit**
	3	**1**	**-**	**4**

Course Pre-Requisite: Engineering Mechanics

Course Description:
This subject enables the student to understand the important concepts of stress and strain, their significance in concept with engineering applications and is useful while studying the Subjects like, Kinematics of Machines, Theory of machines, Dynamics of Machines.

Course Objectives:
1. To gain knowledge of different types of stresses, strains and deformation induced in Mechanical Components due to external loads.
2. To study the distribution of various stresses in Mechanical Elements.
3. To study the effect of component dimensions and shape on stresses and deformation.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Find stresses and deformations of structural members due to different types of loads.	I	Applying
CO2	Interpret elastic behavior of structural members.	II	Understanding
CO3	Analyze stresses developed in oblique loading condition.	IV	Analyzing
CO4	Determine the parameters of structural members under different loadings.	V	Evaluating

CO-PO Mapping:

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1										2	2	
CO2	2	3	1										2	3	
CO3	2	2	1										2	3	
CO4	2	2	2										2	2	

1:low, 2: medium, 3:high

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content

(normally last three modules) covered after MSE.	
Course Contents:	
Unit 1:--- Stresses and Strains Concept of stress and strain (linear, lateral, shear & volumetric),Hooke's Law, Elastic constants & their relationship, Axial force diagram, stresses, strains and deformation in determinate and indeterminate homogeneous and composite bars under concentrated loads, Various strengths of material- Yield strength, Ultimate tensile strength, etc. Normal and shear stresses, Complementary shear stress, Bulk modulus, interrelationship between elastic constants, thermal stresses**.** Concept of Principle Stresses and Principle planes.	7-**Hrs.**
Unit 2:--- Shear Force & Bending Moment Diagram Concept and definition of shear force and Bending Moment in beams due to concentrated load, UDL, uniformly varying loads and couples in determinate beams, Maximum bending moment & positions of points of contra flexure	8-**Hrs.**
Unit 3:--- Bending Stresses and Shear Stress in Beams Bending Stresses: Theory of simple bending, Concept and assumptions, Derivation of flexure formula, Bending stresses distribution diagram, Moment of resistance and section modules calculations, design of rectangular and circular (solid and hollow) sections; L, I and T sections Shear Stress in Beams: Concept and derivation of shear stress distribution formula, Shear stress distribution diagram for symmetrical and unsymmetrical section, maximum and average shear stress	5 -**Hrs.**
Unit 4:--- Deflection of Beams, **Axially loaded Struts and Columns** Deflection of Beams: Concept and definition, relation between Bending moment, slope and deflection, methods for calculation of slope and deflection. Columns: Theory of Columns, Short columns and long columns, End conditions, Euler's formula, Rankine's formula.	6 -**Hrs.**
Unit 5 :--- Design of Simple Machine Elements Design of joints like Knuckle Joint, Turn Buckle, Cotter Joint	7 -**Hrs.**
Unit 6 :--- Design of Spring Types of springs, materials and their applications, Styles of end, Stress and deflection equations for Helical Compression Springs, Springs in Series and Parallel. Design of Helical Compression Springs subjected to static loading.	7 -**Hrs.**

Term work:

The term work shall consist of 5 assignments listed below.

1. Stresses and strains

2. Shear force and bending moment diagram.

3. Bending and shear stresses in beams

4. Deflection of beams

5. Columns.

6. Case study on industrial applications of springs.

7. Case study based on joint and modeling of joint using suitable CAD software.

Textbooks:

1. S. Ramamrutham and R. Narayanan, (2003), Strength of Materials, Dhanpat Rai Publications.
2. S. Timoshenko, Strength of Materials: Part-I (Elementary Theory and Problems), CBS
3. Ferdinand P Beer and E.R. Johnston JR. John Dewolf, Mechanics of Materials 3/e, McGraw Hill Book Company
4. Mechanics of Materials Hibbler 2e Pearson Education Publication

References:

1. Robert Norton, Machine Design, Prentice Hall
2. E.P. Popov, “Introduction to Mechanics of solids”, Prentice Hall Publication
3. Singer and Pytel, “Strength of Materials”, Harper and Row Publications

Title of the Course:Kinematics of Machines Course Code:UMEC0403	L 3	T --	P ---	Credit 3

Course Pre-Requisite:
1. Engineering Mathematics 2. Engineering Physics 3. Engineering Mechanics

Course Description: Kinematics of Machines may be defined asthat branch of Engineering-science, which deals with the studyof relative motion between the various parts of a machine,and forces which act on them. The knowledge of this subjectis very essential for an engineer in designing the various partsof a machine.

Course Objectives:
1.Define various terminology related to kinematics of mechanism
2.Develop competency in drawing velocity and acceleration diagram for simple and complex mechanism
3. Discuss effect of friction in various mechanism
4. Design cam with follower for different applications
5. Select different power transmitting elements

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain kinematics of mechanisms.	2	Understanding
CO2	Identify the mechanisms for various applications.	3	Applying
CO3	Apply the principles of kinematics to mechanisms.	3	Applying
CO4	Analyze mechanisms using graphical methods.	4	Analyzing

CO-PO Mapping:

Course Outcome	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2	2	2											1		
CO3	2	2		1									1		
CO4			2	1									2		

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Course Contents:

Unit 1:---Basic of Kinematics	05 **Hrs.**
Structure, Machine, Link and its types, kinematic pair (lower and higher), Kinematic chain, Mechanism, inversion, Types of constraints,Grubbler‟s criterion, Degree of	

Freedom, Inversions of slider crank chain, Double slider crank chain, Four bar chain.	
Unit 2:---Velocity and acceleration analysis of Mechanisms Graphical analysis of Velocity and acceleration for different mechanisms using relative velocity and acceleration method, Velocity analysis by Instantaneous center method.	09 **Hrs.**
Unit 3:---Friction Introduction of friction, Friction in pivot bearings, Friction in power screw, Friction in clutch, Uniform wear and Uniform pressure for the clutch &bearing.	06 **Hrs.**
Unit 4:---Cams Introduction, Types of cams, Types of followers, Cam terminology, Displacement diagrams, Motions of thefollower, Graphical construction of cam profile.	07 **Hrs.**
Unit 5:--- Belts and Dynamometers Introduction, Type of belts, Slip and creep of belt, Tension ratio in belts, Initial tension, Open & cross belt drive, Length of belt, Power transmitted by belt,Selection of Belts from manufacturing catalogue, Introduction of Chain drive, Classification of dynamometers, Study of rope brake absorption dynamometer and belt transmission dynamometer.	06 **Hrs.**
Unit 6:---Theory of Gears Classification of gears, Types of gears, Spur gears - terminology, fundamental law of toothed gearing, involute and cycloidal profile, conjugate action, contact ratio, minimum number of teeth, interference and under cutting.	07 **Hrs.**

Textbooks:

1. Rattan, S.S.: "Theory of Machines", 2 nd Edition, Tata McGraw-Hill, Publishing Co. Ltd., New Delhi, 2006.
2. Bansal, R. K., "Theory of machines", Laxmi Publications Pvt. Ltd, New Delhi
3. Rao, J.S., and Dukkipati, R.V.: "Mechanism and Machine Theory", Wiley Eastern Ltd.
4. Ghosh, A, and Malick, A. K. "Theory of Mechanisms and Machines" 3 rd Edition, East West Press Pvt. Ltd., 2000.

References:

1. Shigley, J.E. and Uicker, J.J. and Pennock, G. R.. "Theory of Machines and Mechanisms", 3 rd Edition, OxfordUniversity Press, 2005.
2. Bevan T., "Theory of Machines: a text book for engineering students", 3 rd Edition, CBS, New Delhi.

Unit wise Measurable students Learning Outcomes:

1Student will able to understand fundamental & various terminology associated with theory of machine

2Student will able to understand velocity and acceleration diagram for a given mechanism with graphical method.

3Student will able to understand laws of friction and Power loss due to friction in bearings& Clutches

4Student will able to understand different types of cams and followers and their motions and Construct different types of cam profile from given data

5Student will able to understand need and modes of power transmission and types of dynamometers

6Students will be able to solve and determine forces and dimensions of Spur Gear.

Title of the Course: MATERIALS ENGINEERING	L	T	P	Credit
Course Code: **UMEC0404**	**3**	**-**	**-**	**3**
Teaching Scheme: 3 Hrs per week				

Course Prerequisite: BME, Physics, Chemistry, Fundamental knowledge of materials and their basic properties

Course Description:

Material selection is the important stage during product development. To select the appropriate material, its properties have to be determined. Further so as to change the properties as per the requirement, knowledge of heat treatment is also necessary. Study of Metallurgy helps identify the right materials that help power various machines. Alloying enhances the performance of metals while high-purity metals, and new materials used in products including superconductors, advanced coatings, Auto and aerospace components and surgical implants.

Course Objectives:

1. To Explain the concept of phase ,phase diagram & understand the basic terminologies associated with metallurgy. II
2. To Explain composition, microstructure, properties and applications of ferrous and non ferrous metal alloys through study of their Equilibrium diagrams. II
3. To list different classes of materials used in engineering applications and to suggest the right materials for specific applications. I
4. To Classify and Distinguish different types of cast irons, steels and non ferrous alloys. IV

	MATERIALS ENGINEERING Course Outcome - Program Outcome Attainment Matrix														
	PO's												**PSO's**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	0	0	0	0	0	0	0	0	0	1	1	0	0
CO2	3	2	1	0	1	0	0	0	0	0	0	1	1	0	0
CO3	2	2	0	0	0	0	0	0	0	0	0	1	0	1	0
C04	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	**10**
ISE 2	**10**
MSE	**30**
ESE	**50**

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE

Unit 1: Introduction to Metals and alloy systems	**6 Hours**
1.1] Introduction to Metallic and Non-metallic materials and its classification (metals/alloys) 1.2] Alloy System a] Alloy formation by crystallization, Nucleation and growth, Cooling curves, Dendritic structure ,coring b) Solid solutions and intermediate phases c) Phases and Gibbs phase rule d) Construction of equilibrium diagrams from cooling curves, systems as Isomorphous, Eutectic, Partial solubility Peritectic and Intermetallic Compounds ,Lever arm principles, Long and short-range freezing	
Unit 2: Study of Ferrous alloys	**9 Hours**
2.1] Fe- Fe3C equilibrium diagram - Ferrous alloys (Plain carbon steels, cast iron) 2.2] Alloy steels- Free cutting steels, HSLA high carbon low alloy steels, maraging steels,creep resisting steels, Stainless steels-types,Tool steels types 2.3] Selection of materials and Specifications based on -IS, BS, SAE, AISI,DIN,JIS standereds 2.4] Miscellaneous alloys such as super alloys, Heating element alloys-Canthal, low expansion and controlled expansion alloys,shape memory alloys	
Unit 3: Study of Non Ferrous Alloys	**5 Hours**
3.1] Copper based alloys brasses Cu-Zn, Bronzes [Cu- Sn, , Cu- Be, Cu-Ni] 3.2] Aluminum based alloys Al-Cu(Duralumin),Precipitation Hardening, Al-Si (Modification treatment), 3.3] Pb-Sn (Solders and fusible alloys), Sn-Sb alloys (Babbits), Ti alloy (Ti-6Al-4V) 3.4] Criteria for selection of materials for auto Industry aerospace, marine applications.	
Unit 4: Mechanical Testing of materials	**5 Hours**
4.1]Destructive Testing methods- Tensile, Compressive, Impact Test (Charpy and Impact), Fatigue , Creep, Hardness (Rockwell, Brinell and Vickers), 4.2]Non-Destructive Testing- Dye Penetrant, Magnetic, Ultrasonic, Radiography, Eddy Current testing.	
Unit 5: *Heat treatment of Steel*	**12 Hours**

5.1 Principles of Heat treatment process

a) Transformation of Pearlite into austenite upon heating,

b) Transformation of austenite into Pearlite, Bainite and Martensite on cooling.

c) TTT Diagram and CCT Diagrams its significance, Effect of alloying elements on TTT diagram and its significance.

d) Heat treatment furnaces and equipment, controlled atmosphere.

5.2]Heat Treatment Processes:

Annealing: Types-Full, Partial and Sub critical annealing (Various types) and purposes

Normalising: Purposes

Hardening: Types,Purposes, Austempering and Martempering, Mechanism of quenching and Quenching media, Hardenability- Concept and methods of determination of hardenability- Grossmans critical diameter method and Jominy end quench test.

Tempering Types, Structural transformations during tempering, purposes sub zero treatment

5.3] Heat treatment defects and remedies

5.4] Surface hardening - Flame and Induction

5.5] Chemical heat treatments for case hardening-Carburising, Nitriding, Cyaniding, Carbonitriding

Unit 6: Composites	**4 Hours**

Introduction to Advanced Composites, Type of Reinforcements;- carbon fiber, glass fiber, aramid fiber and particulates (Al2O3, SiC, Silicates, ZrO2 etc.), Metal matrix composite,Classification and properties of Composites, Role of Interfaces, Type of Bonding at the Interfaces, Applications, evaluation of composite properties.

Textbooks:

1. S.H. Avner, “Introduction to physical metallurgy”, Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2. Vijendra singh, “Physical metallurgy”, Standard Publishers Delhi
3. W. D Callister, “Material science and engineering”, Wiley India Pvt. Ltd., 5th Edition.
4. V. D. Kodgire, “Material science and metallurgy for engineers”, Everest Publishers Pune
5. T.V. Rajan / C.P. Sharma, “Heat Treatments Principles and Practices”, Prentice Hall of India Pvt Ltd, New Delhi
6. V Raghwan, “Material Science and Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi ,3rd Edition, 1995.
7. Principles of Materials Science and Engineering, William F. Smith, Third Edition, 2002, McGraw-Hill
8. Composite Materials: Engineering and Science, Matthews F.L., and Rawlings
9. Kenneth G. Budinski, “Surface Engineering for wear resistance”, Prentice Hall of India.

References:

1. The Science and Engineering of materials, Donald Askeland,Pradeep Fuley,Wendelin J. Wright, 6th Edition,Publisher Global Engineering:
2. W. Callister, “Materials Science & Engineering”, John Wiley & sons
3. R.A. Higgins, “Engineering Metallurgy”, Viva Books Pvt. Ltd., New Delhi, 1 st Edition
4. ASM Handbook Volume no.5 Surface Engineering

Title of the Course: Manufacturing Processes Course Code: UMEC0405	L 3	T -	P -	C 3

Course Pre-Requisite: Basic Mechanical engineering, workshop practice-I, Engineering chemistry

Course Description:

The Manufacturing Processes theory includes the detail study of foundry technology, welding technology, forming, plastic manufacturing processes and powder metallurgy.

Course Objectives:

1. Student will able to understand fundamentals of casting processes.
2. Student will able to understand metal pouring and modernization in metal casting process
3. Student will able to understand metal joining processes.
4. Student will able to understand different metal forming processes.
5. Students will be able understand plastic and composite material forming processes.

Course Learning Outcomes:

CO	After the completion of the course	Bloom's Cognitive	
		level	Descriptor
CO1	Understand the theory of metal casting process	2	Understanding
CO2	Understand metal pouring and modernization in metal casting process	2	Understanding
CO3	Select the appropriate processes of welding according to Material and application	5	select
CO4	Explain theoretical concepts of metal forming and plastics processing	1	Remember

CO-PO Mapping:

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

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: - Fundamentals of Metal Casting Metal casting: Importance of casting, advantages, disadvantages and limitations of casting processes. Introduction and types of patterns, core boxes. Materials used, pattern allowances and color codes used, Moulding and core processes: Types of sands used in moulding and core making, their properties. Sand moulding types such as Green sand Moulding, shell Moulding, CO_2 Moulding, Investment casting. Components of gating system, functions and importance of runners and risers, (Numerical treatment) solidification control devices: chills, chaplets. Introduction to permanent mould casting processes such as Continuous casting, Gravity die casting, pressure die-casting, Centrifugal casting, Vacuum die casting, Squeeze casting.	**9 Hrs.**
Unit 2: - Melting, Pouring and Modernization- Types of melting furnaces- oil/gas fired furnace, crucible furnace, Electrical furnace, Rotary furnace, (only one type) etc. Furnace selection criteria their applications and melting practice on different furnaces. Cleaning-fettling of castings. Casting defects, their causes and remedies. Modernization, mechanization, use of computers in foundries and layout of foundry.	**7 Hrs.**
Unit 3: - Powder metallurgy- Principle, process, applications, advantages and disadvantages of powder metallurgy, Blending, compaction, mechanisms of sintering.	**4 Hrs.**
Unit 4: Welding Processes: Overview and classification of welding processes: **Arc Welding Processes**- Flux Shielded Metal arc Welding, Sub Merged Arc Welding,Gas tungsten arc welding, Gas metal arc welding,CO_2 Welding, inert gas welding. **Resistance Welding Processes**- Spot welding, Projection Welding, Flash Butt welding. **Gas Welding:**- oxy-acetylene welding, oxy-hydrogen, air-acetylene welding. **Solid State Welding:**- Pressure welding, solid phase welding and friction welding	**06 Hrs.**

Unit 5: -Metal forming: Metal Forming Processes: Nature of plastic deformation, hot working and cold working. Principles of rolling, types of rolling, angle of bite, reduction, defect in rolling. Forging: Forging Basic operations, forging die nomenclature, forging defects. Extrusion: Extrusion principle, types of extrusion, direct, indirect, impact, hydrostatic extrusion, defects, wire drawing, Seamless pipe manufacturing.	**09 Hrs.**
Unit 6: Introduction to Plastic and composite material processes: Shaping of plastics: extrusion, injection moulding, blow moulding, compression moulding, transfer moulding, , thermoforming, rotational moulding, and calendaring etc. **composite material forming processes** -Definitions, Composites types, processes - Hand and spray lay – up, filament winding, pultrusion.	**06 Hrs.**

Textbooks:

1. P. N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I, Tata McGraw-Hill, N 3rd edition, 2009.

2. P. L. Jain, "Principles of Foundry Technology", Tata McGraw-Hill, New Delhi, 2nd Edition,2006.

References:

1. Machine Tools and Mfg. Technology, Steve F. Krar, Mario Rapisarda, Albert F. Check

2. O. P. Khanna, Foundry technology, Khanna Publishers, New Delhi.

3. P L Jain, Principles of foundry technology, Tata McGraw-Hill, New Delhi.

4. O. P. Khanna. Welding technology, Khanna Publishers, New Delhi.

5. Hajra Chowdhary, Elements of Workshop Technology, Vol.I, Media Promoters & Publications, Bombay

6. B.S. Raghuvanshi, W/S Technology, Vol. II, Dhanapat Rai Publi. Delhi, 10th Ed, 2000

7. W.A.J. Chapman, Workshop Technology, Vol. II, Viva Books, New Delhi,

8. Hajra Choudhury and A.K. Hajra Choudhury, Elements of Workshop Technology, Vol. II, S.K. Media Promoters and Publishers, New Delhi, 13th Edition, 2012.

9. Production Technology, R. K. Jain, Khanna Publishers, Delhi, 15th Edition, 2000.

10. Workshop Technology, W.A.J. Chapman, CBS Publishing and Distributors, N. Delhi Vol. I, 2001, Vol. I 2007 and Vol.III, 1995

Unit wise Measurable students Learning Outcomes:

1. Student will able to understand fundamentals of casting processes.
2. Student will able to understand metal pouring and modernization in metal casting process
3. Student will able to understand powder metallurgy process.
4. Student will able to understand metal joining processes.
5. Student will able to understand different metal forming processes.
6. Students will be able understand plastic forming processes.

Title of the Course: Constitution of India Course Code:UMEA0401	L	T	P	Credit
	2	--	--	-

Course Pre-Requisite: Basics of Indian History, Independence Movement, Fundamentals of Civics.

Course Description: This Course is an introduction of Indian Constitution and basic concepts highlighted in this course for understanding the Constitution of India. This course is structured to give a deeper insight for making the nexus between the other law subjects.

Course Objectives

At the end of the course the student is expected to have acquired:

1. A basic understanding of Constitution of India.
2. Builds the ability to apply the knowledge gained from the course to current social legal issues.
3. Ability to understand and solve the contemporary challenges.
4. Understanding constitutional remedies.

Course Learning Outcomes:

CO	After the completion of the course the student should beable to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	**Explain** the significance of Indian Constitution as the fundamental law of land	II	Cognitive (Understand)
CO2	Exercise his fundamental rights in proper sense and at the same time **Identifies** his responsibilities in national building.	II	Cognitive (Applying)
CO3	**Analyze** the Indian political system, the powers and functions of the Union, State and Local Governments	II	Cognitive (Understand)
CO4	**Understand** the genesis, nature and special features of the Constitution and be-aware of the social, political and economic influence on it.	II	Cognitive (Understand)

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1						3		3				3			
CO2						3		3	3	3		3			
CO3						3			3			3			

CO4						3			3			3			

Assessments:

Teacher Assessment:

One EndSemester Examination (ESE) having 100% weights respectively.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content

Course Contents:

Unit 1:-Constitution – Structure and Principles 1.1: Indian Constitution – Meaning, Making and Sources 1.2: Salient Features of Indian Constitution 1.3: Preamble of the Indian Constitution	**(06)Hrs.**
Unit 2:- Fundamental Rights, Duties and Directive Principles 2.1: Fundamental Rights 2.2: Fundamental Duties 2.3: Directive Principles of State Policy 2.4: ConstitutionalRemedies – Writs/PIL	**(08)Hrs.**
Unit 3:-Parliament and Union/ Central Government 3.1: The Parliament: 3.1.1 : President of India – Appointment, Impeachment and Powers 3.1.2 : Lok Sabha – Composition and Powers 3.1.3 : RajyaSabha – Composition and Powers 3.2: Union/ Central Government: 3.2.1 : Prime Minister and Council of Ministers	**(06)Hrs.**
Unit 4:-State Legislature and State Government 4.1: State Legislature: 4.1.1 : Governor –Appointment and Powers 4.1.2 :Legislative Assembly – Composition and powers 4.1.3 : Legislative Council – Composition and powers 4.2: State Government: 4.2.1 : Chief Minister and Council of Ministers	**(08) Hrs.**
Unit 5:-The Indian Judiciary 5.1: The Structure of Judicial System in India 5.2: Supreme Court –Composition and Jurisdiction 5.3: High Court – Composition and Jurisdiction 5.4: Subordinate Courts – Composition and Jurisdictions	**(06) Hrs.**
Unit 6:-Other Constitutional Bodies 6.1: Local Self Government/Municipalities/Panchayats Raj – 73rd and 74thamendments 6.2: Election Commission, CAG, Public Service Commissions, Finance Commission, Commissions for SC,ST, Backward Class – Composition and Functions	**(06) Hrs.**

Textbooks:

1. M.P. Jain, Indian Constitutional Law
2. M.P. Singh (ed.),V.N. Shukla, Constitutional Law of India
3. D.D. Basu, Commentary on the Constitution of India
4. S. S. Desai, Constitutional Law-I
5. M. S. Khairnar&S. S. Desai, Constitutional Law-II

References:

1. Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)
2. M.V.Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)

3. J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency, 2018 (55th edn.)
4. Constitution of India (Full Text), India.gov.in., National Portal of India, https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
5. Durga Das Basu, BharatadaSamvidhanaParichaya, Gurgaon; LexisNexis ButterworthsWadhwa, 2015
6. S. S. Desai, Constitutional Law- I, SS Law Publication, 2021
7. M. S. Khairnar& S. S. Desai, Constitutional Law- II, SS Law Publication, 2021

Title of the Course: FLUID MECHANICS AND HYDRAULIC MACHINES LAB	**L**	**T**	**P**	**Credit**
Course Code: UMEC0406	**-**	**-**	**2**	**1**

Course Pre-Requisite: Fundamental Units and Dimensions, Basic Laws of Mechanics and Thermodynamics and Fluid Mechanics and Hydraulic Machines.

Course Description:
The course aims at experimentation on flow types, measurement of fluid properties, flow measurement and turbo machines like Pelton wheel, Francis turbine, centrifugal pumps etc,. The knowledge gained in Fluid Mechanics and Hydraulic Machines is demonstrated and experimented in this laboratory.

Course Learning Objectives:

CLO1: To prepare students in Fluid Mechanics and Hydraulic Machines Laboratory to succeed in careers in industry, technical professions or entrepreneurship.

CLO2: To provide students with a solid foundation in Fluid Mechanics and Hydraulic Machines Laboratory experiments to solve engineering problems.

CLO3: To train students with good scientific and engineering breadth in the areas of Fluid Mechanics and Hydraulic Machines Laboratory, so as to comprehend, analyze the real life problems.

CLO4: To prepare students to work in a team and effectively contribute in Fluid Mechanics and Hydraulic Machines laboratories.

Course Learning Outcomes:

CO	**After successful completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Demonstrate the working principles of devices in Fluid Mechanics and Hydraulic Machines.	II	Understanding
CO2	Apply the knowledge, facts and techniques gained in Fluid Mechanics and Hydraulic Machines to perform the experiments.	III	Applying
CO3	Analyze the performance of devices in Fluid Mechanics and Machines experimentally and analytically.	IV	Analyzing

CO-PO,PSO Mapping:

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

1:Low 2:Medium 3: High

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Components	Marks
ISE	50
ESE	50

ISE is based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE is based on practical and oral examination on experiment performed and included in journal.

Course Contents:	**Hours**
NOTE: Experiments No. 1 to 10 are to be included for Practical/Oral Examination	
Experiment No.1: Reynolds Apparatus. **Aim and Objectives:** To perform Reynolds experiment for determination of different types of flow. **Outcomes:** Determination of Laminar, Transition & Turbulent flow.	**02**
Experiment No. 2: Bernoulli's Apparatus. **Aim and Objectives:** To verify Bernoulli's Equation. **Outcomes:** Practical verification of Bernoulli's Equation.	**02**
Experiment No. 3: Venturi meter and Orifice meter. **Aim and Objectives:** To determine discharge coefficient of Venturi meter and Orifice meter. **Outcomes:** Calibration of Venturimeter and Orifice meter	**02**
Experiment No. 4: Rectangular and Triangular notch. **Aim and Objectives:** To determine discharge coefficient of Rectangular and Triangular notch. **Outcomes:** Calibration of Rectangular & Triangular notch.	**02**
Experiment No. 5: Friction in pipes. **Aim and Objectives:** To determine coefficient of friction in pipes for different materials. **Outcomes:** To calculate friction factor for different pipe material.	**02**
Experiment No. 6: Orifice under Steady and Unsteady Flow **Aim and Objectives:** To calculate hydraulic coefficients. Outcomes: Study of steady & unsteady flow condition.	**02**
Experiment No. 7: Trial on Pelton Wheel Turbine. **Aim and Objectives:** To determine hydraulic, mechanical and overall efficiency of Pelton Wheel **Outcomes:** The students will be able to understand the performance of Pelton wheel.	**02**
Experiment No. 8: Trial on Francis Turbine **Aim and Objectives:** To determine overall efficiency of Francis Turbine **Outcomes:** The students will be able to understand the performance of Francis turbine.	**02**
Experiment No. 9: Trial on Centrifugal Pump **Aim and Objectives:** To determine overall efficiency of Centrifugal pump **Outcomes:** The students will be able to understand the performance of Centrifugal pump	**02**
Experiment No. 10: Visit to pump working station / Industry **Aim and Objectives:** To get importance of pump testing and various hydraulic machines. **Outcomes:** The students will be able to understand the working and testing of hydraulic machines.	
Experiment No. 11: Demonstration on Redwood viscometer **Aim and Objectives:** To determine viscosity is of oil a time of flow in second through specified hole made in a metallic piece. **Outcomes:** Viscosities for given sample with increase in temperature	**02**
Experiment No. 12: Demonstration of Major and Minor losses in pipes. **Aim and Objectives:** To determine major and minor losses in pipe-fittings **Outcomes:** To calculate major and minor losses in pipes	**02**
Experiment No. 13: Demonstration on Centrifugal blower	**02**

Aim and Objectives: To determine overall efficiency of Centrifugal blower **Outcomes:** The students will be able to understand the performance of Centrifugal blower.	

Text books:

1. Fluid Mechanics-Fundamentals and Applications, **Yunus Cengel , John Cimbala ,** McGraw Hill Education, 4th Edition.
2. Fluid Mechanics, **Frank M White,** McGraw Hill Education India Private Limited, 8th Edition.
3. Introduction to Fluid Mechanics, **Robert W. Fox , Alan T. McDonald , John W. Mitchell,** Wiley Publication, 10th Edition.
4. Introduction to Fluid Mechanics and Fluid Machines, **S K Som , Gautam Biswas , Suman Chakraborty**, Mc Graw Hill India, 3rd Edition.

References:

1. Fluid Mechanics and Hydraulic Machines-Problems and Solution, **K. Subramanya**, McGraw Hill Education, 2nd Edition,.
2. A Textbook of Fluid Mechanics and Hydraulic Machines, **R.K. Bansal,** Laxmi Publications, 10th Edition.
3. Hydraulics and Fluid Mechanics Including Hydraulics Machines, **Dr. P.N. Modi and S.M. Seth,** Standard Book House,22nd Edition.

Title of the Course:Kinematics of Machines **Course Code: UMEC0407**	**L** --	**T** --	**P** 2	**Credit** 1

Course Pre-Requisite:
1. Engineering Mathematics 2. Engineering Physics 3. Engineering Mechanics

Course Description: Kinematics of Machines may be defined asthat branch of Engineering-science, which deals with the studyof relative motion between the various parts of a machine,and forces which act on them. The knowledge of this subjectis very essential for an engineer in designing the various partsof a machine.

Course Objectives:

1.Define various terminology related to kinematics of mechanism
2.Develop competency in drawing velocity and acceleration diagram for simple and complex mechanism
3. Discuss effect of friction in various mechanism
4. Design cam with follower for different applications
5. Select different power transmitting elements

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Explain kinematics of mechanisms.	2	Understanding
CO2	Identify the mechanisms for various applications.	3	Applying
CO3	Apply the principles of kinematics to mechanisms.	3	Applying
CO4	Analyze mechanisms using graphical methods.	4	Analyzing

CO-PO Mapping:

Course Outcome	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3														
CO2	2	2											1		
CO3	2	2		1									1		
CO4			2	1									2		

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Projectassigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:

Experiment No. 1:---Study of Basic of Kinematics **Aim and Objectives:**To study basic concept of kinematics and verify the different laws related to mechanisms Case Study on Basic of Kinematics **Outcomes:** Students should be able to understand different types of mechanisms and their applications **Theoretical Background:**Basic of Kinematics	02 **Hrs.**
Experiment No. 2:-Verification of ratio of angular velocities of shafts connected by Hooke's joint **Aim and Objectives:**To study the theory of Hooke's joint and to verify the of angular velocities of driving and driven shafts using model **Outcomes:**Students should be able to understand the Hooke's joint **Theoretical Background:**Theory ofHooke's joint **Experimentation:**Calculation of ratio of angular velocities of driving and driven shafts using model **Results and Discussions:**Compare Analytical & Experimental ratio of angular velocities of driving and driven shafts **Conclusion:**Drawn conclusion at what value of Ɵ the ratio of angular velocities of driving and driven shafts is maximum, minimum & unity	02 **Hrs.**
Experiment No. 3:---Velocity & Acceleration analysis of mechanisms by Relative Velocity and Acceleration Method **Aim and Objectives:** To study basic theory and analysis of velocity & Acceleration in mechanism **Outcomes:** Analyze velocity and acceleration of mechanisms by vector and graphical methods **Theoretical Background:** Velocity and acceleration analysis of Mechanisms To draw velocity and acceleration diagram for a simple mechanism	02 **Hrs.**
Experiment No. 4:--- The coriolis component of acceleration of mechanisms by Relative Acceleration Method **Aim and Objectives:** To study basic theory and analysis of velocity & Acceleration in mechanism **Outcomes:** Analyze velocity and acceleration of mechanisms by vector and graphical methods **Theoretical Background:** Velocity and acceleration analysis of Mechanisms To draw velocity and acceleration diagram for a coriolis component acceleration.	02 **Hrs.**
Experiment No. 5:--- Velocity analysis of mechanisms by instantaneous centre method.	02 **Hrs.**

Aim and Objectives: To study basic theory and analysis of velocity by instantaneous centre method. **Outcomes:**Analyze velocity by instantaneous centre method **Theoretical Background:** Velocity analysis by instantaneous centre method. To draw velocity diagram using instantaneous centre method	
Experiment No. 6:---Construction of cam profile by considering different follower motion **Aim and Objectives:** To study basic of cam & follower and Construct different types of cam profile from given data **Outcomes:** Students should be able to design cam with follower for different applications **Theoretical Background:** Cams-To draw the layout of cam profile for different follower by considering different follower motion	02 **Hrs.**
Experiment No. 7:--- Sleep & Creep of Belts **Aim and Objectives:** To study the sleep & creep of belts **Outcomes:**Students should be able to understandsleep & creep of belts **Theoretical Background:** Theory ofBelt Drive **Experimentation:** Calculation of percentage of sleep and creep using apparatus **Results and Discussions:** Compare Sleep & Creep percentage for different load **Conclusion:** Find out effect of sleep and creep on belt drive	02 **Hrs.**
Experiment No. 8:--- Study of Rope Brake Dynamometer **Aim and Objectives:** To conduct load test on rope brake using an electrical motor and to find efficiency of the motor **Outcomes:**Students should be able to understandconstruction and working of rope brakedynamometer **Theoretical Background:** Theory ofdynamometer **Experimentation:** Calculation of input power, output power and mechanical efficiency **Results and Discussions:** Compare efficiency of motor for different load **Conclusion:** Find out effect of load on efficiency of the motor	02 **Hrs.**

Textbooks:

5. Rattan, S.S.: "Theory of Machines", 2 nd Edition, Tata McGraw-Hill, Publishing Co. Ltd., New Delhi, 2006.
6. Bansal, R. K., "Theory of machines", Laxmi Publications Pvt. Ltd, New Delhi
7. Rao, J.S., and Dukkipati, R.V.: "Mechanism and Machine Theory", Wiley Eastern Ltd.
8. Ghosh, A, and Malick, A. K. "Theory of Mechanisms and Machines" 3 rd Edition, East West Press Pvt. Ltd., 2000.

References:

3. Shigley, J.E. and Uicker, J.J. and Pennock, G. R.. "Theory of Machines and Mechanisms", 3 rd Edition, OxfordUniversity Press, 2005.
4. Bevan T., "Theory of Machines: a text book for engineering students", 3 rd Edition, CBS, New Delhi.

Experiment wise Measurable students Learning Outcomes:

1 Students should be able to understand different types of mechanisms and their applications
2 Students should be able to understand the Hooke's joint
3 Analyze velocity and acceleration of mechanisms by vector and graphical methods
4.Analyze acceleration of mechanisms by vector and graphical methods
5 Analyze velocity by instantaneous centre method
6 Students should be able to design cam with follower for different applications
7 Students should be able to understandsleep & creep of belts
8 Students should be able to understandconstruction and working of rope brakedynamometer

Title of the Course: **MATERIALS ENGINEERING LAB**	**L**	**T**	**P**	**Credits**
Course Code: **UMEC0408**	**-**	**-**	**2**	**1**

Teaching Scheme: 2 Hrs per week per batch

Course Prerequisite: BME, Physics, Chemistry, Fundamental knowledge of materials and their basic properties

Course Description:

Material selection is the important stage during product development. To select the appropriate material, its properties have to be determined. Further so as to change the properties as per the requirement, knowledge of heat treatment is also necessary. Study of Metallurgy helps identify the right materials that help power various machines. Alloying enhances the performance of metals while high-purity metals, and new materials used in products including superconductors, advanced coatings, Auto and aerospace components and surgical implants.

Course outcomes:

1. To describe solidification behavior of steel and cast irons and predict their microstructure. II
2. To explain the principles of material testing and to apply them for various engineering applications. II
3. To demonstrate Non Destructive Testing technique for determining defects.III
4. To describe and suggest the heat treatment process and to Introduce the concept of hardenability. II

	Course Outcome - Program Outcome Attainment Matrix	
	PO's	**PSO's**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0
CO2	2	1	0	0	0	0	0	0	0	0	0	1	1	0	0
CO3	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0
C04	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assesment	Marks
ISE	**25**
ESE [OE]	**25**

1. ISE is based on ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc
2. ESE: Assesment based on External oral examination

List of Experiments:
1. Measurement of Tensile strength and ductility of mild steel
2. Measurement of Hardness by Brinell and Rockwell test .
3. Measurement of toughness of specimens by Izod and charpy Impact test
4. Study and Demonstration of Non Destructive Test methods. (Any two)
5. Preparation of specimen and study of metallurgical microscope
6. Study of Microstructure of low carbon steels.
7. Preparation and Study of the Microstructure of Cast Irons.
8. Study of microstructure of Non ferrous alloys (Brass, Duralumin, Babbit).
9. To Conduct Heat Treatment on steel specimens (Annealing, Normalizing and Hardening)
10. To Conduct Jominy end-quench test for measurement of hardenability on alloy steels
11. Industrial Visit conducted to observe industrial heat treatment practices if not possible in the laboratory.
12. One seminar on any advanced materials and selection of materials by referring at least 5 research papers from standard journals
Textbooks:
1. S.H. Avner, “Introduction to physical metallurgy”, Mcgraw Hill Book Company Inc, Edition, 2nd, 1974.
2. Vijendra singh, “Physical metallurgy”, Standard Publishers Delhi
3. W. D Callister, “Material science and engineering”, Wiley India Pvt. Ltd., 5th Edition.
4. V. D. Kodgire, “Material science and metallurgy for engineers”, Everest Publishers Pune
5. T.V. Rajan / C.P. Sharma, “Heat Treatments Principles and Practices”, Prentice Hall of India Pvt Ltd, New Delhi
6. V Raghwan, “Material Science and Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi ,3rd Edition, 1995.

7. Principles of Materials Science and Engineering, William F. Smith, Third Edition, 2002, McGraw-Hill
8. Composite Materials: Engineering and Science, Matthews F.L., and Rawlings
9. Kenneth G. Budinski, “Surface Engineering for wear resistance”, Prentice Hall of India.

References:

1. The Science and Engineering of materials, Donald Askeland,Pradeep Fuley,Wendelin J. Wright, 6th Edition,Publisher Global Engineering:
2. W. Callister, “Materials Science & Engineering”, John Wiley & sons
3. R.A. Higgins, “Engineering Metallurgy”, Viva Books Pvt. Ltd., New Delhi, 1 st Edition
4. ASM Handbook Volume no.5 Surface Engineering

Title of the Course: Industrial Fluid Power Lab	**L**	**T**	**P**	**Credit**
Course Code:UMEC0409	**-**	**-**	**2**	**1**

Course Pre-Requisite: Fluid Mechanics

Course Description: This course aims to impart knowledge of fluid power systems such as hydraulics and pneumatics w.r.t. their components, circuits and their industrial applications.

Course Objectives:

1. Study of working principle of various components used in hydraulic and pneumatic systems.
2. Study of ISO/JIC symbols of fluid power systems.
3. Study of hydraulic and pneumatic circuits.
4. To build hydraulic and pneumatic circuits for given application.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**
CO1	**Draw** the ISO/JIC symbols of fluid power systems.
CO2	**Explain** and **demonstrate** basic structure and components of hydraulic and pneumatic systems.
CO3	**Make use of** ISO/JIC symbols to build the fluid power circuits.
CO4	**Construct** and **demonstrate** hydraulic and pneumatic circuits.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2	PSO3
CO1	2												2	2	2
CO2	2														
CO3		2	2		1				2			2	2	2	2
CO4		2	2	2					3	2		2	2	2	2

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1: Study and Demonstration of layouts of hydraulic and pneumatic system	**02 Hrs.**
Experiment No. 2: Study of ISO/JIC Symbols for hydraulic and pneumatic systems.	**02 Hrs.**
Experiment No. 3: Study and Demonstration of different types of control valves used in hydraulic and pneumatic system.	**02 Hrs.**
Experiment No. 4: Preparation of following circuits on hydraulic circuit trainer; a) Basic hydraulic circuit to obtain motions of linear and rotary actuators. b) Speed control circuits	**02 Hrs.**
Experiment No. 5: Preparation of following circuits on hydraulic circuit trainer; a) Sequencing circuit b) Synchronization circuits.	**02 Hrs.**
Experiment No. 6: Preparation of following circuits on hydraulic circuit trainer; a) Counterbalance circuit b) Regenerative circuit	**02 Hrs.**
Experiment No. 7: Demonstration of electro-hydraulics circuit trainer and Preparation of at least two circuits on electro-hydraulics circuit trainer	**02 Hrs.**
Experiment No. 8: Preparation of following circuits on pneumatic circuit trainer; a) Automatic reciprocating motion circuits b) Speed control circuits	**02 Hrs.**
Experiment No. 9: Preparation of following circuits on pneumatic circuit trainer; a) Sequencing circuits (travel dependent) b) Circuit involving use of shuttle valve (OR logic circuit) AND logic circuit	**02 Hrs.**
Experiment No. 10: Circuit preparations (at least two) by using Fluid Simulation Software.	**02 Hrs.**

Textbooks:

1. "Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication.
2. "Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.

3. “Industrial Fluid Power”,D. S. Pawaskar, Nishant Prakashan.
4. “Hydraulics and Pneumatics”, Shaikh and Khan, R.K. Publication.
5. “Fluid Power with Application”, Esposito, Pearson Education, 7th Edition.
6. “Basic Hydraulic – Festo Manual”
7. “Basic Pneumatic – Festo Manual”
8. “Industrial Fluid Power”, S.S. Kuber, Nirali Prakashan, 3rd Edition.
9. “Hydraulics and Pnuematics”,Dr.Anand Bewoor, Late S.K.Ponde,Nirali Prakashan.

References:

1. “Hydraulic and Pneumatic”,H.L.Stewart,Industrial Press.
2. “Industrial Hydraulic”, J. J. Pipenger, Tata McGraw Hill.
3. “Power Hydraulics”, Goodwin 1st Edition.
4. “Introduction to Hydraulic and Pneumatics”,S. Ilango and V Soundararajan, Prentice Hall of India, 2nd Edition.
5. “Pneumatic Control”,Joji P.,Wiley. , 1st Edition.
6. “Fluid Power”,Jagadeesha T. , Wiley Publications.
7. Eaton (Vickers) Manual.
8. Product Manuals and books from Vickers/ Eaton, FESTO, SMC pneumatics.

Experiment wise Measurable students Learning Outcomes:

1. Explain and demonstrate the structure and layouts of hydraulic and pneumatic systems.
2. Make use of ISO symbols of fluid power systems to represent the system.
3. Explain and demonstrate construction and working of various types of control valves used in hydraulic and pneumatic system.
4. Construct and demonstrate hydraulic circuits on circuit trainer.
5. Construct and demonstrate hydraulic circuits on circuit trainer.
6. Construct and demonstrate hydraulic circuits on circuit trainer.
7. Construct and demonstrate electro- hydraulic circuits on circuit trainer.
8. Construct and demonstrate pneumatic circuits on circuit trainer.
9. Construct and demonstrate pneumatic circuits on circuit trainer.
10. Make use of fluid simulation software.

Title of the Course: Workshop Practice III **Course Code: UMEC0410**	**L** **-**	**T** **-**	**P** **2**	**C** **1**

Course Pre-Requisite: Basic Mechanical engineering, workshop practice-I, Engineering chemistry

Course Description:

Being a practice-oriented course, the present course focuses on practicing various skills useful for making different components/jobs using various workshop operations.

Course Objectives:

1. Acquire skills in basic sand in casting process.
2. Perform sand testing
3. Perform different welding operations
4. Develop a mould and pattern for specific application

Course Learning Outcomes:

CO	After the completion of the course	Bloom's Cognitive	
		level	Descriptor
CO1	Understand the application of sand in casting process.	2	Understanding
CO2	Develop a mould and pattern for casting process.	6	Create
CO3	Select process parameter for arc welding operations	5	select

CO-PO Mapping:

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

Strength of Correlation: Key: 3: High, 2:Medium, 1:Low

Assessments :

Teacher Assessment:

Assessment	Marks
ISE 1	25

ISE is based on practical performed/ Quiz/ Presentation/ Group Discussion/Role plays/Assignments, etc

Distribution:

Term work shall consist of job along with workshop Diary completion.

Attendance and practical performance- 10

Workshop journal completion - 10

Industrial Visit attendance and Report -5

Course Contents:

1. Perform different sand testing a) To find Size analysis and Grain fineness Number of moulding sand. b) To calculate Hardness (mould/core) and Green Compressive strength of moulding sand c) To find Permeability, Moisture percentage and Clay content of given sand	**4 Hrs.**
2. Job on welding process	**2 Hrs.**
3. From given component drawing, draw pattern layout, pattern drawing (with allowances included) and drawing of mould ready to pour with gating and rising.	**2 Hrs.**
4. Industrial visit report (Industrial visit to have practical knowledge of casting, forging, rolling and plastic forming etc.)	**4 Hrs.**

Textbooks:

1. P. N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I, Tata McGraw-Hill, N 3rd edition, 2009.
2. P. L. Jain, "Principles of Foundry Technology", Tata McGraw-Hill, New Delhi, 2nd Edition,2006.
3. P. C. Sharma, "A Textbook

References:

1. Machine Tools and Mfg. Technology, Steve F. Krar, Mario Rapisarda, Albert F. Check
2. O. P. Khanna, Foundry technology, Khanna Publishers, New Delhi.
3. P L Jain, Principles of foundry technology, Tata McGraw-Hill, New Delhi.
4. O. P. Khanna. Welding technology, Khanna Publishers, New Delhi.
5. Hajra Chowdhary, Elements of Workshop Technology, Vol.I, Media Promoters & Publications, Bombay
6. B.S. Raghuvanshi, W/S Technology, Vol. II, Dhanapat Rai Publi. Delhi, 10th Ed, 2000
7. W.A.J. Chapman, Workshop Technology, Vol. II, Viva Books, New Delhi,
8. Hajra Choudhury and A.K. Hajra Choudhury, Elements of Workshop Technology, Vol. II, S.K. Media Promoters and Publishers, New Delhi, 13th Edition, 2012.
9. Production Technology, R. K. Jain, Khanna Publishers, Delhi, 15th Edition, 2000.
10. Workshop Technology, W.A.J. Chapman, CBS Publishing and Distributors, N. Delhi Vol. I, 2001, Vol. I 2007 and Vol.III, 1995

Title of the Course: Project Lab-I	**L**	**T**	**P**	**Credit**
Course Code:UMEC0411	**-**	**-**	**2**	**1**

Course Pre-Requisite: Basic sciences, Basic engineering sciences, Engineering Drawing

Course Description: This course provides an opportunity to students to work on real life problems related to identified course and to provide optimum solution to them. This approach is known as student's centric learning. Because of this way of learning, improvement in important process skills like problem solving ability, critical thinking, team working, communication skills and self learning abilities can be achieved.

Course Objectives:

1. To have a focus on long-term, multidisciplinary, and student-centered project-based learning activities.
2. To foster autonomous and collaborative learning by using resources to solve problems from the real world.

3. Possessing the ability to create software based on the principles of mechanical engineering, mostly by utilizing previously acquired information.
4. To gain hands-on experience in the specification, design, implementation, and testing phases of the mechanical system development life cycle.
5. To gain an ability to choose and use the proper mechanical engineering concepts while designing and evaluating a particular mechanical system.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO1	IDENTIFY the real-world problem (related to CLPBL course) through a rigorous literature survey and formulate / set relevant aims and objectives
CO2	PROPOSE a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.
CO3	ANALYZE the results and arrive at valid conclusions
CO4	USE of technology in proposed work and demonstrate learning in oral and written form.
CO5	DEVELOP ability to work as an individual and as a team member.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO12	PSO1	PSO2	PSO3
CO1	2	1	1									2	2	2	2
CO2	2	2	2								2	2	2	2	2
CO3		2	2	1								2			
CO4					1			2		2		2			
CO5									2			2			2

Assessments :

Teacher Assessment:

Assessment	Marks
In Semester Evaluation (ISE)	50

ISE are based on CLPBL Project assigned/Models preparation/ Presentation/ Group Discussion/ etc.

Course Contents:

Preamble:

Worldwide, engineering education is currently going through considerable structural changes. The engineering curriculum must be regularly revised in light of emerging topics and with a multidisciplinary focus due to the fast changing technological landscape. In order to include these fresh themes into educational programs while maintaining the development of traditional abilities, it is required to develop, execute, and assess creative pedagogical approaches. In this setting, interest in project-based learning strategies is quickly growing across the educational community.

The typical classroom teaching method used in the majority of engineering programs places a strong emphasis on lectures and gives students little (if any) control over how they will learn. However, the rapid advancement of engineering and technology necessitates the adoption of a teaching strategy that would help students not only build a foundation of abilities relevant to their business, but also prepare them for future career choices.

Group Structure:

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 4-6 students in each class.
2. A supervisor/mentor teacher is assigned to 4-6 groups or one batch.

Project Selection:

Suitable project should be identified with respect to the problem statement specified by the course coordinator of CLPBL course.

A survey of journal articles, patents, or a field visit can be used to choose the project. Problems can be theoretical, practical, social, technical, symbolic, cultural, or scientific. The

issue must have the following components: an analysis of the issue, design and development of the system, and the viability of finding a solution (hardware or virtual).
It is advised to "learn by doing" in order to solve problem-based initiatives. The concept starts with the identification of an issue, which frequently develops from a query or "wondering." Then, this defined problem serves as the foundation for learning. Students' exploration of many academic fields and professional settings results in problems that can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific in nature.

Ethical Practices, teamwork and project management:

Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation:

It is necessary for the students to master excellent writing techniques in order to equip our engineering graduates with the ability to create successful documentation. The literature review, problem statement, aim and objectives, system block diagram, system implementation details, discussion and analysis of results, conclusion, system limitations, and future scope are anticipated to be included in the PBL final report. It is expected that PBL mentors and guides will instruct students on how to use reliable information sources (such as scholarly articles, books, and periodicals) relating to their PBL topic.

Evaluation & Continuous Assessment

The comprehensive and ongoing monitoring and evaluation of student achievement is key to the PBL concept's effectiveness. It is recommended that regular reporting of all actions be mandated. Students must maintain a PBL log book at the department with regular evaluations of their PBL work. The following should be recorded in the PBL log book:

1. Student guidance and information
2. The PBL guide's weekly oversight,
3. Evaluation form for the PBL guide to review the PBL work

Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (kind of survey). (10%)
2. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
3. Attended reviews, poster presentation and model exhibition. (10%)
4. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
5. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
6. Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small application, design of control systems, development of various systems/ /Hackathon/ application development and similar activities/ System performance and analysis) (40%)
7. Participation in various competitions/ publication/ copyright/ patent) (10%)

Reference Books / Research Articles:

1. John Larmer, John R. Mergendoller, and Suzie Boss, “Setting the Standard for Project Based Learning”
2. John Larmer and Suzie Boss, “Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences” 3. Erin M. Murphy and Ross Cooper, “Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry”.
3. Shinde,V.,(2014).Design of Course Level Project Based Learning Models for an Indian Engineering Institute: An assessment of students' learning experiences and learning outcomes .Institute for Planning, Aalborg University, 2014.
4. Vikas V Shinde and S S Inamdar. (2013). Problem Based Learning (PBL) for Engineering Education in India: Need and Recommendations. Wireless Peers Communication, 69, 1097-1105.
5. Shinde, V. (2011). Relevance of the problem and project based learning (PBL) to the

Indian engineering education, across the disciplines: research into best practice. In 3rd international research symposium on PBL (pp. 489–501). U.K.: Coventry University, 28–29 November 2011.
6. Rahul C. Bhedasgaonkar et.al (2019), "Course Level PBL: an Excellent Teaching Method for Increasing Skill Levels and Learning Motivation in First Year of Engineering Students", Proceedings of Regional Research Symposium on PBL Nov.2019, KLE Tech University, Hubbalii, Karnataka, India.