

Savitribai Phule Pune University
Faculty of Science & Technology



Curriculum

For

First Year

Bachelor of Engineering
(Choice Based Credit System)

(2019 Course)

(With Effect from Academic Year 2019-20)

TABLE -1 First Engineering _Structure for Semester-I

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credits			
		Theory	Practical	Tutorial	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
107001	Engineering Mathematics-I	03	--	01	30	70	25	--	--	125	03	--	01	04
107002/ 107009	Engineering Physics / Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
102003	Systems in Mechanical Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
111006	Workshop [@]	--	02	--	--	--	--	25	--	25	--	01	--	01
Total		16	10	01	150	350	25	125	--	650	16	05	01	22
101007	Audit Course 1 ^{&}	02	Environmental Studies-I											

Induction Program : 2 weeks at the beginning of semester-I and 1 week at the beginning of semester-II

TABLE -2 First Engineering _Structure for Semester-II

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credits			
		Theory	Practical	Tutorial	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
107008	Engineering Mathematics-II	04	--	01	30	70	25	--	--	125	04	--	01	05
107002/ 107009	Engineering Physics/ Engineering Chemistry	04	02	--	30	70	--	25	--	125	04	01	--	05
103004 / 104010	Basic Electrical Engineering / Basic Electronics Engineering	03	02	--	30	70	--	25	--	125	03	01	--	04
110005/ 101011	Programming and Problem Solving / Engineering Mechanics	03	02	--	30	70	--	25	--	125	03	01	--	04
102012	Engineering Graphics ^Ω	01	02	01	--	50	25		--	75	01	01		02
110013	Project Based Learning [§]	--	04	--	--	--	25	50	--	75	--	02	--	02
Total		15	12	02	120	330	75	125	--	650	15	05	02	22
101014	Audit Course 2 ^{&}	02	Environmental Studies-II											
107015		--	Physical Education-Exercise and Field Activities											

Instructions:

- PR/Tutorial must be conducted in three batches per division.
 - Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
 - Every Student should appear for Engineering Physics, Engineering Chemistry, Engineering Mechanics, Basic Electrical Engineering, Basic Electronics Engineering, Programming and Problem solving during the year.
 - College is allowed to distribute Teaching workload of subjects Engineering Physics, Engineering Chemistry, Basic Electrical Engineering, Basic Electronics Engineering, Engineering Mechanics, Programming and Problem solving in semester I and II dividing number of FE divisions into two appropriate groups.
 - Assessment of tutorial work has to be carried out as term-work examination. Term-work Examination and Practical Examination at first year of engineering course **shall be internal continuous assessment only.**
- Ω 1 Credit for Engineering Graphics theory has to be awarded on the basis of End semester examination of 50 marks while 1 credit of tutorial and practical **shall be awarded on internal continuous assessment only.**
- @ Credit for the course of workshop practical is to be awarded on the basis of continuous assessment / submission of job work.
- § Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload a load of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.
- & Audit course for Environmental Studies and II (As per D.O.No.F.13-1/2000 (EA/ENV/COS-I) dated 14 May, 2019) is mandatory but non-credit course. Examination has to be conducted at the end of Sem I & II respectively for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.
- Audit course for Physical education is mandatory non-credit course. Examination has to be conducted at the end of Semester for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point &CGPA.
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Guidelines for Induction Program

Induction programme for first year students is introduced to familiarize them to the new environment and encourage them to look beyond classrooms. Objective is to help new students adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self exploration. Induction Program should be preferably of 3 weeks (**2 weeks at the beginning of semester-I and 1 week at the beginning of semester-II**).

In order to implement the (SIP) in the College the following activities can be taken at College.

- Physical Activity-This would involve a daily routine of physical activity with games and sports.
- Creative Arts: - Every student would choose one skill related to the arts whether visual arts or performing arts.
- Mentoring and Universal Human values:-Mentoring and connecting the students with faculty members and other students is the most important part of student induction. This can be effectively done by forming a group of 20-22 students with a faculty mentor each. This can be implemented through group discussion and real life activities rather than lecturing.
- Familiarization with College, Department, Branch :-The incoming student should be told about the credit, grading system and scheme of the examination. They should be explained how the study in College differs from the study in school. They should be taken on College tour and shown important points such as library, canteen, gymkhana etc. They should be shown their department.
- Literary Activity :-Literary Activity would encompass reading book, writing a summary, debating, checking play etc.
- Proficiency modules :- The modules can be designed to overcome some critical lacunas that students might have like English Speaking, Computer familiarity etc.
- Lectures by Eminent People:- The lectures of Eminent people to be organized to expose the student to social activity public life.
- Visit to local Area:-A couple of visits to the landmark of the city or a hospital or orphanage could be organized.
- Extracurricular activities in College:-The new students should be introduced to the extracurricular activities at the College.
- Feedback and Report on the program:-Students should be asked to give their mid program Feedback and each group of 20-22 students should be asked to prepare a single report on their experience of the program.

To Summarize the above activity the sequence of activities can be planned as given below :

- Address by Principal, HOD's and other functionaries and welcome the new students along with their parents.
- The branch wise allocation of students to be done and a group of 20-22 students is to be formed along with one faculty as mentor.
- A detail time table of various activities is to be prepared and displayed for all students. The timetable should give details of location and details of faculty in charge of the activity.
- The visit to local areas can be arranged on Saturdays.

The various activities to be carried out can be divided into three phases :-

1. Initial phase:- Which may include Address by Principal, HOD's and other functionaries College and Dept Visit, interaction with parents Forming of students group and assigning of mentor mentee.
2. Regular Phase:- This phase may include the activities such as creative arts / universal

Human values Games & Sports in the morning session and in the afternoon session. Literary activities, Proficiency module, Lectures & workshop, Extra curricular Activities can be scheduled.

3. Closing Phase:- This phase may include taking feed back of students, preparation of Report by each group, Test of creative Arts, Human Values can be taken. These are summarized guidelines given to the student inducing induction programme (SIP) Please refer SIP Manual published by AICTE for detail guidelines [2].

Savitribai Phule Pune University		
First Year Engineering (2019 Course)		
107001 – Engineering Mathematics – I		
Teaching Scheme: TH : 3 Hrs./Week TUT : 1 Hr/Week	Credits 04	Examination Scheme: In-Semester Exam :30 Marks End-Semester Exam :70 Marks TW :25 Marks
Prerequisites: Differentiation, Integration, Maxima and Minima, Determinants and Matrices.		
Course Objectives: To make the students familiarize with concepts and techniques in Calculus, Fourier series and Matrices. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.		
Course Outcomes (COs): The students will be able to learn CO1: Mean value theorems and its generalizations leading to Taylors and Maclaurin's series useful in the analysis of engineering problems. CO2: the Fourier series representation and harmonic analysis for design and analysis of periodic continuous and discrete systems. CO3: to deal with derivative of functions of several variables that are essential in various branches of Engineering. CO4: to apply the concept of Jacobian to find partial derivative of implicit function and functional dependence. Use of partial derivatives in estimating error and approximation and finding extreme values of the function. CO5: the essential tool of matrices and linear algebra in a comprehensive manner for analysis of system of linear equations, finding linear and orthogonal transformations, Eigen values and Eigen vectors applicable to engineering problems		
Course Contents		
Unit I: Differential Calculus: (08 Hrs.) Rolle's Theorem, Mean Value Theorems, Taylor's Series and Maclaurin's Series, Expansion of functions using standard expansions, Indeterminate Forms, L' Hospital's Rule, Evaluation of Limits and Applications.		
Unit II: Fourier Series (08 Hrs.) Definition, Dirichlet's conditions, Full range Fourier series, Half range Fourier series, Harmonic analysis, Parseval's identity and Applications to problems in Engineering.		
Unit III: Partial Differentiation (08Hrs.) Introduction to functions of several variables, Partial Derivatives, Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative, Change of Independent variables		
Unit IV: Applications of Partial Differentiation (08 Hrs.) Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.		
Unit V: Linear Algebra-Matrices, System of Linear Equations (08 Hrs.) Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in Engineering.		
Unit VI: Linear Algebra-Eigen Values and Eigen Vectors, Diagonalization (08 Hrs.) Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonalization of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations.		
Text Books:		

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)
5. Applied Mathematics (Vol. I & Vol. II) by P.N.Wartikar and J.N.Wartikar Vidyarthi Griha Prakashan, Pune.
6. Linear Algebra –An Introduction, Ron Larson, David C. Falvo (Cenage Learning, Indian edition)

Tutorial and Term Work:

- i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students maximum) per division.
- ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on performance and continuous internal assessment.

107002: Engineering Physics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week	05	In-Semester :30 Marks
PR: 02 Hr/Week		End-Semester :70 Marks
		PR :25 Marks

Prerequisite Courses, if any:

Fundamentals of: optics, interference, diffraction polarization, wave-particle duality, semiconductors and magnetism

Companion Course, if any: Laboratory Practical

Course Objectives:

To teach students basic concepts and principles of physics, relate them to laboratory experiments and their applications

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop understanding of interference, diffraction and polarization; connect it to few engineering applications.

CO2: Learn basics of lasers and optical fibers and their use in some applications.

CO3: Understand concepts and principles in quantum mechanics. Relate them to some applications.

CO4: Understand theory of semiconductors and their applications in some semiconductor devices.

CO5: Summarize basics of magnetism and superconductivity. Explore few of their technological applications.

CO6: Comprehend use of concepts of physics for Non Destructive Testing. Learn some properties of nanomaterials and their application.

Course Contents

Unit I **Wave Optics** **(08 Hrs)**

Interference

- Introduction to electromagnetic waves and electromagnetic spectrum
- Interference in thin film of uniform thickness (with derivation)
- Interference in thin film wedge shape (qualitative)
- Applications of interference: testing optical flatness, anti-reflection coating

Diffraction

<ul style="list-style-type: none"> - Diffraction of light - Diffraction at a single slit, conditions for principal maxima and minima, diffraction pattern - Diffraction grating, conditions for principal maxima and minima starting from resultant amplitude equations, diffraction pattern - Rayleigh's criterion for resolution, resolving power of telescope and grating <p>Polarization</p> <ul style="list-style-type: none"> - Polarization of light, Malus law - Double refraction, Huygen's theory of double refraction <p>Applications of polarization: LCD</p>	
<p>Unit II</p> <p>Laser</p> <ul style="list-style-type: none"> - Basics of laser and its mechanism, characteristics of laser - Semiconductor laser: Single Hetro-junction laser - Gas laser: CO₂ laser - Applications of lasers: Holography, IT, industrial, medical <p>Optic Fiber</p> <ul style="list-style-type: none"> - Introduction, parameters: Acceptance Angle, Acceptance Cone, Numerical Aperture - Types of optical fiber- step index and graded index - Attenuation and reasons for losses in optic fibers (qualitative) - Communication system: basic building blocks <p>Advantages of optical fiber communication over conventional methods.</p>	<p>Laser and Optic Fibre</p> <p>(08 Hrs)</p>
<p>Unit III</p> <ul style="list-style-type: none"> - De-Broglie hypothesis - Concept of phase velocity and group velocity (qualitative) - Heisenberg Uncertainty Principle - Wave-function and its physical significance - Schrodinger's equations: time independent and time dependent - Application of Schrodinger's time independent wave equation - Particle enclosed in infinitely deep potential well (Particle in RigidBox) - Particle in Finite potential well (Particle in Non Rigid box) (qualitative) - Tunneling effect, Tunneling effect examples (principle only): Alpha Decay, Scanning Tunneling Microscope, Tunnel diode - Introduction to quantum computing 	<p>Quantum Mechanics</p> <p>(08 Hrs)</p>
<p>Unit IV</p> <ul style="list-style-type: none"> - Free electron theory (Qualitative) - Opening of band gap due to internal electron diffraction due to lattice Band theory of solids - Effective mass of electron Density of states - Fermi Dirac distribution function - Conductivity of conductors and semiconductors - Position of Fermi level in intrinsic and extrinsic semiconductors (with derivations based on carrier concentration) - Working of PN junction on the basis of band diagram - Expression for barrier potential (derivation) - Ideal diode equation - Applications of PN junction diode: Solar cell (basic principle with band diagram) IV Characteristics and Parameters, ways of improving efficiency of solar cell - Hall effect: Derivation for Hall voltage, Hall coefficient, applications of Hall effect 	<p>Semiconductor Physics</p> <p>(08 Hrs)</p>

Unit V	Magnetism and Superconductivity	(8Hrs.)
Magnetism		
<ul style="list-style-type: none"> - Origin of magnetism - Classification of magnetism on the basis of permeability (qualitative) - Applications of magnetic devices: transformer cores, magnetic storage, magneto-optical recording 		
Superconductivity		
<ul style="list-style-type: none"> - Introduction to superconductivity; Properties of superconductors: zero electrical resistance, critical magnetic field, persistent current, Meissner effect - Type I and Type II superconductors - Low and high temperature superconductors (introduction and qualitative) - AC/DC Josephson effect; SQUID: basic construction and principle of working; Applications of SQUID - Applications of superconductors 		
Unit VI	Non Destructive Testing and Nanotechnology	(8 Hrs.)
Non Destructive Testing		
<ul style="list-style-type: none"> - Classification of Non-destructive testing methods - Principles of physics in Non-destructive Testing - Advantages of Non-destructive testing methods - Acoustic Emission Testing - Ultrasonic (thickness measurement, flaw detection) - Radiography testing 		
Nanotechnology		
<ul style="list-style-type: none"> - Introduction to nanotechnology - Quantum confinement and surface to volume ratio - Properties of nanoparticles: optical, electrical, mechanical <p>Applications of nanoparticles: Medical (targeted drug delivery), electronics, space and defense, automobile</p>		
Books & Other Resources:		
Text Books:		
<ol style="list-style-type: none"> 1. Engineering Physics, Avadhanulu, Kshirsagar, S. Chand Publications 2. A textbook of optics – N Subrahmanyam and BriLal , S. Chand Publications 3. Engineering Physics, Gaur, Gupta, Dhanpat Rai and Sons Publications 		
Reference Books:		
<ol style="list-style-type: none"> 1. Fundamentals of Physics, Resnick and Halliday (John Wiley and Sons) 2. Optics, Jenkins and White (Tata Mcgraw Hill) 3. Principles of Physics, Serway and Jewett (Saunders college publishing) 4. Introduction to Solid State Physics, C. Kittel (Wiley and Sons) 5. Principles of Solid State Physics, H. V. Keer, New Age International 6. Laser and Non-Linear Optics, B. B. Laud (Oscar publication) 7. Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni (Capital Publishing Company) 		
Guidelines for Instructor's Manual		
Lab manual is expected to cover following points:		
<ol style="list-style-type: none"> 1. Engineering Program Outcome (Graduate Attribute) and which attributes will be covered during practical 2. List of experiments to be performed with mention of objectives and outcome of the experiment 		

Guidelines for Student's Lab Journal

Student's lab journal is expected to cover:

1. List of experiments to be performed with mention of objectives and outcome of the experiment.
2. Instructions to students for performing the experiments
3. Precautions for each experiment
4. Write up of experiment (Preferably mentioning significance of experiment).

Guidelines for Lab /TW Assessment

1. The distribution of weightage of term work marks should be informed to students before start of the semester.
2. Term work assessment should be on continuous basis. At frequent intervals students are expected to inform about their progress/lagging.

Guidelines for Laboratory Conduction

1. DO's and DONT'S, along with precautions, are need to be displayed at prominent location in laboratory
2. Students should be informed about DO'S and DON'T and precautions before performing the experiment

Suggested List of Laboratory Experiments (Any eight)

Sr.	Experiment
1	Experiment based on Newton's rings (determination of wavelength of monochromatic light, determine radius of curvature of plano-convex lens)
2	To determine position of diffraction minima by studying diffraction at a single slit
3	To determine unknown wavelength by using plane diffraction grating
4	To find out Resolving power of Diffraction Grating/Telescope
5	To verify Malus Law
6	Any experiment based on Double Refraction (Determination of refractive indices, identification of types of crystal)
7	Any Experiment based on Laser (Thickness of wire, determination of number of lines on grating surface)
8	An experiment based on optic fibers
9	To study IV characteristics of Solar Cell and determine parameters (fill factor and efficiency)
10	To determine band gap of given semiconductor
11	To determine Hall coefficient and charge carrier density
12	Temperature dependence characteristics of semiconductor laser
13	To find out Magnetic susceptibility of given material
14	Ultrasonic Interferometer: Determination of velocity of ultrasonic waves in given liquid and find its compressibility
Suggested Demonstration Experiments	
1	Michelson interferometer
2	Half shade Polarimeter
3	Determination of absorption coefficient of sound of given material
4	Temperature dependence
5	Brewster's law
6	Measurement of sound pressure level

102003 - Systems in Mechanical Engineering		
Teaching Scheme: TH : 3 Hrs./week PR : 2 Hrs./Week	Credits 04	Examination Scheme: In-Semester :30 Marks End-Semester :70 Marks PR :25 Marks
Course Objectives:		
<ol style="list-style-type: none"> 1. To identify the sources of energy and their conversions 2. To explain the basic concept of engineering thermodynamics and its application 3. To understanding the specifications of vehicles 4. To get acquainted with vehicle systems 5. To introduce manufacturing processes applying proper method to produce components 6. To be able to select and compare domestic appliances 		
Course Outcomes		
On completion of the course, learner will be able to		
CO1: Describe and compare the conversion of energy from renewable and non-renewable energy sources		
CO2: Explain basic laws of thermodynamics, heat transfer and their applications		
CO3: List down the types of road vehicles and their specifications		
CO4: Illustrate various basic parts and transmission system of a road vehicle		
CO5: Discuss several manufacturing processes and identify the suitable process		
CO6: Explain various types of mechanism and its application		
Course Contents		
Unit I Introduction of energy sources & its conversion (06 Hrs)		
Energy sources: Thermal energy, Hydropower energy, Nuclear energy, Solar energy, Geothermal energy, Wind energy, Hydrogen energy, Biomass energy and Tidal energy. Grades of Energy. (<i>Numerical on efficiency calculation of thermal power plant</i>)		
Energy conversion devices: Introduction of pump, compressor, turbines, wind mills etc (<i>Simple numerical on power and efficiency calculations</i>)		
Unit II Introduction to Thermal Engineering (06Hrs)		
Laws of thermodynamics, heat engine, heat pump, refrigerator (<i>simple numerical</i>)		
Modes of heat transfer: conduction, convection and radiation, Fourier's law, Newton's law of cooling, Stefan Boltzmann's law. (<i>Simple numerical</i>)		
Two stroke and Four stroke engines (Petrol, Diesel and CNG engines). Steam generators.		
Unit III Vehicles and their Specifications (04 Hrs)		
Classification of automobile. Vehicle specifications of two/three wheeler, light motor vehicles, trucks, buses and multi-axle vehicles. Engine components (Introduction). Study of engine specifications, comparison of specifications of vehicles. Introduction of Electric and Hybrid Vehicles. Cost analysis of the Vehicle.		
Unit IV Vehicle systems (08 Hrs)		
Introduction of chassis layouts, steering system, suspension system, braking system, cooling system and fuel injection system and fuel supply system. Study of Electric and Hybrid Vehicle systems. Study of power transmission system, clutch, gear box (Simple Numerical), propeller shaft, universal joint, differential gearbox and axles. Vehicle active and passive safety arrangements: seat, seat belts, airbags and antilock brake system.		

<p>Unit V Introduction to Manufacturing (06 Hrs) Conventional Manufacturing Processes: Casting, Forging, Metal forming (Drawing, Extrusion, etc.), Sheet metal working, Metal joining, etc. Metal cutting processes and machining operations- Turning, Milling and Drilling, etc. Micromachining. Additive manufacturing and 3D Printing. Reconfigurable manufacturing system and IOT, Basic CNC programming: Concept of Computer Numerical Controlled machines.</p>
<p>Unit VI Engineering Mechanisms and their application in Domestic Appliances (6Hrs.) Introduction to Basic mechanisms and equipment: Pumps, blowers, compressors, springs, gears, Belt-Pulley, Chain-Sprocket, valves, levers, etc. Introduction to terms: Specifications, Input, output, efficiency, etc. Applications of: Compressors - Refrigerator, Water cooler, Split AC unit; Pumps - Water pump for overhead tanks, Water filter/Purifier units; Blower - Vacuum cleaner, Kitchen Chimney; Motor - Fans, Exhaust fans, Washing machines; Springs - Door closure, door locks, etc.; Gears - Wall clocks, watches, Printers, etc.; Application of Belt-Pulley/Chain-Sprocket - Photocopier, bicycle, etc.; Valves - Water tap, etc.; Application of levers - Door latch, Brake pedals, etc.; Electric/Solar energy - Geysers, Water heater, Electric iron, etc. (simple numerical on efficiency calculation)</p>
<p>Books & Other Resources Text Books</p> <ol style="list-style-type: none"> 1. Nag, P. K., "Engineering Thermodynamics," Tata McGraw-Hill Publisher Co. Ltd. 2. Chaudhari and Hajra, "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers, Mumbai 3. Agrawal, Basant and Agrawal, C. M., (2008), "Basics of Mechanical Engineering", John Wiley and Sons, USA 4. Rajput, R.K., (2007), "Basic Mechanical Engineering", Laxmi Publications Pvt. Ltd. 5. Pravin Kumar, (2018), "Basic Mechanical Engineering, 2nd Ed.", Pearson (India) Ltd. 6. Moran, M. J., Shapiro, H. N., Boettner, D. D., and Bailey, M. "Fundamentals of Engineering Thermodynamics", Wiley 7. Surinder Kumar, (2011), "Basic of Mechanical Engineering", Ane Books Pvt. Ltd. New Delhi
<p>Reference Books</p> <ol style="list-style-type: none"> 1. Khan, B. H., "Non Conventional Energy Sources, Tata McGraw-Hill Publisher Co. Ltd. 2. Boyle, Godfrey, "Renewable Energy", 2nd Ed., Oxford University Press 3. Khurmi, R.S., and Gupta, J. K., "A Textbook of Thermal Engineering", S. Chand & Sons 4. Incropera, F. P. and Dewitt, D.P., (2007), "Fundamentals of Heat and Mass Transfer, 6th Ed., John Wiley and Sons, USA 5. Groover, Mikell P., (1996), "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Prentice Hall, USA 6. Norton, Robert L., (2009), "Kinematics and Dynamics of Machinery", Tata McGrawHill 7. Cleghorn, W. L., (2005), "Mechanisms of Machines", Oxford University Press 8. Juvinal, R. C., (1994), "Fundamentals of Machine Component Design", John Wiley and Sons, USA 9. Ganeshan, V., (2018), "Internal Combustion Engines", McGraw Hill 10. Anderson, Curtis Darrel and Anderson, Judy, (2010), "Electric and Hybrid Cars: A History", 2nd Ed., McFarland
<p style="text-align: center;">Guidelines for Instructor's Manual</p> <p>The Instructor's Manual should contain following related to every experiment:</p> <ul style="list-style-type: none"> • Brief theory related to the experiment. • Apparatus with their detailed specifications.

- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.
- Relevance of practical in real life /industry

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment:

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Schematic, Layout /diagram.
- Observation table/ simulation plots/graphs.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, and understanding.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

The student shall complete the following activity as a term work.

Sr. No.	Activity
1.	<p>Group A: Industry / Workshop / Showroom Visit: The visit of students is mandatory, to provide awareness and understanding of the course.</p>
2.	<p>Group B: Assignments: The student shall complete the following assignments on:</p> <ol style="list-style-type: none"> i. Energy sources (Minimum one assignment on Conventional and one on Non-conventional sources) ii. Vehicle specifications and systems in passenger car iii. Electric vehicle specifications and its systems iv. Domestic appliances viz. refrigerator, air-conditioner, washing machine, cold storage
3.	<p>Group C: Experiments: The student shall complete the following (any four) experiments:</p> <ol style="list-style-type: none"> i. Demonstration of power train system in the vehicle ii. Demonstration of vehicle systems (automobile chassis, steering system, suspension system, braking system - Any Two) iii. Demonstration of energy conversion devices iv. Demonstration of additive manufacturing / rapid prototyping techniques v. Demonstration of CNC

103004: Basic Electrical Engineering		
Teaching Scheme: TH : 03 Hr/week PR : 02 Hr/Week	Credits 04	Examination Scheme: In-Semester : 30 Marks End-Semester : 70 Marks PR : 25 Marks
Prerequisite Courses, if any: Engineering physics, electron theory, electricity, potential and kinetic energy		
Course Overview: This course aims at enabling students of all Engineering Branches to understand the basic concepts of electrical engineering. This course is designed to provide knowledge of fundamentals and various laws in electromagnetic and magnetic circuits, electrostatics. The steady state analysis of AC and DC circuits, and its applications transformer, batteries and different energy conversion techniques are also included in this course.		
Course Objectives: <ol style="list-style-type: none"> 1. To introduce fundamental concepts, various laws-principles and theorems associated with electrical systems. 2. To impart basic knowledge of all electrical quantities such as current, voltage, power, energy, frequency along with different types of fields. 3. To provide knowledge about fundamental parameters such as resistance, inductance and capacitance and magnetic circuits, AC and DC circuits. 4. To provide knowledge of the concepts of transformer, different energy conversions techniques. 		
Course Outcomes: At the end of course students will be able to CO1: Differentiate between electrical and magnetic circuits and derive mathematical relation for self and mutual inductance along with coupling effect. CO2: Calculate series, parallel and composite capacitor as well as characteristics parameters of alternating quantity and phasor arithmetic CO3: Derive expression for impedance, current, power in series and parallel RLC circuit with AC supply along with phasor diagram. CO4: Relate phase and line electrical quantities in polyphase networks, demonstrate the operation of single phase transformer and calculate efficiency and regulation at different loading conditions CO5: Apply and analyze the resistive circuits using star-delta conversion KVL, KCL and different network theorems under DC supply. CO6: Evaluate work, power, energy relations and suggest various batteries for different applications, concept of charging and discharging and depth of charge.		
Course Contents		
Unit I	Electromagnetism:	(6Hrs)
Review: resistance, emf, current, potential, potential difference and Ohm's law Electromagnetism: Magnetic effect of an electric current, cross and dot conventions, right hand thumb rule, nature of magnetic field of long straight conductor, solenoid and toroid. Concept of mmf, flux, flux density, reluctance, permeability and field strength, their units and relationships. Simple series magnetic circuit, Introduction to parallel magnetic circuit(Only theoretical treatment), comparison of electric and magnetic circuit, force on current carrying conductor placed in magnetic field, Fleming's left hand rule. Faradays laws of electromagnetic induction, Fleming's right hand rule, statically and dynamically induced e.m.f., self and mutual inductance, coefficient of couplings. Energy stored in magnetic field.		

Unit II	Electrostatics and AC Fundamentals	(6 Hrs)
<p>A) Electrostatics: Electrostatic field, electric flux density, electric field strength, absolute permittivity, relative permittivity and capacitance. Capacitor, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors (no derivation) and time constant. (2Hrs)</p> <p>B) AC Fundamentals: Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of cycle, Period, frequency, instantaneous, peak(maximum), average and r.m.s. values, peak factor and form factor. Phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasor. (4Hrs)</p>		
Unit III	Single Phase AC Circuits	(06 Hrs)
<p>Study of AC circuits consisting of pure resistance, pure inductance, pure capacitance, series R-L, R-C and R-L-C circuits, phasor diagrams, voltage, current and power waveforms, resonance in series RLC circuits, concept of impedance, concept of active, reactive, apparent, complex power and power factor, Parallel AC circuits (No numericals), concept of admittance</p>		
Unit IV	Polyphase A.C. Circuits and Single phase Transformers	(06 Hrs)
<p>A) Polyphase A.C. Circuits: Concept of three-phase supply and phase sequence. Balanced and unbalanced load, Voltages, currents and power relations in three phase balanced star-connected loads and delta-connected loads along with phasor diagrams. (3Hrs)</p> <p>B) Single phase transformers: principle of working, construction and types, emf equation, voltage and current ratios. Losses, definition of regulation and efficiency, determination of these by direct loading method. Descriptive treatment of autotransformers. (3Hrs)</p>		
Unit V	DC Circuits:	(06 Hrs)
<p>Classification of electrical networks, Energy sources – ideal and practical voltage and current sources, Simplifications of networks using series and parallel combinations and star-delta conversions, Kirchhoff's laws and their applications for network solutions using loop analysis, Superposition theorem, Thevenin's theorem.</p>		
Unit VI	Work, Power, Energy and Batteries	(06 Hrs)
<p>A) Work, Power, Energy: Effect of temperature on resistance, resistance temperature coefficient, insulation resistance, conversion of energy from one form to another in electrical, mechanical and thermal systems. (4Hrs)</p> <p>B) Batteries : Different types of batteries (Lead Acid and Lithium Ion), construction, working principle, applications, ratings, charging and discharging, concept of depth of charging, maintenance of batteries, series -parallel connection of batteries (2Hrs)</p>		
Books & Other Resources:		
Text Books:		
<ol style="list-style-type: none"> 1. V.D. Toro, Principles of Electrical Engineering, Prentice Hall India, 1989 2. D. P. Kothari, I.J. Nagrath, Theory and Problems of Basic Electrical Engineering, PHI Publication 3. V.K. Mehta, Rohit Mehata Basic Electrical Engineering, S Chand Publications 4. B.L. Theraja, A text book on electrical technology Vol-I 		
Reference Books:		
<ol style="list-style-type: none"> 1. H Cotton, Electrical technology, CBS Publications 2. L. S. Bobrow, —Fundamentals of Electrical Engineering, Oxford University Press, 2011. 3. E. Hughes, —Electrical and Electronics Technology, Pearson, 2010. 4. D. C. Kulshreshtha, —Basic Electrical Engineering, McGraw Hill, 2009. 		
Guidelines for Instructor's Manual		
<p>The Instructor's Manual should contain following related to every experiment –</p> <ul style="list-style-type: none"> • Brief theory related to the experiment. • Apparatus with their detailed specifications. 		

- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.
- Relevance of practical in real life /industry

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical, understanding .
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Suggested List of Laboratory Experiments/Assignments

Group A

Following **eight** practical are compulsory

1. To study safety precautions while working on electrical systems, handling of various equipment's such as multimeter, ammeters, voltmeters, wattmeter's, real life resistors, inductors and capacitors
2. To calculate and measure of charging and discharging of capacitor and observe the response on storage oscilloscope.
3. To measure steady state response of series RL and RC circuits on AC supply and observations of voltage and current waveforms on storage oscilloscope.
4. To derive resonance frequency and analyze resonance in series RLC circuit.
5. To verify the relation between phase and line quantities in three phase balanced star delta connections of load.
6. To determine efficiency and regulation of transformer by direct loading test of a single phase transformer.
7. To verify KVL and Superposition theorem.
8. To verify Thevenin's theorem in a DC network

Group B

From following **minimum two** practical are compulsory

1. To measure insulation resistance of electrical equipment's/cable using Megger
2. To demonstrate different types of electrical protection equipments such as fuses, MCB, MCCB, ELCB.
3. To measure of earth resistance at substation earthing using fall of potential method with IS 3043 standard.
4. To study of LT and HT electricity bills.

Unit III	Functions and Modules	(08 Hrs)
Need for functions, Function: definition, call, variable scope and lifetime, the return statement. Defining functions, Lambda or anonymous function, documentation string, good programming practices. Introduction to modules, Introduction to packages in Python, Introduction to standard library modules.		
Unit IV	Strings	(07 Hrs)
Strings and Operations- concatenation, appending, multiplication and slicing. Strings are immutable, strings formatting operator, built in string methods and functions. Slice operation, ord() and chr() functions, in and not in operators, comparing strings, Iterating strings, the string module.		
Unit V	Object Oriented Programming	(08 Hrs)
Programming Paradigms-monolithic, procedural, structured and object oriented, Features of Object oriented programming- classes, objects, methods and message passing, inheritance, polymorphism, containership, reusability, delegation, data abstraction and encapsulation. Classes and Objects: classes and objects, class method and self object, class variables and object variables, public and private members, class methods.		
Unit VI	File Handling and Dictionaries	(07 Hrs)
Files: Introduction, File path, Types of files, Opening and Closing files, Reading and Writing files. Dictionary method. Dictionaries- creating, assessing, adding and updating values. Case Study: Study design, features, and use of any recent, popular and efficient system developed using Python. (This topic is to be excluded for theory examination).		
Text Books:		
<ol style="list-style-type: none"> 1. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press, ISBN 13: 978-0-19-948017-6 2. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press; Second edition ISBN-10: 938605230X, ISBN-13: 978-9386052308 ASIN: B07BFSR3LL 		
Reference Books:		
<ol style="list-style-type: none"> 1. R. G. Dromey, “How to Solve it by Computer”, Pearson Education India; 1st edition, ISBN-10: 8131705625, ISBN-13: 978-8131705629 Maureen Spankle, “Problem Solving and Programming Concepts”, Pearson; 9th edition, ISBN-10: 9780132492645, ISBN-13: 978-0132492645 2. Romano Fabrizio, “Learning Python”, Packt Publishing Limited, ISBN: 9781783551712, 1783551712 3. Paul Barry, “Head First Python- A Brain Friendly Guide”, SPD O’Reilly, 2nd Edition, ISBN:978-93-5213-482-3 4. Martin C. Brown, “Python: The Complete Reference”, McGraw Hill Education, ISBN-10: 9789387572942, ISBN-13: 978-9387572942, ASIN: 9387572943 5. Jeeva Jose, P. Sojan Lal, “Introduction to Computing & Problem Solving with Python”, Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810 		
Programming and Problem Solving Laboratory		
Guidelines for Instructor's Manual		
The instructor’s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), copy of curriculum, conduction & Assessment guidelines, topics under consideration- concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.		
Guidelines for Student's Lab Journal		
The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of		

tool/framework/language used, Design, test cases, conclusion. Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

List of laboratory assignments is provided below for reference. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of coding style, proper indentation and comments.

Use of open source software and recent version is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Suggested List of Laboratory Experiments/Assignments (Any 6 to 8 laboratory assignments)

Sr. No.	Problem Statement Write Program in Python (with function/class/file, as applicable)
1.	To calculate salary of an employee given his basic pay (take as input from user). Calculate gross salary of employee. Let HRA be 10 % of basic pay and TA be 5% of basic pay. Let employee pay professional tax as 2% of total salary. Calculate net salary payable after deductions.
2.	To accept an object mass in kilograms and velocity in meters per second and display its momentum. Momentum is calculated as $e=mc^2$ where m is the mass of the object and c is its velocity.
3.	To accept N numbers from user. Compute and display maximum in list, minimum in list, sum and average of numbers.
4.	To accept student's five courses marks and compute his/her result. Student is passing if he/she scores marks equal to and above 40 in each course. If student scores aggregate greater than 75%, then the grade is distinction. If aggregate is $60 \geq$ and <75 then the grade is first division. If aggregate is $50 \geq$ and <60 , then the grade is second division. If aggregate is $40 \geq$ and <50 , then the grade is third division.
5.	To check whether input number is Armstrong number or not. An Armstrong number is an integer with three digits such that the sum of the cubes of its digits is equal to the number itself. Ex. 371.
6.	To simulate simple calculator that performs basic tasks such as addition, subtraction, multiplication and division with special operations like computing x^y and $x!$.

7.	To accept the number and Compute a) square root of number, b) Square of number, c) Cube of number d) check for prime, d) factorial of number e) prime factors
8.	To accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these two numbers.
9.	To accept a number from user and print digits of number in a reverse order.
10.	To input binary number from user and convert it into decimal number.
11.	To generate pseudo random numbers.
12.	To accept list of N integers and partition list into two sub lists even and odd numbers.
13.	To accept the number of terms a finds the sum of <i>sine</i> series.
14.	To accept from user the number of Fibonacci numbers to be generated and print the Fibonacci series.
15.	Write a python program that accepts a string from user and perform following string operations- i. Calculate length of string ii. String reversal iii. Equality check of two strings iii. Check palindrome ii. Check substring
16.	To copy contents of one file to other. While copying a) all full stops are to be replaced with commas b) lower case are to be replaced with upper case c) upper case are to be replaced with lower case.
17.	To count total characters in file, total words in file, total lines in file and frequency of given word in file.
18.	Create class EMPLOYEE for storing details (Name, Designation, gender, Date of Joining and Salary). Define function members to compute a)total number of employees in an organization b) count of male and female employee c) Employee with salary more than 10,000 d) Employee with designation “Asst Manager”
19.	Create class STORE to keep track of Products (Product Code, Name and price). Display menu of all products to user. Generate bill as per order.
Mini-Projects	
20.	Calculator with basic functions. Add more functionality such as graphic user interface and complex calculations.
21.	Program that simulates rolling dice. When the program runs, it will randomly choose a number between 1 and 6 (Or other integer you prefer). Print that number. Request user to roll again. Set the min and max number that dice can show. For the average die, that means a minimum of 1 and a maximum of 6.
22.	Use raspberry pi/or similar kit and python for- <ul style="list-style-type: none"> • Room Temperature Monitoring System • Motion Detection System • Soil Moisture Sensor • Home Automation System • A robot • Smart mirror or a smart clock. • Smile Detection using Raspberry Pi Camera
23.	Guess Number: Randomly generate a number unknown to the user. The user needs to guess what that number is. If the user’s guess is wrong, the program should return some sort of indication as to how wrong (e.g. the number is too high or too low). If the user guesses correctly, a positive indication should appear. Write functions to check if the user input is an actual number, to see the difference between the inputted number and the randomly generated numbers, and to then compare the numbers.

111006 -Workshop Practice		
Teaching Scheme: PR : 2 Hrs/Week	Credits 01	Examination Scheme: PR : 25 Marks
Course Objectives:		
<ol style="list-style-type: none"> 1. To understand the construction and working of machine tools and functions of its parts. 2. To develop the skill through hands-on practices using hand tools, power tools, machine tools in manufacturing and assembly shop leading to understanding of a production processes. 3. To understand workshop layout and safety norms. 		
Course Outcomes:		
CO1: Familiar with safety norms to prevent any mishap in workshop.		
CO2: Able to handle appropriate hand tool, cutting tool and machine tools to manufacture a job.		
CO3: Able to understand the construction, working and functions of machine tools and their parts.		
CO4: Able to know simple operations (Turning and Facing) on a centre lathe.		
Note		
<ol style="list-style-type: none"> 1. The demonstration of machine tools to be conducted by <u>teaching</u> faculty. 2. Minimum eight experiments to be conducted out of 10. 		
Guidelines for Instructor's Manual		
Instructor manual shall contain:		
<ul style="list-style-type: none"> • The production drawing of a job with all linear and geometric dimensions, Raw material, size and shape, allowances provided. • List of tooling required. • Process plan to complete the job. • General safety instructions. 		
Guidelines for Student's Lab Journal		
<ol style="list-style-type: none"> i. Student has to maintain a workshop diary consisting of drawing / sketches of the jobs and a brief description of tools, equipment, and procedure used for doing the job and time schedule. ii. Student has to maintain one file for write ups based on demonstration of machine tools and safety norms 		
Guidelines for LAB/TW Assessment		
Term work assessment shall be based on the timely completion of jobs, quality of job, skill acquired, and maintain of workshop diary and brief write-ups on illustrations/sketches of demonstrated parts/mechanisms/machine tools etc.		
Guidelines for Laboratory Conduction		
<ol style="list-style-type: none"> i. 1st on importance of workshop practical and shop floor safety norms ii. 2nd to 6th Sessions are about demonstration of machine tools (Any 4) iii. 7th to 9th on making utility job (Any 2) iv. 10th& 11th session on preparation of workshop layout and safety norms. 		
Suggested List of Laboratory Experiments/Assignments		
Sr. No.	List of Experiments	
1.	Mandatory briefing on shop-floor safety	
2.	Demonstration and working of centre lathe Demonstration on various functions of lathe parts: Headstock, Tailstock, Carriage, Lead screw, All geared Mechanism, Apron mechanism etc.	
3.	Demonstration of Lathe operations: Step turning and facing, drilling operation on a Mild Steel cylindrical job on centre lathe. Understanding the concept of speed, feed and depth of cut.	

4.	Demonstration of Drilling machine Demonstration on construction of Radial drilling machine, Tool holding devices, Concept of speed, feed and depth of cut.
5.	Demonstration on Milling machine Demonstration on construction, table movements, indexing and tooling of milling machine.
6.	Demonstration of Shaper/Grinding machine (Any one) Shaper: Crank and slotted link mechanism, Work feed mechanism Grinding: Surface grinder/Cylindrical grinding machine, Mounting of grinding wheel
7.	Term work includes one job of Carpentry Introduction to wood working, kinds of woods, hand tools & machines, Types of joints, wood turning. Pattern making, types of patterns and its allowances.
8.	Term work to include one job involving fitting to size, male-female fitting with drilling and tapping operation on Mild Steel plate; Introduction to marking, cutting and sawing, sizing of metal, shearing, Concept of fits and interchangeability, selection of datum and measurements.
9.	Term work to include one utility job preferably using sheet metal (e.g. Tray, Funnel etc.) with riveting/welding/brazing/soldering (at least one temporary and one Permanent joint either using resistance welding/Arc welding); Introduction to sheet metal operations: punching, blanking, bending, drawing.
10.	Prepare a Layout of Workshop To prepare a work shop layout.
11.	Collection of information about safety norms in any one of the following type of industry: Metalworking/Chemical/Cement/Pharmaceuticals/Defense/Atomic energy/Aerospace /Marine/Construction/Railway etc.

Reference/Text Books

1. John, K. C., (2010), "Mechanical Workshop Practice, Prentice Hall Publication, New Delhi
2. Hazra and Chaudhary, Workshop Technology-I & II, Media promoters & Publisher Pvt. Ltd.

**101007: Environmental Studies-I
(Mandatory Non-Credit Course)**

TH:02 Hrs./week

Course Objectives:

1. To explain the concepts and strategies related to sustainable development and various components of environment.
2. To examine biotic and abiotic factors within an ecosystem, to identify food chains, webs, as well as energy flow and relationships.
3. To identify and analyze various conservation methods and their effectiveness in relation to renewable and nonrenewable natural resources.
4. To gain an understanding of the value of biodiversity and current efforts to conserve biodiversity on national and local scale.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Demonstrate an integrative approach to environmental issues with a focus on sustainability.

CO2: Explain and identify the role of the organism in energy transfers in different ecosystems.

CO3: Distinguish between and provide examples of renewable and nonrenewable resources & analyze personal consumption of resources.

CO4: Identify key threats to biodiversity and develop appropriate policy options for conserving biodiversity in different settings.

Course Contents

Unit I	Introduction to environmental studies	(02 Hrs)
Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.		
Unit II	Ecosystems	(06 Hrs)
What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)		
Unit III	Natural Resources: Renewable and Non-renewable Resources	(08 Hrs)
Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.		
Unit IV	Biodiversity and Conservation	(08 Hrs)
Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity; In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.		
Suggested Readings:		
<ol style="list-style-type: none"> 1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt. 2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press. 3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge. 4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology. Sunderland: Sinauer Associates, 2006. 6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India’s Himalaya dams. Science, 339:36-37. 7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books. 8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century. 		
107008 – Engineering Mathematics – II		
Teaching Scheme: TH : 4 Hrs./Week TUT : 1 Hr./Week	Credits 05	Examination Scheme: In-Semester : 30 Marks End-Semester : 70 Marks TW : 25 Marks
Prerequisites: Integration, Differential Equation, Three-dimensional coordinate systems		

Course Objectives:		
To make the students familiarize with Mathematical Modeling of physical systems using differential equations advanced techniques of integration, tracing of curve, multiple integrals and their applications. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.		
Course Outcomes (COs): The students will be able to learn		
CO1: the effective mathematical tools for solutions of first order differential equations that model physical processes such as Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.		
CO2: advanced integration techniques such as Reduction formulae, Beta functions, Gamma functions, Differentiation under integral sign and Error functions needed in evaluating multiple integrals and their applications.		
CO3: to trace the curve for a given equation and measure arc length of various curves.		
CO4: the concepts of solid geometry using equations of sphere, cone and cylinder in a comprehensive manner.		
CO5: evaluation of multiple integrals and its application to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.		
Course Contents		
Unit I:	First Order Ordinary differential Equations	(09 Hrs.)
Exact differential equations, Equations reducible to exact form. Linear differential equations, Equations reducible to linear form, Bernoulli's equation.		
Unit II:	Applications of Differential Equations	(09 Hrs.)
Applications of Differential Equations to Orthogonal Trajectories, Newton's Law of Cooling, Kirchoff's Law of Electrical Circuits, Rectilinear Motion, Simple Harmonic Motion, One dimensional Conduction of Heat.		
Unit III:	Integral Calculus	(09 Hrs.)
Reduction Formulae, Beta and Gamma functions, Differentiation Under Integral Sign and Error functions.		
Unit IV:	Curve Tracing	(09 Hrs.)
Tracing of Curves – Cartesian, Polar and Parametric curves, Rectification of curves.		
Unit V:	Solid Geometry	(09 Hrs.)
Cartesian, Spherical polar and Cylindrical coordinate systems, Sphere, Cone and Cylinder.		
Unit VI:	Multiple Integrals and their Applications	(09 Hrs.)
Double and Triple integrations, Change of order of integration, Applications to find Area, Volume, Mass, Centre of Gravity and Moment of Inertia.		
Text Books:		
1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill)		
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi)		
Reference Books:		
1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.)		
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education)		
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning)		
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson)		
5. Applied Mathematics (Vol. I and II) by P.N. Wartikar and J.N. Wartikar Vidyarthi Griha Prakashan, Pune.		
6. Differential Equations by S. L. Ross (John Wiley and Sons)		
Tutorial and Term Work:		
i) Tutorial for the subject shall be engaged in minimum three batches (batch size of 22 students) per division.		
ii) Term work shall consist of six assignments on each unit-I to unit-VI and is based on		

performance and continuous internal assessment.		
107009: Engineering Chemistry		
Teaching Scheme: TH : 04 Hrs/week PR : 02 Hrs/Week	Credits 05	Examination Scheme: In Semester : 30 Marks End Semester: 70 Marks PR : 25 Marks
Prerequisite Courses, if any: Types of titrations, volumetric analysis, structure property relationship, types of crystals, periodic table, classification and properties of polymers, electromagnetic radiation, electrochemical series		
Companion Course, if any: Laboratory Practical		
Course Objectives: 1. To understand technology involved in analysis and improving quality of water as commodity. 2. To acquire the knowledge of electro-analytical techniques that facilitates rapid and precise understanding of materials. 3. To understand structure, properties and applications of speciality polymers and nano material. 4. To study conventional and alternative fuels with respect to their properties and applications. 5. To study spectroscopic techniques for chemical analysis. 6. To understand corrosion mechanisms and preventive methods for corrosion control.		
Course Outcomes: On completion of the course, learner will be able to– CO1: Apply the different methodologies for analysis of water and techniques involved in softening of water as commodity. CO2: Select appropriate electro-technique and method of material analysis. CO3: Demonstrate the knowledge of advanced engineering materials for various engineering applications. CO4: Analyze fuel and suggest use of alternative fuels. CO5: Identify chemical compounds based on their structure. CO6: Explain causes of corrosion and methods for minimizing corrosion.		
Course Contents		
Unit I	Water Technology	(08Hrs)
Impurities in water, hardness of water: Types, Units and Numericals. Determination of hardness (by EDTA method using molarity concept) and alkalinity, numericals. Ill effects of hard water in boiler - priming and foaming, boiler corrosion, caustic embrittlement, scale and sludge. Water treatment: i) Zeolite method and numericals ii) Demineralization method. Purification of water: Reverse osmosis and Electrodialysis.		
Unit II	Instrumental Methods of Analysis	(08Hrs)
Introduction: Types of reference electrode (calomel electrode), indicator electrode (glass electrode), ion selective electrode: ion selective membranes such as solid membrane, enzyme based membrane and gas sensing membrane. [A] Conductometry: Introduction, conductivity cell, conductometric titrations of acid versus base with titration curve. [B] pHmetry: Introduction, standardization of pH meter, pH metric titration of strong acid versus strong base with titration curve.		

Unit III	Engineering Materials	(08Hrs)
<p>A] Speciality polymers: Introduction, preparation, properties and applications of the following polymers:</p> <ol style="list-style-type: none"> 1. Engineering Thermoplastic: Polycarbonate, 2. Bio-degradable polymers: Poly (hydroxybutyrate-hydroxyvalanate), 3. Conducting Polymer: Polyacetylene, 4. Electroluminescent polymer: Polyphenylenevinylene, 5. Polymer composites: Fiber reinforced plastic (FRP)- Glass reinforced and Carbon reinforced polymer composite <p>[B] Nanomaterials: Introduction, classification of nanomaterials based on dimensions (zero dimensional, one-dimensional, two-dimensional and three-dimensional), structure, properties and applications of graphene and carbon nanotubes, quantum dots (semiconductor nanoparticles).</p>		
Unit IV	Fuels	(08Hrs)
<p>Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel),</p> <p>Calorific value (CV): Higher calorific value (HCV) and Lower calorific value (LCV), Determination of Calorific value: Principle, construction and working of Bomb calorimeter and Boy's gas calorimeter and numericals,</p> <p>Solid fuel: Coal: Analysis of Coal-Proximate and Ultimate analysis, numericals,</p> <p>Liquid fuel: Petroleum: Refining of petroleum /crude oil and composition, boiling range and uses of various fractions,</p> <p>Gaseous fuel: Composition, properties and applications of CNG. Hydrogen gas as a future fuel</p> <p>Alternative fuels: Power alcohol and biodiesel.</p>		
Unit V	Spectroscopic Techniques	(08Hrs)
<p>[A]UV-Visible Spectroscopy:</p> <p>Introduction, interaction of electromagnetic radiation with matter, statement of Beer's law and Lambert's law, absorption of UV radiation by organic molecule leading to different electronic transitions, terms involved in UV-visible Spectroscopy- chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic shift and hypochromic shift, Instrumentation and basic principle of single beam spectrophotometer, applications of UV-visible spectroscopy.</p> <p>[B] Infra red Spectroscopy:</p> <p>Introduction, Principle of IR Spectroscopy, types of vibrations: Stretching (symmetric and asymmetric) and bending (scissoring, rocking, wagging and twisting), conditions of absorption of IR radiations, vibration of diatomic and polyatomic molecules. Instrumentation with block diagram. Parts of IR spectrum, fundamental group region, fingerprint region, applications of IR spectroscopy.</p>		
Unit VI	Corrosion Science	(08Hrs)
<p>Introduction, Types of corrosion – Dry and Wet corrosion, mechanism of dry corrosion, nature of oxide films and Pilling-Bedworth's rule, wet corrosion – mechanism: hydrogen evolution and oxygen absorption, galvanic cell corrosion, concentration cell corrosion, Factors influencing rate of corrosion. Methods of corrosion control and prevention: cathodic and anodic protection, metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, cladding, electroplating, cementation.</p>		
Books & Other Resources:		
Text Books:		
<ol style="list-style-type: none"> 1. Engineering Chemistry by O .G. Palanna, Tata Magraw Hill Education Pvt. Ltd. 2. Textbook of Engineering Chemistry by Dr. S. S. Dara, Dr. S. S. Umare, S. Chand & Company Ltd. 3. Textbook of Engineering Chemistry by Dr. Sunita Rattan, S. K. Kataria& Sons Publisher 		

Reference Books:

1. Engineering Chemistry, Wiley India Pvt. Ltd.
2. Inorganic Chemistry, 5 ed by Shriver and Atkins, Oxford University Press
3. Basic Concept of Analytical Chemistry, 2ed , S. M. Khopkar, New Age-International Publisher
4. Instrumental Methods of Chemical Analysis, G. R. Chatwal& S. K. Anand, Himalaya Publishing House
5. Spectroscopy of organic compounds, 2 ed, P. S. Kalsi, New Age-International Ltd., Publisher
6. Polymer Science, V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, Wiley Eastern Limited

1. To determine hardness of water by EDTA method
2. To determine alkalinity of water
3. To determine strength of strong acid using pH meter
4. To determine maximum wavelength of absorption of $\text{CuSO}_4/\text{FeSO}_4/\text{KMnO}_4$, verify Beer's law and find unknown concentration of given sample.
5. Titration of a mixture of weak acid and strong acid with strong base using conductometer
6. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin
7. To determine molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
8. Proximate analysis of coal.
9. To coat copper and zinc on iron plate using electroplating.
10. Preparation of biodiesel from oil.
11. Colloidal synthesis of 2-6 or 3-5 semiconductor quantum dots nanoparticles

104010:Basic Electronics Engineering**Teaching Scheme:**

TH : 03 Hrs./week
PR : 02 Hrs./week

Credits

04

Examination Scheme

In - Semester : 30 Marks
End - Semester : 70 Marks
PR : 25 Marks

Course Objectives:

1. The principle of electronics and working principle of PN junction diode and special purpose diodes.
2. The functioning of transistors like BJT, MOSFETs and OPAMP.
3. Basics of various logic gates, digital circuits and their applications.
4. Working and functions of various electronic instruments.
5. The operating principles and applications of various active and passive sensors.
6. Basic principles of communication systems.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Explain the working of P-N junction diode and its circuits.

CO2: Identify types of diodes and plot their characteristics and also can compare BJT with MOSFET.

CO3: Build and test analog circuits using OPAMP and digital circuits using universal/basic gates and flip flops.

CO4: Use different electronics measuring instruments to measure various electrical parameters.

CO5: Select sensors for specific applications.

CO6: Describe basic principles of communication systems.

Course Contents

Unit I	Introduction to Electronics	(08Hrs)
Evolution of Electronics, Impact of Electronics in industry and in society. Introduction to active and passive components, P-type Semiconductor, N-type Semiconductor. Current in semiconductors(Diffusion and Drift Current) P-N Junction Diode: P-N Junction diode construction and its working in forward and reverse bias condition, V-I characteristics of P-N junction Diode, Diode as a switch, Half Wave Rectifier, Full wave and Bridge Rectifier. Special purpose diodes: Zener diode, Light Emitting Diode (LED) and photo diode along with V-I characteristics and their applications.		
Unit II	Transistor and OPAMP	(07Hrs)
Bipolar Junction Transistor : Construction, type, Operation, V-I Characteristics, region of operation, BJT as switch and CE amplifier Metal Oxide Semiconductor Field Effect Transistors (MOSFET): Construction, Types, Operation, V-I characteristics, Regions of operation, MOSFET as switch & amplifier. Operational amplifier: Functional block diagram of operational amplifier, ideal operational amplifier, Op-amp as Inverting and Non inverting amplifier		
Unit III	Number System and Logic Gates	(07Hrs)
Number System:- Binary, BCD, Octal, Decimal, Hexadecimal their conversion and arithmetic, De-Morgan's theorem. Basic Gates:- AND, OR, NOT, Universal Gate- XOR, XNOR, Half adder, Full adder Flip Flop's SR, JK, T and D Introduction to Microprocessor and Microcontroller (Only block diagram and explanation)		
Unit IV	Electronic Instrumentation	(06Hrs)
Electronic Instruments: Principles and block diagram of digital multimeter, Function Generator, Digital Storage Oscilloscope (DSO) Power scope, AC/DC power supply, Auto transformer, Analog ammeter and voltmeter.		
Unit V	Sensors	(07Hrs)
Classification of a sensors, Active /Passive Sensors, Analog/Digital Sensors, Motion Sensors (LVDT, Accelerometer), Temperature Sensors (Thermocouple, Thermistor, RTD), Semiconductor Sensors(Gas Sensors), Optical Sensors (LDR), Mechanical Sensors (Strain Guage, Load Cell, Pressure sensors), Biosensors. (Working Principle and one application).		
Unit VI	Communication Systems	(07Hrs)
Basic Communication System: Block Diagram, Modes of Transmission, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Allotment of frequency band for different applications, Block Diagram of AM and FM Transmitter and receiver, Mobile Communication System: Cellular concept, Simple block diagram of GSM system.		
Books & Other Resources:		
Text Books:		
1. "Electronics Devices" by Thomas. L. Floyd, 9 th Edition, Pearson (Unit I, II)		
2. "Modern Digital Electronics" by R.P. Jain, 4 th Edition, Tata McGraw Hill (Unit III)		
3. "Electronic Instrumentation" by H.S. Kalsi, 3 rd Edition, Tata McGraw Hill (Unit IV)		
4. "Sensors and Transducers" by D. Patrnabis, 2 nd Edition, PHI (Unit V)		
5. "Electronic Communication Systems" by Kennedy & Davis, 4 th Edition, Tata McGraw Hill (Unit VI)		
6. "Mobile Wireless communication" by M. Schwartz, Cambridge University Press (Unit VI)		
Reference Books:		
1. "Digital Fundamentals" by Thomas. L. Floyd, 11 th Edition, Pearson		

2.	“Mobile Communication” by J. Schiller, 2 nd Edition, Pearson
3.	“Sensors Handbook”, by S. Soloman, 2 nd Edition.
List of Laboratory Experiments/Assignments	
1.	Electronic Components: Study of Active and Passive components a) Resistors (Fixed & Variable), Calculation of resistor value using color code. b) Capacitors (Fixed & Variable) c) Inductors, Calculation of inductor value using color code. d) Devices such Diode, BJT, MOSFETs, various IC packages e) Switches & Relays
2.	Measurements using various measuring equipments: a) Set up CRO and function generator for measurement of voltage, frequency b) Obtain the phase shift between to signals using CRO with the help of Lissagous pattern. c) Measure voltage, resistance using digital multimeter. Also use multimeter to check diode, BJT
3.	V-I characteristics of: a) P-N Junction Diode (Study the datasheet of typical PN junction diode 1N 400X) b) Zener Diode (Study the datasheet of typical Zener diode 1N 4148)
4.	Rectifier circuits: a) Implement half wave, full wave and bridge rectifier using diodes b) Observe the effect of capacitor filter on rectifier output
5.	Frequency response of MOSFET: a) To plot frequency response of BJT amplifier.(Simulation) b) To plot frequency response of MOSFET amplifier.(Simulation)
6.	Linear applications of Op-amp: Build inverting and non-inverting amplifier using op-amp (Study the datasheet of typical Op-Amp 741)
7.	Test and verify the truth tables of: a) Basic and Universal Gates (Study the data sheet of respective IC’s) b) Half / Full Adder c) RS/JK/T/D flip flop
8.	Study of transducers : (Any 3)
9.	Build and test any circuit using BJT/MOSFET/Op-Amp/Logic Gates using any one sensor.
10.	Case Study of any one electronics appliances with block diagram, specification etc.
<u>Guidelines for Instructor's Manual</u>	
<ul style="list-style-type: none"> • The instructor’s manual is to be developed as a hands-on resource and reference. • Copy of Curriculum, Conduction & Assessment guidelines, List of Experiments to be attached. 	
<u>Guidelines for Student's Lab Journal</u>	
<ul style="list-style-type: none"> • The laboratory assignments/experiments are to be submitted by student in the form of journal. • Journal consists of Certificate, table of contents, and handwritten write-up for each experiment. • Each experiment should consist of : <ul style="list-style-type: none"> ✓ Title. ✓ Objectives. ✓ Problem Statement, Outcomes ✓ Hardware / Software (If any) requirements. ✓ Concept. ✓ Experimental procedure / Setup. 	

<ul style="list-style-type: none"> ✓ Observation table ✓ Conclusion. 		
<u>Guidelines for Laboratory Conduction</u>		
<ul style="list-style-type: none"> • All the experiments mentioned in the syllabus are compulsory. • Use of open source software and recent version is to be encouraged. 		
<u>Guidelines for Lab /TW Assessment</u>		
<ul style="list-style-type: none"> • Continuous assessment of laboratory work is done based on overall performance. • Each lab assignment/ experiment assessment will assign grade / marks based on parameters with appropriate weightage. • Suggested parameters for overall assessment as well as each lab assignment / experiment assessment include: <ul style="list-style-type: none"> ✓ Timely completion. ✓ Performance. ✓ Punctuality and neatness. • The parameters for assessment is to be known to the students at the beginning of the course. 		
101011: Engineering Mechanics		
Teaching Scheme: TH : 3 Hrs./week PR : 2 Hrs./Week	Credits 04	Examination Scheme: In-Semester : 30 Marks End-Semester : 70 Marks PR : 25 Marks
Prerequisite Courses, if any: 12th Physics, Maths		
Course Objectives:		
<ol style="list-style-type: none"> 1. To impart knowledge about force systems and methods to determine resultant centroid and moment of inertia 2. To teach methods to calculate force of friction 3. To impart knowledge to determine reaction of beams, calculate member forces in trusses, cables and frames using principles of equilibrium 4. To teach space force systems 5. To train students to solve problems related to particle mechanics using principles of kinematics, kinetics and work power energy 		
Course Outcomes:		
On completion of the course, learner will be able to–		
CO1: Determine resultant of various force systems		
CO2: Determine centroid, moment of inertia and solve problems related to friction		
CO3: Determine reactions of beams, calculate forces in cables using principles of equilibrium		
CO4: Solve trusses, frames for finding member forces and apply principles of equilibrium to forces in space		
CO5: Calculate position, velocity and acceleration of particle using principles of kinematics		
CO6: Calculate position, velocity and acceleration of particle using principles of kinetics and Work, Power, Energy		
Course Contents		
Unit I	Resolution and Composition of Forces	(07Hrs)
Principle of statics, Force system, Resolution and composition of forces, Resultant of concurrent forces. Moment of a force, Varignon's theorem, resultant of parallel force system, Couple, Equivalent force couple system, Resultant of parallel general force system		
Unit II	Distributed Forces and Friction	(06Hrs)
Moment of area, Centroid of plane lamina and wire bends, Moment of Inertia. Friction- Laws of friction, application of friction on inclined planes Wedges and ladders friction Application to flat belt		

Unit III	Equilibrium	(06Hrs)
Free body diagram Equilibrium of concurrent, parallel forces in a plane Equilibrium of general forces in a plane Equilibrium of three forces in a plane, Types of beams, simple and compound beams, Type of supports and reaction, Forces in space, Resultant of concurrent and parallel forces in a space, Equilibrium of concurrent and parallel forces in a space.		
Unit IV	Analysis of Structures	(06 Hrs)
Two force member, Analysis of plane trusses by Method of joints Analysis of plane trusses by method of section, Analysis of plane frames, Cables subjected to point load multi force member.		
Unit V	Kinematics of Particle	(06 Hrs)
Kinematics of linear motion- Basic concepts Equation of motion for constant acceleration Motion under gravity, Variable acceleration motion curves. Kinematics of curvilinear motion- Basic Concepts Equation of motion in Cartesian coordinates Equation of motion in path coordinates Equation of motion in polar coordinates Motion of projectile.		
Unit VI	Kinetics of Particle	(06Hrs)
Kinetics- Newton's Second Law of motion Application of Newton's Second Law. Work, power, energy, conservative and non-conservative forces Conservation of energy for motion of particle, Impulse, Momentum, Direct central impact. Coefficient of restitution, Impulse Momentum principle of particle.		
Books & Other Resources:		
Text Books:		
1. Vector Mechanics for Engineers, by F. P. Beer and E. R. Johnson, McGraw-Hill Publication 2. Engineering Mechanics by R. C. Hibbeler, Pearson Education		
Reference Books:		
1. Engineering Mechanics by S. P. Timoshenko and D. H. Young, McGraw- Hill publication 2. Engineering Mechanics by J. L. Meriam and Craige, John Willey 3. Engineering Mechanics by F L Singer, Harper and Rowe publication 4. Engineering Mechanics by A. P. Boresi and R. J. Schmidt, Brooks/Cole Publication		
Laboratory Course		
Guidelines for Instructor's Manual		
An instruction manual with aim, objective, apparatus, procedure and calculations to be performed for each experiment to be provided for students called as Lab Manual. Every year problems for assignment should be changed. It is advisable to give different data to different batches		
Guidelines for Student's Lab Journal		
Journal should be hand written		
Guidelines for Lab /TW Assessment		
Each and every experiment should be assessed and given mark out of 10. Finally the marks can be converted as per given in the structure.		
Guidelines for Laboratory Conduction		
Divide the students of a batch in groups of not more than 4 students and ask each group to take readings separately followed by calculations for each experiment. After every experiment faculty should sign the lab manual of readings of every student in the batch		
Suggested List of Laboratory Experiments/Assignments		

Sr. No.	Group A	
	1. Verification of law of parallelogram of forces/polygon of forces. 2. To determine support reaction of simple/compound beams. 3. Determination of coefficient friction of belt/inclined plane. 4. To determine forces in the members of space force system. 5. To study the curvilinear motion. 6. Determination of coefficient of restitution.	
	Group B	
	Assignment of five problems on every unit to be solved during practical	
	Group C	
	Any two assignments of the following by graphical method using any drawing software. a) To determine the resultant of general force system. b) To determine unknown forces of concurrent force system c) To determine the forces in the member of the plane truss d) To determine velocity and acceleration of particle from given s-t diagram.	
102012: Engineering Graphics		
Teaching Scheme:	Credits	Examination Scheme:
TH : 01 Hr/week	02	End-Semester : 50 Marks
PR : 02 Hrs/Week		TW : 25 Marks
TUT : 01 Hr/Week		
Course Objectives		
1. To acquire basic knowledge about engineering drawing language, line types, dimension methods, and simple geometrical construction. 2. To draw conic sections by various methods, involutes, cycloid and spiral. 3. To acquire basic knowledge about physical realization of engineering objects and shall be able to draw its different views. 4. To visualize three dimensional engineering objects and shall be able to draw their isometric views. 5. To imagine visualization of lateral development of solids. 6. To acquire basic knowledge about the various CAD drafting software's and its basic commands required to construct the simple engineering objects.		

Course Outcomes		
On completion of the course, learner will be able to		
CO1: Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.		
CO2: Construct the various engineering curves using the drawing instruments.		
CO3: Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.		
CO4: Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.		
CO5: Draw the development of lateral surfaces for cut section of geometrical solids.		
CO6: Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools.		
Course Contents		
Unit I	Fundamentals of Engineering Drawing	(01 Hrs)
Need of Engineering Drawing and design, Sheet layout, Line types and dimensioning and simple geometrical constructions		
Unit II	Introduction to 2D and 3D computer aided drafting packages	(02 Hrs)
Evolution of CAD, Importance of CAD, Basic Commands - Edit, View, Insert, Modify, Dimensioning Commands, setting and tools etc. and its applications to construct the 2D and 3D drawings		
Unit III	Engineering Curves	(01 Hr)
Introduction to conic sections and its significance, various methods to construct the conic sections. Helix for cone and cylinder , rolling curves (Involute , Cycloid) and Spiral		
Unit IV	Orthographic Projection	(02 Hrs)
Principle of projections, Introduction to First and Third angle Projection methods, Orthographic projection of point, line, plane, solid and machine elements/parts		
Unit V	Isometric Projection	(03 Hrs)
Introduction to isometric projection, oblique projection and perspective projection. Draw the isometric projection from the given orthographic views		
Unit VI	Development of Lateral Surfaces	(03 Hrs)
Introduction to development of lateral surfaces and its industrial applications. Draw the development of lateral surfaces for cut section of cone, pyramid, prism etc.		
Books & Other Resources		
Text Books		
<ol style="list-style-type: none"> 1. Bhatt, N. D. and Panchal, V. M., (2016), "Engineering Drawing", Charotar Publication, Anand, India 2. K. Venugopal, K, (2015), "Engineering and Graphics", New Age International, New Delhi 3. Jolhe, D. A., (2015), "Engineering Drawing with introduction to AutoCAD", Tata McGraw Hill, New Delhi 4. Rathnam, K., (2018), " A First Course in Engineering Drawing", Springer Nature Singapore Pte. Ltd., Singapore 		
Reference Books		
<ol style="list-style-type: none"> 1. Madsen, D. P. and Madsen, D. A., (2016), "Engineering Drawing and design", Delmar Publishers Inc., USA 2. Bhatt, N. D., (2018), "Machine Drawing", Chartor Publishing house, Anand, India 3. Dhawan, R. K., (2000), "A Textbook Of Engineering Drawing", S. Chand, New Delhi 4. Luzadder, W. J. and Duff, J. M., (1992), "The Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production", Peachpit Press, USA 5. Giesecke, F. E., Mitchell, A., Spencer, H. C., Hill, I. L., Loving, R. O., Dygon, J. T., (1990), "Principles of engineering graphics", McMillan Publishing, USA 		

6. Jensen, C., Helsel, J. D., Short, D. R., (2008), "Engineering Drawing and Design", McGraw-Hill International, Singapore

Guidelines for Laboratory Conduction

Tutorial Session

Can be utilized to teach the basic commands of any drafting package, by using this knowledge students shall be able to complete the five assignments on the CAD software. (Minimum 2 problems in each assignment)

Assignment 1: Construct any Engineering Curve using any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment 4 :Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session).

Assignment 5: Draw the development of lateral surface of a solid/ truncated solid.

Practical Session

Draw minimum two problems on each assignment on the A3 size drawing sheet.

Suggested List of Laboratory Experiments/Assignments

Assignment 1: Construct any Engineering Curve by any method

Assignment 2: Orthographic view of any machine element along with sectional view.

Assignment 3: Draw Isometric view for given orthographic views.

Assignment 4: Draw the development of lateral surface of a solid/ truncated solid

Assignment 5: Draw the isometric or Orthographic view of a product/object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session.)

110013: Project Based Learning

Teaching Scheme:

PR: 04 Hrs/Week

Credits

02

Examination Scheme:

PR : 50 Marks

Preamble:

For better learning experience, along with traditional classroom teaching and laboratory learning; project based learning has been introduced with an objective to motivate students to learn by working in group cooperatively to solve a problem.

Project-based learning (PBL) is a student-centric pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Problem based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development.

Course Objectives:

1. To emphasizes learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent learning by problem solving with social context.
3. To engages students in rich and authentic learning experiences.
4. To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes:

CO1: Project based learning will increase their capacity and learning through shared cognition.

CO2: Students able to draw on lessons from several disciplines and apply them in practical way.

CO3: Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Group Structure:

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

- There should be team/group of 5 -6 students
- A supervisor/mentor teacher assigned to individual groups

Selection of Project/Problem:

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or “wondering”. This formulated problem then stands as the starting point for learning. Students design and analyze the problem within an articulated interdisciplinary or subject frame.

A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students’ wondering within different disciplines and professional environments. A chosen problem has to be **exemplary**. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

- A few hands-on activities that may or may not be multidisciplinary
- Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize and present their learning.
- Activities may include- Solving real life problem, investigation /study and Writing reports of in depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.

Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment AND evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

- Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
- Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that the all activities are to be record and regularly, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor (you may call it PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment, evaluation and weightage:

- Idea Inception (5%)
- Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (50%) (Individual assessment and team assessment)
- Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents) (25%)
- Demonstration (Presentation, User Interface, Usability etc) (10%)
- Contest Participation/ publication (5%)
- Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (5%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

References:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com
- www.wikipedia.org
- www.howstuffworks.com

101014: Environmental Studies-II**TH: 02 Hr/week****Mandatory Non-Credit Course****Course Objectives:**

1. To provide a comprehensive overview of environmental pollution and the science and technology associated with the monitoring and control.
2. To understand the evolution of environmental policies and laws.
3. To explain the concepts behind the interrelations between environment and the development.
4. To examine a range of environmental issues in the field, and relate these to scientific theory.

Course Outcomes: On completion of the course, learner will be able to–

CO1: Have an understanding of environmental pollution and the science behind those problems and potential solutions.

CO2: Have knowledge of various acts and laws and will be able to identify the industries that are violating these rules.

CO3: Assess the impact of ever increasing human population on the biosphere: social, economic issues and role of humans in conservation of natural resources.

CO4: Learn skills required to research and analyze environmental issues scientifically and learn how to use those skills in applied situations such as careers that may involve environmental problems and/or issues.

Course Contents**Unit V****Environmental Pollution****(08 Hrs)**

Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution

Nuclear hazards and human health risks

Solid waste management: Control measures of urban and industrial waste

Pollution case studies.

Unit VI Environmental Pollution (07 Hrs)

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities & agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto Protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context

Unit VII Human Communities and the Environment (06 Hrs)

Human population and growth; Impacts on environment, human health and welfare. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit VIII Field work (05 Hrs)

- Visit to an area to document environmental assets; river/forest/flora/fauna, etc.
- Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river Delhi Ridge, etc

Suggested Readings:

1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology, Sunderland: Sinauer Associates, 2006
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Savitribai Phule Pune University



Syllabus

FOR

S.E. Mechanical and Automobile Engineering

2015 Course

UNDER FACULTY OF ENGINEERING

EFFECTIVE FROM June 2016

**Structure of S.E. (Mechanical Engineering/ Automobile Engineering)
2015 Course**

Semester-I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits	
		Hours/Week			In-Sem (online)	End-Sem	TW	PR.	Oral		Lect/Tut	PR/OR
		L	Tut.	PR								
207002	Engineering Mathematics – III	04	01	-	50	50	25	-	-	125	05	-
202041	Manufacturing Process-I	03	-	02	50	50	50	-	-	150	03	01
202042	Computer Aided Machine Drawing	01	-	02	--	--		50	-	50	01	01
202043	Thermodynamics	04	-	02	50	50	-	-	50	150	04	01
202044	Material Science	03	01	-	50	50	25	-	-	125	03	01
202051	Strength of Materials	04	-	02	50	50	-	-	50	150	04	01
202055	Audit course											
					--	--						
	Total	19	02	08	250	250	100	50	100	750	20	05
	Total of Part-I	29 Hrs					750				25	

Note: Material Science and Engineering Mathematics-III practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

Semester-II

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits	
		Hours/Week			In-Sem (online)	End-Sem	TW	PR.	Oral		Lect/Tut	PR/OR
		L	Tut.	PR								
202045	Fluid Mechanics	04	-	02	50	50	-	50	-	150	04	01
202047	Soft Skills	-	-	02	--	--	25	-	-	25	-	01
202048	Theory of Machines – I	04	01	-	50	50	25	-	25	150	04	01
202049	Engineering Metallurgy	03	01	-	50	50	-	-	25	125	03	01
202050	Applied Thermodynamics	04	-	02	50	50	-	50	-	150	04	01
203152	Electrical and Electronics Engineering	03	-	02	50	50	25	-	-	125	03	01
202053	Machine Shop – I	-	-	02	--	--	25	-	-	25	-	01
	Total	18	02	10	250	250	100	100	50	750	18	07
	Total of Part-II	30 Hrs					750				25	

Note: Theory of Machine-I and Engineering Metallurgy practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

Audit Course1

In addition to credits courses, it is recommended that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses, starting in second year first semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose one audit course from the list. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

(Ref-http://www.unipune.ac.in/Syllabi_PDF/revise-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

List of courses under Audit Course1

Course Code	Audit Course Title
202054 A	Road Safety
202054 B	Innovations in engineering field / Agriculture
202054 C	Value Education

The detail course contents of above mentioned audit courses are available in Mechanical Engineering 2015 course syllabus. Moreover students can opt for any other audit course from the list of Audit Course1 of any branch of engineering.

SEMESTER-I

207002: Engineering Mathematics III (Mechanical + SW / Production + SW / Industrial /Automobile Engineering)

Teaching Scheme:**Lectures:** 4 Hrs./Week**Tutorials:** 1 Hr./Week**Credit Scheme:****Theory:** 04**Tutorial:** 01**Examination Scheme:****Ins-Sem:** 50 Marks**End-Sem:** 50 Marks**Term work:** 25 Marks

Prerequisites: - Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of central tendency and dispersion, Vector algebra

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Ordinary and partial differential equations applied to Mechanical engineering problems such as mechanical vibrations and heat transfer.
2. Integral Transform techniques such as Laplace transform, Fourier transform and applications to ordinary and partial differential equations in Vibration theory, Fluid dynamics, Heat transfer and Thermodynamics.
3. Statistical methods such as correlation, regression analysis and probability theory in analyzing and interpreting experimental data applicable to Reliability engineering
4. Vector differentiation and integration applied to problems in Fluid Mechanics.

Course Outcomes:

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

- 1) Solve higher order linear differential equations and apply to modeling and analyzing mass spring systems.
- 2) Apply Laplace transform and Fourier transform techniques to solve differential equations involved in Vibration theory, Heat transfer and related engineering applications.
- 3) Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.
- 4) Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.
- 5) Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Unit I: Linear Differential Equations (LDE) and Applications (09 Hours)

LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of mass-spring systems, free and forced damped and undamped systems.

Unit II: Transforms (09 Hours)

Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.

Unit III: Statistics and Probability (09 Hours)

Measure of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Probability, Probability distributions: Binomial, Poisson and Normal distributions, Population and sample, Sampling distributions, t-distribution, Chi-square distribution.

Unit IV: Vector Differential Calculus (09 Hours)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09 Hours)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) (09 Hours)

Basic concepts, modeling of Vibrating String, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier Transforms, Two-dimensional wave equation.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work:

- i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
- ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

202041: Manufacturing Process- I

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hrs/week	Th: 03	In-Sem: 50
	Tut:--	End-Sem: 50
PR: 02 Hrs/week	PR/OR/TW: 01	PR: --
		OR: --
		TW: 50

Course Objectives:

- To make acquaintance of foundry processes pattern making and casting
- To study metal forming processes such forging, rolling, extrusion and wire drawing.
- To make study of different plastic molding processes
- To study metal joining processes
- To design and development of product with Sheet metal working process
- Introduction to center lathe

Course Outcomes:

On completion of the course, learner will be able to–

- Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
- Understand and analyze Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
- Understand different plastic molding processes, Extrusion of Plastic and Thermoforming
- Understand different Welding and joining processes and its defects
- Understand, Design and Analyze different sheet metal working processes
- Understand the constructional details and Working of Centre Lathe

Course Contents

Unit I Casting Processes:

(9 Hrs)

SAND CASTING – Pattern- types, material and allowances, Molding sand- types, properties and testing, Molding – types, equipment's, tools and machines, Core – types and manufacturing, Gating system and Riser – types and design (Numerical), Heating and pouring, cooling and solidification- process and time estimation (Numerical), Cleaning and Finishing, Defects and remedies, Inspection techniques. Die casting, Investment casting, Centrifugal Casting, Continuous Casting- Types, equipment, process parameters, material to cast.

Unit II Metal Forming Processes:**(8 Hrs)**

Hot and Cold Working – Concepts and comparative study, Material behavior in metal forming, strain rate sensitivity, friction and lubrication in metal forming Rolling – Types of rolling mills, flat rolling analysis, power required per roll for simple single pass two rollers. (Simple Numerical) Forging – Types, process parameter, Analysis of open die forging (Numerical) Extrusion – Types, process parameter, Extrusion dies, Shape factor (Numerical), Drawing – Wire drawing and its analysis (Numerical), tube drawing

Unit III Plastic Processing:**(6Hrs)**

Molding – Compression molding, Transfer molding, Blow molding, Injection molding – Process and equipment. Extrusion of Plastic – Type of extruder, extrusion of film, pipe, cable and sheet Thermoforming – Principle, pressure forming and vacuum forming

Unit IV Joining Processes:**(6Hrs)**

Surface preparation and types of joints. Welding Classification Arc welding – Theory, SMAW, GTAW, FCAW, Submerged arc welding, Stud welding. Resistance welding – Theory, Spot, seam and projection weld process. Gas welding. Soldering, brazing and braze welding. Joint through Adhesive – classification of adhesive, types of adhesive, applications. Weld inspection, Defects in various joints and their remedies.

Unit V Sheet Metal Working:**(7Hrs)**

Types of sheet metal operations, Types of dies and punches, material for dies and punches, Die design for Progressive and Drawing Die, clearance analysis, center of pressure, blank size determination (Numerical), strip layout, sheet utilization ratio (Numerical), method of reducing forces

Unit VI Centre lathe:**(7Hrs)**

Introduction to centre lathe, types of lathe, construction and working of lathe, attachments and accessories, various operations on lathe, taper turning and thread cutting methods (numerical), machining time calculation (numerical)

Books:**Text**

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House
2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd.

Reference:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India
2. Reikher – Casting: An analytical approach – Springer
3. Wang – Rapid tooling guidelines for sand casting – Springer
2. J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons
3. M.P Grover – Fundamentals of modern manufacturing: Materials and systems
4. A.S Athalye – Processing of plastic – Colour Publication (Pvt.)Ltd. U.K
5. Cryil Donaldson and George H LeCain – Tool Design – Tata McGraw Hill Education Pvt. Ltd.
6. Dr. R. S. Parmar, Welding Processes And Technology, Khanna Publishers, New Delhi.

Lab Assignments

1. Manufacturing of any one assembly consisting of minimum two components and involving all the lathe operations
2. Demonstration of Sand Moulding Processes
3. Job on TIG/ MIG/ Resistance welding

Guidelines for Term Work assessment

Each student must complete and submit following Term Work

- i) Assgmenyt-1 and assignment-3 w.r.t. above mentioned laboratory assignments
- ii) Journal consisting of following write-ups:
 - a) Study of casting processes
 - b) Study of plasting moulding processes
 - c) Study of welding processes
 - d) Study of centre lathe and single point cutting tool geometry

202042: Computer Aided Machine Drawing

Teaching Scheme:	Credits	Examination Scheme:
TH: 01 hr/week	Th:01	TH In-Sem: 50
		End-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	PR: 50
		OR: --
		TW: --

Prerequisites: -

1. Fundamentals Engineering Drawing
2. Projection of Solids
3. Basic knowledge of 2-D drafting using graphics software

Course Objectives:

- To understand Parametric Modeling Fundamentals, Procedure, and "Shape before Size" Approach.
- To develop an ability to Create Parametric 2-D Sketches, and Create and Edit Parametric Dimensions.
- To develop an ability to Create Solid Models of machine components. The student should be able to apply these skills to the solution of a variety of practical problems and be able to employ their knowledge to solve more complicated problems.
- To develop an ability to Create assembly models of simple machine (minimum 5 components). The student should be prepared to continue the study of computer aided machine drawing through further subjects/projects in further years of engineering.
- To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
- To develop an ability to create 2D drawings from 3D models

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD, PLM.
- Understand the significance of parametric technology and its application in 2D sketching.
- Understand the significance of parametric feature-based modeling and its application in 3D machine components modeling.
- Ability to create 3D assemblies that represent static or dynamic Mechanical Systems.
- Ability to ensure manufacturability and proper assembly of components and assemblies.
- Ability to communicate between Design and Manufacturing using 2D drawings.

Course Contents

- Unit I Introduction** (2 Hrs)
Introduction – evolution of CAD, importance of CAD in the light of allied technologies, solid modeling, introduction to Graphical User Interface (GUI) of any commercially used solid modeling software
- Unit II Parametric Sketching** (2 Hrs)
Parametric sketching - draw and modify 2D entities, apply/modify constraints and dimensions
- Unit III Parametric Solid Modelling** (2 Hrs)
Parametric solid modeling - fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, Free form feature modeling, design by features, feature recognition.
- Unit IV Assembly Modelling** (2 Hrs)
Assembly modeling - defining relationship between various parts of machine, creation of constraints, generation of exploded view
- Unit V Geometric Dimensioning and Tolerancing** (2 Hrs)
Geometric dimensioning and tolerancing - Limits, Fits, Dimensional Tolerances, Geometric Tolerances, Introduction to ASME Y14.5 – 2009
- Unit VI Production Drawing** (2 Hrs)
Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning and tolerancing

Books:

Text Books:

1. Bhat N. D., “Machine Drawing”, Charotar Publications, New Delhi 2014
2. Ajeet Siingh, “ Machine Drawing”, Mc Graw Hill Publications, New Delhi 2012
3. ASME Y14.5 -2009, ASME, 2009

Lab Work:

1. Assignment on 2-D sketching with geometrical and dimensional constraints (2 hrs.)
2. Assignment on parametric solid modeling of a machine component (4 hrs.)
3. Assignment on solid modeling of the parts of a machine (min. 5 components) (10 hrs.)
4. Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions and generation of exploded view. (4 hrs.)
5. Generation of production drawings of the parts and assembly with appropriate tolerancing. (4 hrs.)

2043: Thermodynamics

Teaching Scheme:	Credits	Examination Scheme:	
TH: 04 Hr/week	Th:04	TH	In-Sem: 50
			End-Sem: 50
PR: 02 Hrs/week	PR/OR/TW:01	PR:	--
		OR:	50
		TW:	--

Prerequisites: -

1. Engg. Mathematics
2. Engg. Physics/Chemistry
3. Fundamental Concepts and laws of Thermodynamics.

Course Objectives:

- Identify and use units and notations in Thermodynamics.
- State and illustrate first and second laws of Thermodynamics.
- Explain the concepts of entropy, enthalpy, reversibility and irreversibility.
- Apply the first and second laws of Thermodynamics to various gas processes and cycles.
- To get conversant with properties of steam, dryness fraction measurement, vapor processes and Thermodynamic vapor cycles, performance estimation.
- To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions.

Course Outcomes:

- On completion of the course, learner will be able to–
- Apply various laws of thermodynamics to various processes and real systems.
- Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties for various ideal gas processes.
- Estimate performance of various Thermodynamic gas power cycles and gas refrigeration cycle and availability in each case.
- Estimate the condition of steam and performance of vapour power cycle and vapour compression cycle.
- Estimate Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants.
- Use Psychrometric charts and estimate various essential properties related to Psychrometry and processes

Course Contents

<p>Unit I Laws of thermodynamics (6 Hrs)</p> <p>Introduction of thermodynamics, Review of basic definitions, Zeroth law of thermodynamics, Macro and Microscopic Approach, State Postulate, State, Process and Thermodynamic Cycles, First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles. Steady flow energy equation and its application to different devices. Equivalence of Clausius and Kelvin Planck Statement, PMM I and II, Concept of Reversibility and Irreversibility.</p>
<p>Unit II Entropy (4 Hrs)</p> <p>Entropy as a property, Clausius inequality, Principle of increase of Entropy, Change of entropy for an ideal gas and pure substance.</p> <p>Ideal Gas (6 Hrs)</p> <p>Ideal Gas definition Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes, Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy.</p>
<p>Unit III Thermodynamic cycles (6 Hrs)</p> <p>Gas Power Cycles: Air Standard Cycle, Efficiency and Mean Effective Pressure, Carnot Cycle, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles, Brayton cycle, Gas Refrigeration Cycle: Reversed Carnot, Bell Coleman Cycle.</p> <p>Availability (4 Hrs)</p> <p>Available and unavailable energy, concept of availability, availability of heat source at constant temperature and variable temperature, Availability of non flow and steady flow systems, Helmholtz and Gibbs function, irreversibility and second law efficiency.</p>
<p>Unit IV Properties of Pure substances (5 Hrs)</p> <p>Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined)</p> <p>Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer.</p> <p>Thermodynamic Vapour Cycle (5 Hrs)</p> <p>Vapour Power Cycles: Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle, Vapour Refrigeration Cycles: Reversed Carnot Vapor Cycle, Vapor Compression Cycle and representation of cycle on P-h and T-s diagram, Refrigerating effect, Compressor power and COP estimation (Numerical treatment using R134a only and enthalpy Cp, Cv data should be provided in tabulated form).</p>

Unit V Steam Generators (6 Hrs) Introduction to fuels, Theoretical amount of Oxygen / Air required for combustion. Stoichiometric Air: Fuel ratio, Excess air, lean and rich mixtures, Stoichiometric A: F ratio for petrol (No Numerical Treatment on fuels and combustion, only basic definitions and terminologies to be covered). Classification, Constructional details of low pressure boilers, Features of high pressure (power) boilers, Introduction to IBR, Boiler performance calculations-Equivalent evaporation, Boiler efficiency Energy balance, Boiler draught (natural draught numerical only).
Unit VI Psychrometry (6 Hrs) Psychrometry and Psychrometric Properties, Basic Terminologies, Psychrometric Relations, Psychrometric Chart, Psychrometric Processes, Thermodynamics of Human Body, Comfort Conditions (Numerical treatment using Psychrometric chart only).
Books:
Text: 1. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications 2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications 3.
Reference: 1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach, 2. P. L Ballany: Thermal Engineering, Khanna Publishers 3. C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill. 4. S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers.

List of Practical's:

1. Joule's experiment to validate first law of thermodynamics.
2. Determination of C_p and C_v for Ideal gas.
3. Performance estimation of Air standard cycle using standard simulation software's (MATLAB, VC++ etc.).
4. Determination of dryness fraction of steam (At least two Calorimeters).
5. Experiment to Calculate COP of Simple Vapor Compression Cycle (VCC).
6. Performance estimation of VCC using any professional software (CoolPack etc.)
7. Study of Boiler Mountings.
8. Study of Boiler Accessories.
9. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
10. Industrial visit to any process industry which uses boiler and submission of detailed report.
11. Demonstration of Psychrometric processes (At least four).

Notes:

1. Minimum 8 experiments should be performed.
2. Experiment No. 9 and 10 are compulsory.

202044: Material Science

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hrs/week	Theory: 03	TH In-Sem: 50
TUT: 01 Hr/week	Tutorial: 01	End-Sem: 50
		PR: 50
		OR: --
		TW: 25

Course Objectives:

- To acquaint students with the basic concepts and properties of Material Science
- To impart a fundamental knowledge of Materials Processing
- Selection and application of different Metals & Alloys
- To understand the structure of Engineering Materials
- To develop futuristic insight into Materials

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the basic concepts and properties of Material.
- Understand about material fundamental and processing.
- Select proper metal, alloys, nonmetal and powder metallurgical component for specific requirement
- Detect the defects in crystal and its effect on crystal properties.
- Evaluate the different properties of material by studying different test
- Recognize how metals can be strengthened by cold-working and hot working

Course Contents**Unit I Structure of Metals & Materials. (6 Hrs)**

Basic concepts of Crystal structures, Types of crystal systems , Crystal structure of metals(BCC, FCC and HCP systems), ceramics & molecular arrangement of polymers , Miller indices , indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density)

Unit II Mechanical Behaviors of Metal & Materials (6 Hrs)
Introduction to Crystal imperfections & Classification , Crystal imperfections : point defects, line defects- edge and screw dislocations, surface defects, volume defects, Mechanism of Elastic & plastic deformation (slip and twinning) ,Theory of dislocation , deformation of single crystal by slip, plastic deformation of polycrystalline materials, work hardening theory, Changes in properties due to cold working & hot working.
Unit III Destructive & Non-destructive Testing (8 Hrs)
Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evolution of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichsen Cupping Test.
Non Destructive testing: Principals & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing.
Unit IV Metals Corrosion & Its Prevention (4 Hrs)
Classification of corrosion : Dry corrosion & wet corrosion, Mechanism of corrosion ,Types of corrosion : Pitting corrosion, stress corrosion , season cracking, cavitation corrosion, caustic embrittlement , intergranular corrosion , crevice corrosion , erosion corrosion, uniform corrosion, galvanic corrosion,
Corrosion prevention methods : classification of different methods, e.g, inhibitors, cathodic & anodic protection, internal & external coatings, Low & High temperature corrosion. Design against corrosion.
Unit V Surface Modification Methods. (6 Hrs)
Importance of surface modification, classification of different methods & factors affecting : electroplating , PVD , CVD ,IVD, powder coating, shot blasting, ion implantation, plasma nitriding , anodizing, Surface preparation before coating & coating defects.

Unit VI Powder Metallurgical Technology (6 Hrs)

Basic steps of powder metallurgy process, classification & methods of powder manufacturing, characteristics of metal powders, Conditioning of metal powders (Screening, Blending & mixing, annealing), Compaction techniques (cold compaction, hot compaction, Isostatic compaction & powder rolling) , mechanism & importance of sintering , Pre-sintering & sintering secondary operations

Advantages, limitations and applications of powder metallurgy. Production of typical P/M components (with flow charts), self lubricated bearing, cemented carbides, cermets, refractory metals, electrical contact materials, friction materials, and diamond impregnated tools, friction plate, clutch plate, commutator brushes.

Books:**Text:**

1. Kodgire V. D. "Material Science and Metallurgy"
2. "Material Science & Engg." Raghvan V., Prentice Hall of India , New Delhi. 2003

Reference:

1. Science of Engineering Materials, Smith, Prentice-Hall
2. Materials Science and Engineering, Callister W. D., John Wiley
3. "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004.
4. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.
5. Mechanical Metallurgy, Dieter, G.E., McGraw-Hill, 1988.

List of Tutorials

1. Numerical based on Indexing, Atomic packing factor, Density.
2. Study and Trial of Tensile Test & numerical based on Tensile test.
3. Study of Compression Test
4. Study and Trial of Rockwell Hardness Test & Hardness conversion number.
5. Study of Ultra Sonic Test.
6. Vickers Hardness Test.
7. Brinell Hardness Test
8. Poldi Hardness Test
9. Magnetic Particle Test.
10. Dye Penetrant Test.
11. Impact Test.
12. Study of Self lubricated Bearings / Cemented carbide tips ,in Powder Metallurgy

Note : Out of above Twelve Tutorials , any Eight Tutorials should be conducted .

202051: Strength of Materials

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 hr/week	Th:04	TH In-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	End-Sem: 50
		PR: --
		OR: 50
		TW: --

Prerequisites: -

1. Fundamentals of engineering mechanics
2. Analysis of forces and moments
3. Laws of motion, kinetics, kinematics
4. Algebra and trigonometry

Course Objectives:**To understand**

- Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit.
- Fundamental concepts related to deformation, strain energy, moment of inertia, load carrying capacity, slope and deflection of beams, shear forces, bending moments, torsional moments, column and struts, principal stresses and strains and theories of failure

Course Outcomes:**Student should be able to**

- Apply knowledge of mathematics, science for engineering applications
- Design and conduct experiments, as well as to analyze and interpret data
- Design a component to meet desired needs within realistic constraints of health and safety
- Identify, formulate, and solve engineering problems
- Practice professional and ethical responsibility
- Use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Contents

<p>Unit I Simple stresses and strains (8 Hrs) Stress, strain, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety. Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self weight. Temperature stresses in simple members.</p>
<p>Unit II Shear Force and Bending Moment Diagrams (8 Hrs) Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading, shear force and bending moment. Maximum bending moment and position of points of contra flexure.</p>
<p>Unit III Stresses in Machine Elements (8 Hrs) Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus. Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web.</p>
<p>Unit IV (8 Hrs) Slope and deflection of beams: Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope and deflection for standard cases. Strain energy: Strain energy due to axial load (gradual, sudden and impact), strain energy due to bending and torsion.</p>
<p>Unit V (8 Hrs) Torsion: Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts. Buckling of columns: Concept of buckling of columns, derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, limitations of Euler's formula, Rankine's formula, safe load on columns</p>

Unit VI	(8 Hrs)
<p>Principal stresses and strains: Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear.</p> <p>Graphical solution using Mohr's circle of stresses. Principal stresses in shaft subjected to torsion, bending moment and axial thrust (solid as well as hollow),</p> <p>Concept of equivalent torsional and bending moments.</p> <p>Theories of elastic failure: Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory – their applications and limitations.</p>	
Books:	
Text:	
<ol style="list-style-type: none"> 1. G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India 2. S.S. Rattan - Strength of Material – Tata McGraw Hill Publication Co. Ltd. S. 3. Ramamurtham - Strength of material - Dhanpat Rai Publication. 4. Timoshenko and Young - Strength of Materials - CBS Publication 	
Reference:	
<ol style="list-style-type: none"> 1. Beer and Johnston - Strength of materials - CBS Publication. 2. E.P. Popov - Introduction to Mechanics of Solids - Prentice Hall Publication. 3. Singer and Pytel - Strength of materials - Harper and row Publication. 4. B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi. 	
List of Practicals:	
(Any 6 out of 1 to 8 and any 2 out of 9 to 11)	
<ol style="list-style-type: none"> 1. Tension test for aluminum alloy and mild steel using extensometer. 2. Tension test for brass using extensometer 3. Shear test of ductile material on Universal Testing Machine. 4. Experimental verification of flexural formula in bending for cantilever beam. 5. Experimental verification of flexural formula in bending for simply supported beam. 6. Measurement of stresses and strains in beams for different end conditions using strain gauges. 7. Experimental verification of torsion formula for circular bar. 8. Experimental verification of von Mises theory of failure. <p>Graphical simulation of - (using suitable software like MD-Solids, Matlab, MS-Excel etc.)</p> <ol style="list-style-type: none"> 9. Shear force and bending moment diagrams with different end conditions. 10. Slope and deflection. 11. Principal stresses through graphical and analytical method. 	

202054: Value Education

Teaching Scheme:	Credits	Examination Scheme:
TH: --	Tut:01	TH In-Sem: --
		End-Sem: --
Tutorial: 01 hr/ week	TW:--	PR: --
		OR: --
		TW: 25

Course Objectives:

- To enable the students to understand meaning of values and select their goals by self-investigation based on personal values.
- To enable the students to understand value of truth, commitments, honesty, sacrifice, care, unity, team work and relationship.
- To educate and make the young generation students aware of their social responsibilities.
- To increase awareness among students about environment and create attitude towards sustainable lifestyle.

Course Outcomes:

On completion of the course, learner will be able to–

- Understood human values, their significance and role in life.
- Promote self-reflection and critical inquiry that foster critical thinking of one's value and the values of others.
- Practice respect for human rights and democratic principles.
- Familiarized with various living and non-living organisms and their interaction with environment.
- Understood the basics regarding the leadership and to become a conscious professional.

Course Contents**UNIT 1: Introduction of Value Education (2 Hrs)**

Value Education: Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

UNIT 2: Salient values for life (2 Hrs)

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

UNIT 3: Human Rights (2 Hrs)

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

UNIT 4: Environment and Ecology (2 Hrs)

Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...

UNIT 5: Social values & Ethical values (2 Hrs)

Social values - Social consciousness and responsibility, Consumer rights and responsibilities.

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Books:**Text:**

1. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007
2. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics & Human Values", PHI Learning Press, 2013.

References:

1. Chakravarthy S. K., "Values and ethics for Organizations: Theory and Practice", Oxford University Press, New Delhi, 1999.
2. Man Singh Das, Vijay Kumar Gupta, "Social values among young adults: A changing scenario", MD Publications Pvt. Ltd, 1995.
3. Ram Ahuja, "Social Problems in India", Rawat Publications, 2012.
4. Leah Levin, "HUMAN RIGHTS Questions and Answers", UNESCO Publishing, 2012.
5. [P D Sharma](#), Ecology and Environment, Rastogi publications, 2005.
6. Kalam A P J, Arun Tiwari, "Wings of Fire", University Press Publications, 2003.
7. http://www.ncert.nic.in/recent/env_edu.html
8. http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf
9. <https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf>

Term Work shall consist of following assignments:

1. Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life?
(Observe and analyze by student themselves and write outcome.)
2. Visit to Non Governmental Organizations (NGO), charitable trusts working for welfare of people in society and submit visit report.
3. (a) Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.

(b) Conduct Guest Lecturer on: The role of media in value building and Right to Information Act - 2005 - a Tool for Good Governance. (Make report on seminars outcome)
4. Arrange a **Group Discussion** on topics:
Energy and natural resource depletion, Environmental pollution, Global warming, Ozone depletion, Deforestation, Soil degradation, Drought, Water harvesting etc. Make a report on outcomes.
(Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback. Write outcomes.)
5. Make Report on Code of ethics for engineers, Consumer rights and responsibilities and report conclude with role of Value, value Education and its relevance in present days.

202054 A: Innovations in Engineering Field/ Agriculture

Prerequisites:

1. Knowledge of Mathematics, Physics, and Chemistry is necessary.
2. Out of box/ unconventional thinking for solving typical problems.
3. Adapting analytical tools traditionally.
4. Application oriented thinking of learnt topics

Course Objectives:

- To develop holistically built thinking habit needed for innovative ideas.
- To make students aware about key field of agriculture contributing to sustenance and development of a mankind.
- To expose students to their roles and responsibilities of building a nation through engineering insights in agriculture
- To be updated with innovations and technological advancements in respective fields of engineering.

Course Outcomes:

On completion of the course, learner will be able to -

- Understand what is thinking, its tools and process and its application to innovation
- Practice application of innovation in engineering
- Understand important terms like national productivity, sustainable development and inclusive growth
- Throw a light on developing technologies in agriculture
- Learn Interdisciplinary Engineering applications in Agriculture

Course Contents

Unit I: Thinking and thinking process (2 Hrs)

Thinking and thinking tools: Thinking, Types of thinking, Top-Down (Analysis) & Bottom-Up (Synthesis) thinking and combination of both, Judgement and Creativity, Concept Maps-Connecting the ideas, Generating ideas. Communicating ideas. Systems thinking and beyond. Critical thinking. Definition of innovation. Example of application of thinking process to any one practical innovation.

Unit II: Engineering Innovation and its scope (2 Hrs)

Incremental, radical and disruptive Innovation. Scope of innovation: Product innovation, Process innovation, Position innovation, Paradigm innovation. Innovation within the engineering profession. Awareness about latest technological advancements.

Unit III: Agriculture and innovation	(2 Hrs)
Definition of agriculture? Role of Agriculture in our life and in national productivity. Concept of sustainable development and inclusive growth. India's urban awakening. Innovation in agriculture and its types. Importance of agriculture innovation.	
Unit IV: Developing technologies in agriculture	(2 Hrs)
Favorable conditions for Agriculture innovation. Dynamics of Innovation System. Role and responsibility of Engineers in agricultural innovations and making India the net exporter of major agricultural produces. FINOvation Awards. Ideas on developing technologies in agriculture viz. Vehicle automation, Engine emissions technology, Fire suppression technology etc. The future of robotics on farms.	
Unit V: Interdisciplinary Engineering in Agriculture	(2 Hrs)
Technological innovations that are revolutionizing Indian agriculture. Case study presenting Interdisciplinary Engineering application in Agriculture.	
Books:	
Text:	
<ol style="list-style-type: none"> 1. Kasser, J., E., 2015. Holistic Thinking: Creating Innovative Solutions to Complex Problems: Volume 1 (Solution Engineering). Create Space Independent Publishing Platform; 2 edition. 2. Wenwu Zhang, 2011. Intelligent Energy Field Manufacturing: Interdisciplinary Process Innovations. CRC Press, Taylor & Francis Group. 3. Educating engineers to drive the innovation economy, 2012. Publisher: The Royal Academy of Engineering, London. 	
Reference:	
<ol style="list-style-type: none"> 1. Crowder, J., A., Carbone, J., N., Demijohn, R., 2016. Multidisciplinary Systems Engineering: Architecting the Design Process. Springer Publishing. 2. India's urban awakening: Building inclusive cities, sustaining economic growth, 2010. Mckinsey Global Institute report. 	

List of Tutorials/Assignments:

1. What is 'thinking?' What are different tools of thinking? Write a note on Analysis and Synthesis and combination of both. Give any one example of application of thinking process to a practical innovation.
2. What are the types of innovations? What is its scope? Write a note on Innovation within engineering. State and explain 10 engineering innovations took place in last year.
3. What is agriculture? Explain its role in our life and in national productivity. What is sustainable development? What is inclusive growth? What is innovation in agriculture? What is importance of agriculture innovation?
4. What is favorable condition for agriculture innovation? Write a note on dynamics of innovation system. Discuss the ideas of developing technologies in agriculture. Write a note on future of robotics in agriculture.
5. State and explain minimum 10 Technological innovations that are revolutionizing Indian agriculture. Discuss any one case study encompassing Interdisciplinary Engineering application in Agriculture

Notes: All above 5 tutorials/ assignments are compulsory

202054 B : Road Safety

Prerequisites:

1. Awareness about traffic rules and road accidents.
2. Understanding the need of studying such topics.
3. Considerations to other, sensitivity and care while travelling/ driving.

Course Objectives:

- To acquire knowledge and understanding of the road environment.
- To inculcate decision making and behavioral skills necessary to survive in the road environment.
- To impart knowledge and understanding of the causes and consequences of accidents.
- To understand roles and responsibilities in ensuring road safety.

Course Outcomes:

On completion of the course, learner will be able to–

- Generate awareness about number of people dying every year in road accidents, traffic rules and characteristics of accident.
- Gain information and knowledge about people responsible for accidents and their duties
- Understand the importance of multidisciplinary approach to planning for traffic safety and rehabilitation
- Acquire a certificate of coordination/ participation in compulsory events based on the topic under study

Course Contents

Unit I: Introduction to Road Safety **(2 Hrs)**

Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash.

Unit II: Planning for Road safety **(2 Hrs)**

Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.

Unit III: Responsibility of Road accidents and Safety measures **(2 Hrs)**

People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering - by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.

<p>Unit IV: Road Safety Education (2 Hrs)</p> <p>Introduction to Road Safety Education. 5 P's of Road safety education: 1. Pre-school road safety education 2. Practical rather than theory education 3. Principles of own development as regards to road safety education 4. Presentations on road safety education 5. Place for road safety education in syllabus</p>
<p>Unit V: Road Safety Events (2 Hrs)</p> <p>Discussions on efforts done by Government on Road Safety. Celebration of Road Safety week or Workshop on Road Safety week/ Organization of seminar on Road Safety. This is to be entirely organized by students under the mentorship of concerned Head of the Department.</p>
<p>Books:</p>
<p>Text:</p> <ol style="list-style-type: none"> 4. Kadiyali L.R., Traffic Engineering & Transport Planning, Khanna Publishers, 2003 5. CROWN AGENTS Ref: TEA/A369, 1995. (Unpublished contractors report for Ministry of Transport and Communications, Ghana). Road safety study and the institutional strengthening of the vehicle examination and licensing division. 6. TRRL OVERSEAS UNIT, 1991. Towards safer roads in developing countries: a guide for planners and engineers. Crow Thorne: Transport and Road Research Laboratory.
<p>Reference:</p> <ol style="list-style-type: none"> 3. Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996 4. Indian Roads Congress, Road Safety Audit Manual, IRC:SP-88-2010
<p>List of Tutorials/ Assignments:</p> <ol style="list-style-type: none"> 6. Discussion and presentations on: Road traffic accidents scenario in India. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash. 7. Discussion and presentations on: Assisting Traffic control authorities, Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled. 8. Discussion and presentations on: People responsible for accident prevention, 4 E's of Accidents Prevention. 9. Introduction to Road Safety Education. 5 P's of Road safety education 10. Organization of One Day seminar/ workshop by students on Road Safety. Participation for every student is compulsory. They are expected to prepare brief report of about 3 to 4 pages of this event.
<p>Notes: All above 5 tutorials/ assignments are compulsory</p>

202054 C: Value Education

Course Contents

UNIT 1: Introduction of Value Education (2 Hrs)

Value Education: Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

UNIT 2: Salient values for life (2 Hrs)

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

UNIT 3: Human Rights (2 Hrs)

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

UNIT 4: Environment and Ecology (2 Hrs)

Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...

UNIT 5: Social values & Ethical values (2 Hrs)

Social values - Social consciousness and responsibility, Consumer rights and responsibilities.

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Books:

Text:

3. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007
4. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics & Human Values", PHI Learning Press, 2013.

References:

10. Chakravarthy S. K., “Values and ethics for Organizations: Theory and Practice”, Oxford University Press, New Delhi, 1999.
11. Man Singh Das, Vijay Kumar Gupta, “Social values among young adults: A changing scenario”, MD Publications Pvt. Ltd, 1995.
12. Ram Ahuja, “Social Problems in India”, Rawat Publications, 2012.
13. Leah Levin, “HUMAN RIGHTS Questions and Answers”, UNESCO Publishing, 2012.
14. [P D Sharma](#), Ecology and Environment, Rastogi publications, 2005.
15. Kalam A P J, Arun Tiwari, “Wings of Fire”, University Press Publications, 2003.
16. http://www.ncert.nic.in/recent/env_edu.html
17. http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf
18. <https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf>

SEMESTER-II

202045: Fluid Mechanics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 hr/week	Th:04	TH In-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	End-Sem: 50
		PR: 50
		OR: --
		TW: --

Prerequisites: -

1. Engineering Mathematics
2. Engineering Physics

Course Objectives:

- To understand of various properties of fluids
- To learn fluid statics and dynamics.
- To understand of Boundary layer, Drag, and Lift
- To understand of Bernoulli's equation
- To Know of various applications of Bernoulli's equation

Course Outcomes:

On completion of the course, learner will be able to–

- Use of various properties in solving the problems in fluids
- Use of Bernoulli's equation for solutions in fluids
- Determination of forces drag and lift on immersed bodies

Course Contents

Unit I Fundamentals of Fluid Mechanics

(8 Hrs)

Properties of Fluids:- Definition of fluid, concept of continuum, Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Newton's law of viscosity, types of fluid, Rheological diagram, Surface Tension, Capillarity, Compressibility, Vapour pressure

Fluid Statics: - Pascal's Law, Pressure at a point, Total Pressure & Centre of pressure for inclined flat plate, Buoyancy, metacenter and floatation.

(No numerical treatment for Buoyancy, metacenter and floatation)

<p>Unit II: Kinematics of Fluid Motion (8 Hrs)</p> <p>Eulerian and Lagrangian approach of fluid flow, total or material derivative for velocity field, Continuity equation, types of flows (One, two, three dimensional, steady unsteady, uniform, non-uniform, laminar, turbulent, compressible, incompressible, rotational, Irrotational) . Visualization of flow field (Stream, Path and Streak line), vorticity in two dimensional flow, stream function and velocity potential function</p>
<p>Unit III: Fluid Dynamics (8 Hrs)</p> <p>Introduction to flow models- control volume and infinitesimally small element, Linear momentum Equation using differential Approach, Introduction to Navier – Stokes Equation,</p> <p>Euler equation of motion, derivation of Bernoulli's equation along stream line , concept of HGL and THL or TEL, application of Bernoulli's equation to venturimeter, Pitot tube, Submerged Orifices, Orifice meter, V-notch</p>
<p>Unit IV: Internal Flow (8 Hrs)</p> <p>Laminar and Turbulent flow physics, entrance region and fully developed flow. Velocity and shear Stress distribution for laminar flow in a pipe, fixed parallel plates and Couette flow, hydro dynamically smooth and rough boundaries, Velocity profile of Turbulent flow.</p>
<p>Unit V: Flow through Pipes (8 Hrs)</p> <p>Energy losses through pipe-Major and Minor losses, Darcy-Weisbach equation, pipes in series, pipes in parallel and concept of equivalent pipe, Moody's diagram, Siphons, Transmission of power, (No derivations for minor losses)</p> <p>Dimensional Analysis: Dimensions of Physical Quantities, dimensional homogeneity, Buckingham π Theorem and important dimensionless numbers.</p>
<p>Unit VI: External flows (8 Hrs)</p> <p>Boundary layer formation for flow over Flat plate, boundary layer thickness:-displacement, momentum and energy, Separation of Boundary Layer and Methods of Controlling. Forces on immersed bodies: -Lift and Drag (No derivation on lift), flow around cylinder and aerofoil (Pressure distribution and Circulation).</p>
<p>Books:</p>

Text:

1. Fundamentals of Fluid Mechanics- Munson, Young and Okiishi- Wiley India
2. Fluid Mechanics- Potter Wiggert –Cengage Learning
3. Introduction to Fluid Mechanics- Fox, Pichard , McDonald- Wiley
4. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
5. Hydraulics and Fluid Mechanics, - Modi P. N. and Seth S. M -Standard Book House.
6. Fluid Mechanics,- Cengel&Cimbla- TATA McGraw-Hill
7. Fluid Mechanics- White- TATA McGraw-Hill

Reference:

1. Fluid Mechanics- Kundu, Cohen, Dowling- Elsevier India
2. Fluid Mechanics – Chaim Gutfinger David Pnueli-Cambridge University press.
3. Introduction to Fluid Mechanics-Edward Shaughnessy, Ira Katz James Schaffer- OXFORD University Press.

List of Practical

(Any ten of the following out of which experiment number 3 is compulsory)

1. Pressure measurement using any two types of manometer.
2. Determination of viscosity of liquids and its variation with temperature.
3. Determination of metacentric height of floating object.
4. Laminar and Turbulent flow by Reynolds's apparatus.
5. Draw flow net using electrical analogy apparatus.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter.
8. Determination of hydraulic coefficients of orifice.
9. Calibration of V-notch
10. Determination of minor losses due to pipe fittings.
11. Determination of Major losses through metal & non-metal pipes.

Notes:

3. Minimum 10 experiments should be performed.
4. Experiment No. 3 is compulsory.

202047: Soft Skills		
Teaching Scheme:	Credits	Examination Scheme:
TH: -- hr/week	Th/Tut: --	TH In-Sem: --
PR: 02 hrs/week	PR: 01	End-Sem: --
		PR: --
		OR: --
		TW: 25
Course Objectives:		
<ul style="list-style-type: none"> To develop students overall personality. To understand and aware about importance, role and contents of soft skills through instructions, knowledge aquisition, demonstration and practice.To improve his writing and documentation skills. 		
Course Outcomes:		
On completion of the course, learner will be able to–		
<ul style="list-style-type: none"> Improved communication, interaction and presentation of ideas. Right attitudinal and behaviouralchange Developed right-attitudinal and behavioral change 		
Course Contents		
Term Work/Assignments		
Term work will consist the record of any 6 assignments of following exercises		
1. SWOT analysis		(4 Hrs)
Student should do his/her SWOT analysis & submit the report.		
Method of Execution		
Explain the meaning & benefits of SWOT analysis to students. Give them time to think on their strength, weakesses, opportunities & threats. Ask them to write their own SWOT anlysis		
2. Listening Skills		(4 Hrs)
Listen to a short audio book and make notes out of it & make a report.		
Method of Execution		
Ask every students to download any freely available english audio book of one hour duration. Also ask them to listen it carefully and write it's review on journal paper		

<p>3. Oral presentation skills/Speaking Skills (4 Hrs)</p> <p>Hold the poster of any inspirational personality & speak about his/her life for five minutes.</p> <p>Method of Execution</p> <p>The personality can be from the fields like sports, politics, literature, entertainment etc. Ask every students to read & study about therespective personality & deliver the oral presentation infront of his/her batchmates.</p>
<p>4. Resume writing (4 Hrs)</p> <p>Design a cover letter & resume for yourself.</p> <p>Method of Execution</p> <p>Show some of the different resumes according to respective job profiles to students & ask them to prepare their own resume. Also guide them to write a cover letter for any job application.</p>
<p>5. Corporate / Business Etiquettes (4 Hrs)</p> <p>Apply to any five internship openings over internet by writing an email to the company HR. Students must submit email print.</p> <p>Method of Execution: Tell students about any five recent internship openings & ask them to apply for same through email with resume as an attachment. Ask students to take a sent mail print for submission record</p>
<p>6. Group Discussion (4 Hrs)</p> <p>Organize the group discussion on a current topics in a batch of ten students & ask every student to make minutes of meeting & submit.</p> <p>Method of Execution: Take some of the current topics for group discussion, divide students in two batches of ten students in each, Allot 10 minutes time & one topic for discussion, meanwhile instructor have to assess each student's performance & give feedback to respective student. Also ask students to write the minutes of the meeting from same GD</p>
<p>7. Team Activity (4 Hrs)</p> <p>Make a 20 minutes english video documentary & post it on a social media. Also provide the link of the same as submission record.</p> <p>Method of Execution: Make a group of four students & guide them to choose a topic for making a video documenatry. Video can be posted on facebook, twitter or youtube.The video can be recorded on cellphone as well</p>
<p>Books:</p>
<p>Text:</p> <ol style="list-style-type: none"> 1. Basics Of Communication In English : Francis Sounderaj, MacMillan India Ltd.2 2. English for Business Communication : Simon Sweeney , Cambridge University Press 3. An Introduction to Professional English And Soft Skills : Das , Cambridge University Press

Reference:

1. A course in Listening and Speaking Vol I & Vol II, V.Sasikumar, P. Kiranmai, Geetha Rajeevan, Cambridge University Press
2. Cambridge English For Job Hunting : ColmDownes, Cambridge University Press
3. The Complete Letter Writer :MacMillan India Ltd
4. E Writing – 21st Century Tools for Effective Communication :Booher , MacMillan India Ltd
5. NASSCOM-Global Business Foundation Skills: Cambridge University Press

202048: Theory of Machines – I

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 hr/week	Th: 04	TH In-Sem: 50
Tutorial: 01 hr/week	Tut: 01	End-Sem: 50
		PR: --
		OR: 25
		TW: 25

Prerequisites: -

1. Engineering Mathematics
2. Engineering Physics
3. Engineering Mechanics

Course Objectives:

- To make the student conversant with commonly used mechanism for industrial application.
- To develop competency in drawing velocity and acceleration diagram for simple and complex mechanism.
- To develop analytical competency in solving kinematic problems using complex algebra method.
- To develop competency in graphical and analytical method for solving problems in static and dynamic force analysis.
- To develop competency in conducting laboratory experiments for finding moment of inertia of rigid bodies.

Course Outcomes:

On completion of the course, learner will be able to–

- Identify mechanisms in real life applications.
- Perform kinematic analysis of simple mechanisms.
- Perform static and dynamic force analysis of slider crank mechanism.
- Determine moment of inertia of rigid bodies experimentally.
- Analyze velocity and acceleration of mechanisms by vector and graphical methods.

Course Contents

<p>Unit I Fundamentals of Kinematics and Mechanisms (10 Hrs)</p> <p>Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Straight line mechanisms such as: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism, watt mechanism. Equivalent linkage of mechanisms., Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism.</p>
<p>Unit II: Static and Dynamic Force Analysis (8Hrs)</p> <p>Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension.</p> <p>Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T-θ diagram.</p> <p>Friction: Friction in turning pair, friction circle, friction axis, friction in slider crank mechanism.</p>
<p>Unit III: Friction Clutches, Brakes and Dynamometer (8 Hrs.)</p> <p>Pivot and collar friction, Classification of Clutches, torque transmitting capacity of - plate clutch, cone clutch and centrifugal clutch, Classification of brakes, braking torque of - shoe brakes, internal shoe brake, disc brake, brake power of absorption and transmission type dynamometers – prony brake, rope brake, belt transmission, epicyclic train and Bevis-Gibson torsion</p>
<p>Unit IV: Kinematic Analysis of Mechanisms: Analytical Method (8 Hrs)</p> <p>Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism.</p> <p>Position analysis of links with vector and complex algebra methods, Loop closure equation, Chase solution, Velocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods.</p> <p>Hooke's joint, Double Hooke's joint.</p>
<p>Unit V: Velocity and Acceleration Analysis of Simple Mechanisms: Graphical Methods-I (8 Hrs)</p> <p>Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms.</p> <p>Relative acceleration method: Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple mechanisms. (limit to only 4 link mechanisms)</p> <p>Instantaneous center of rotation (ICR) method: Definition of ICR, Types of ICRs, Methods of locating ICRs (limit to only 6 link mechanisms), Kennedy's Theorem, Body and space centrode.</p>
<p>Unit VI: Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-II (8 Hrs)</p> <p>Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. (limit to only 4 link mechanisms) Klein's construction.</p>

Books:**Text:**

5. Thomas Bevan, "Theory of Machines" CBS Publisher and Distributors, Delhi.
6. S. S. Ratan, "Theory of Machines", Tata McGraw Hill.
7. Ashok G. Ambekar, "Mechanism and Machine Theory", Prentice Hall, India
8. Sadhu Singh, "Theory of Machines", Pearson

Reference:

1. Shigley J. E., and Uicker J.J., "Theory of Machines and Mechanism", McGraw Hill Inc.
2. Shigley J. E 'Mechanical Engineering Design', McGraw Hill Inc.
3. Ghosh Amitabh and Mallik A. K. "Theory of Machines and Mechanism", East- West Press.
4. Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery", Person Education.
5. Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice –Hall of India

Term Work based on following Tutorials to be submitted in the form of Journal:

1. Draw (any 4) configurations of mechanisms and determine types of pairs, links, degree of freedom.
2. To determine experimentally the mass moment of inertia of a connecting rod using a compound pendulum method.
3. To determine experimentally the mass moment of inertia of a flat bar using bifilar suspension method or to determine experimentally the mass moment of inertia of a flywheel/gear/circular disc using trifilar suspension method.
4. Numerical based on Friction Clutches, Brakes and Dynamometer Or to measure torque transmitting capacity of friction clutch experimentally.
5. Numerical based on - single and double Hooke's joint.
6. One problem on velocity and acceleration analysis using: Vector algebra and Complex algebra and comparison of results.
7. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method.
8. **Two problems** on velocity analysis using ICR method.
9. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method involving Coriolis component.
10. Problems on velocity and acceleration analysis using Klein's construction for uniform and non-uniform crank velocity.

Note: 1. Sr. No. 1,7,8,9 and 10 Problems based on Graphical methods are to be solved on half imperial drawing sheets.

2. **Oral based on above Term work conducted in the tutorial class.**

202048: Engineering Metallurgy

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 hr/week	Th:03	TH In-Sem: 50
Tutorial: 01 hr/week	PR/OR/TW:01	End-Sem: 50
		PR: --
		OR: 25
		TW: --

Course Objectives:

- To acquaint students with the basic concepts of Metal Structure
- To impart a fundamental knowledge of Ferrous & Non Ferrous Metal Processing
- Selection and application of different Metals & Alloys
- To Know Fundamentals of Metallography
- To develop futuristic insight into Metals

Course Outcomes:

On completion of the course, learner will be able to–

- describe how metals and alloys formed and how the properties change due to microstructure
- apply core concepts in Engineering Metallurgy to solve engineering problems.
- conduct experiments, as well as to analyze and interpret data
- select materials for design and construction.
- possess the skills and techniques necessary for modern materials engineering practice
- recognize how metals can be strengthened by alloying, cold-working, and heat treatment

Course Contents**Unit I Overview of Metallurgy****(6 Hrs)**

Methods of metal extraction (Principle only of pyro , hydro & electro metallurgy), cast v/s wrought products, Related terms and their definitions : System, Phase, Variable, Component, Alloy, Solid solution, Hume Ruther's rule of solid solubility, Allotropy and polymorphism, Concept of solidification of pure metals & alloys, Nucleation : homogeneous and heterogeneous,

Dendritic growth, super cooling, equiaxed and columnar grains, grain & grain boundary effect.

Cooling curves, Plotting of Equilibrium diagrams, Lever rule, Coring, Eutectic system, Partial eutectic and isomorphous system.

Unit II: Micro & macroscopic study of Metals	(6 Hrs)
Classification of metal observations: their definition, difference & importance.	
Microscopy: Various sampling techniques, specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching.	
Microscopic techniques : optical microscopy, electron microscopy, transmission electron microscopy (TEM), scanning electron microscopy (SEM), scanning probe microscopy (SPM), AFM etc. (principal & application only)	
Study of Metallurgical microscope .Measurement of grain size by different methods & effect of grain size on various mechanical properties.	
Macroscopy: Sulphur printing, flow line observations, spark test.	
Unit III: Iron-Carbon alloy system & Cast Iron	(8 Hrs.)
Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, structure & property relationship, classification and application of steels.	
Cast Irons: Classification, Manufacturing, Composition , Properties & applications of white C.I., Grey cast iron, malleable C.I., S.G. cast iron, chilled and alloy cast iron, effect of various parameters on structure and properties of cast irons. Specific applications such as machine tools, automobiles, pumps, valves etc.	
Introduction to non-equilibrium cooling of steels, widmanstatten structure	
Unit IV: Heat- treatment Of Steels	(6 Hrs)
Transformation products of Austenite, Time Temperature Transformation diagrams, critical cooling rate, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalising, Hardening & Tempering, quenching media, other treatments such as Martempering, Austempering, Patenting, Ausforming. Retention of austenite, effects of retained austenite. Elimination of retained austenite (Subzero treatment). Secondary hardening, temper embrittlement, quench cracks, Hardenability & hardenability testing, Defects due to heat treatment and remedial measures.	
Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening.	
Unit V: Engineering Alloy Steels & designation	(4 Hrs)
Classification of alloy steels & Effect of alloying elements, examples of alloy steels, stainless steels, sensitization & weld decay of stainless steel, tool steels, heat treatment of high speed steel, special purpose steels with applications, super alloys. Heat affected zone. Designation (for plane & alloy steels) : IS, AISI, SAE, DIN etc.	

Unit VI: Non Ferrous Metals (6 Hrs)
Classification of nonferrous metals. Importance of nonferrous metals in engineering applications & compositions, study of different mechanical properties: Cu & Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium & its alloys, Tin & Lead base alloys, Bearing materials: important properties & applications.
Books:
Text: <ol style="list-style-type: none">1. “Material Science & Metallurgy For Engineers”, Dr. V.D. Kodgire & S. V. Kodgire , Everest Publication.2. “Mechanical Behaviour & Testing Of Materials ”, A . K. Bhargava, C.P. Sharma P H I Learning Private Ltd.
Reference: <ol style="list-style-type: none">1. “Engineering Metallurgy”, Higgins R. A., Viva books Pvt. Ltd., 2004.2. “Material Science & Engg.” Raghvan V., Prentice Hall of India , New Delhi. 20033. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.4. Engineering Metallurgy Dr. O.P. Khanna
Term Work based on following <ol style="list-style-type: none">1 Study & Demonstration of Specimen Preparation for microscopic examination.2 Study of Optical Metallurgical microscope.3 Study and Drawing of Microstructure of Steels of various compositions.4 Study and Drawing of Microstructure of Cast Irons.5 Study and Drawing of Microstructure of Non Ferrous Metals.6 Heat treatment of Plain Carbon Steel and determination of relative hardness.7 Study and Drawing of Microstructure of Heat Affected Zone in Welding.8 Jominy End Quench Test for hardenability.9 Spark Test.10 Sulfur Printing Test.11 Flow Line Observation Test.12 Characterization techniques like SEM, TEM. <p>Note : Out of above Twelve practical , any Eight practical should be conducted .</p>

202050: Applied Thermodynamics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 hr/week	Th:04	TH In-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	End-Sem: 50
		PR: 50
		OR: --
		TW: --

Prerequisites: - 1. Engineering Thermodynamics.
2. Engineering Mathematics

Course Objectives:

- To get familiar with fundamentals of I. C. Engines, Construction and working Principle of an Engine and Compare Actual, Fuel-Air and Air standard cycle Performance.
- To study Combustion in SI and CI engines and its controlling factor in order to extract maximum power.
- To study emission from IC Engines and its controlling method, Various emission norms.
- Perform Testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies
- To understand theory and performance Calculation of Positive displacement compressor.

Course Outcomes:

On completion of the course, learner will be able to–

- Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and make out various losses in real cycles.
- Understand Theory of Carburetion, Modern Carburetor, Stages of Combustion in S. I. Engines and Theory of Detonation, Pre-ignition and factors affecting detonation.
- Understand Fuel Supply system, Types of Injectors and Injection Pumps, Stages of Combustion in CI Engines, Theory of Detonation in CI Engines and Comparison of SI and CI Combustion and Knocking and Factors affecting, Criteria for good combustion chamber and types.
- Carry out Testing of I. C. Engines and analyze its performance.
- Describe construction and working of various I. C. Engine systems (Cooling, Lubrication, Ignition, Governing, and Starting) also various harmful gases emitted from exhaust and different devices to control pollution and emission norms for pollution control.
- Describe construction, working of various types of reciprocating and rotary compressors with performance calculations of positive displacement compressors.

Course Contents	
<p>Unit I Basics of IC Engines</p> <p>Heat Engine, IC and EC engines, I.C. Engine construction - components and materials, Engine nomenclature, Valve timing diagram, Intake and exhaust system, Engine classification, Applications.</p> <p>Fuel Air Cycle and Actual Cycle</p> <p>Fuel air cycle, Assumptions, Comparison with air standard cycle, Effect of variables on performance, Actual cycle and various losses, Comparison of Air standard Vs Fuel Vs Actual cycle.</p>	<p>(5 Hrs)</p> <p>(5 Hrs)</p>
<p>Unit II SI Engines</p> <p>Theory of Carburetion, Types of carburetors, Electronic fuel injection system, Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion, Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion chambers, Rating of fuels in SI engines, Additives.</p>	<p>(5 Hrs)</p>
<p>Unit III CI Engines</p> <p>Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, Methods of knock control, Types of combustion chambers, rating of fuels in CI engines. Dopes & Additives, Comparison of knocking in SI & CI engines.</p>	<p>(5 Hrs)</p>
<p>Unit IV Testing of IC Engines</p> <p>Objective of testing, Various performance parameters for I.C. Engine - Indicated power, brake power, friction power, SFC, AF ratio etc. Methods to determine various performance parameters, characteristic curves, heat balance sheet.</p> <p>Supercharging</p> <p>Supercharging and turbo-charging methods and their limitations</p>	<p>(6 Hrs)</p> <p>(2 Hrs)</p>
<p>Unit V I.C. Engine Systems</p> <p>Cooling System, Lubrication System, Ignition System, Governing system, Starting System</p> <p>I.C. Engine Emissions and Control</p> <p>Air pollution due to IC engine and its effect, Emissions from petrol/gas and diesel engines, Sources of emissions, Euro norms, Bharat stage norms, Emission control methods for SI and CI engines</p>	<p>(6 Hrs)</p> <p>(4 Hrs)</p>

<p>Unit VI Positive Displacement Compressors (Reciprocating and Rotary) (10 Hrs)</p> <p>Reciprocating Compressor - Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistaging of compressor, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter-cooling and after cooling, Capacity control of compressors</p> <p>Rotary Compressor – Introduction, vane compressors, roots blower, screw compressor. (Numerical treatment on Reciprocating compressor single stage and multistage only)</p>
<p>Books:</p>
<p>Text:</p> <ol style="list-style-type: none"> 1) V. Ganesan: Internal Combustion Engines, Tata McGraw-Hill 2) M.L. Mathur and R.P. Sharma: A course in Internal combustion engines, Dhanpat Rai 3) H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd.
<p>Reference:</p> <ol style="list-style-type: none"> 1. Heywood: Internal Combustion Engine Fundamentals, Tata McGraw-Hill 2. Domkundwar & Domkundwar: Internal Combustion Engine, Dhanpat Rai 3. R. Yadav: Internal Combustion Engine, Central Book Depot, Ahmedabad. 3. S. Domkundwar, C. P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & Co.
<p>List of Practical's:</p> <ol style="list-style-type: none"> 1. Study of Carburetor 2. Study of Fuel pump and injector 3. Study of Ignition System 4. Demonstration & study of commercial exhaust gas analyzers. 5. Morse Test on Multi cylinder Petrol/ Diesel engine for determination of Friction power. 6. Variable load test on diesel engine to determine various efficiencies, SFC and Heat balance sheet. 7. Test on variable compression ratio engine. 8. Visit to Automobile service station 9. Test on Positive Displacement Air Compressor 10. Assignment on any one advanced technology related to I.C. Engine such as VVT, VGT, HCCI 11. Assignment on alternative fuels used in I.C. Engines. <p>Notes:</p> <ol style="list-style-type: none"> 1. Minimum 8 experiments should be performed. 2. Perform any 3 from 1 to 4. 3. Perform any 2 from 5, 6, and 7. 4. Experiment 8 and 9 are compulsory.

203152: Electrical and Electronics Engineering

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 hr/week	Th: 03	TH In-Sem
		[Online]: 50
		End-Sem: 50
PR: 02 hrs/week	PR/OR/TW: 01	PR: --
		OR: --
		TW: 25

Prerequisites: - 1. Basic Electrical Engineering 2. Basic Electronics Engineering

Course Objectives:

To understand

1. Principle of operation and speed control of DC machines
2. Induction motor principle and its applications
3. Working principle of special purpose motors
4. Microcontrollers
5. Embedded systems terminologies and sensors
6. Data acquisition system for mechanical applications

Course Outcomes:

Student should be able to

1. Develop the capability to identify and select suitable DC motor / induction motor / special purpose motor and its speed control method for given industrial application.
2. Program Arduino IDE using conditional statements
3. Interfacing sensors with Arduino IDE

Course Contents

Electrical Engineering

Unit I D. C. Machines

(6Hrs)

Construction, working principle of D.C. generator, emf equation of D. C. generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, back emf, torque equation for D.C. motor, characteristics of D.C. motor (series and shunt only), three-point starter for D.C shunt motor, methods for speed control of D.C. shunt and series motors, industrial applications.

<p>Unit II Three Phase Induction Motors (6Hrs)</p> <p>Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency, starters (auto transformer starter, star delta starter); methods of speed control and industrial applications.</p>
<p>Unit III Special Purpose Motors (6 Hrs)</p> <p>Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C servomotors, universal motors, industrial applications, brushless DC motors, linear induction motors, single phase induction motors,(types, construction, working principle of split phase and shaded pole type induction motors), descriptive treatment for AC series motor (difference between AC series and DC series motor, construction and working).</p>
<p>Electronics Engineering</p>
<p>Unit IV Introduction to Microcontrollers (6 Hrs)</p> <p>Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega 328P- features, architecture, portstructure, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements.</p>
<p>Unit V Peripheral Interface-1 (6 Hrs)</p> <p>Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE</p>
<p>Unit VI Peripheral Interface-2 (6Hrs)</p> <p>Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM</p>
<p>Books:</p>
<p>Text:</p> <p>[T1] Edward Hughes “Electrical Technology”, ELBS, Pearson Education. [T2] Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Sons. [T3] S. K. Bhattacharya, “Electrical Machine”, Tata Mc Graw Hill publishing Co. Ltd, 2nd Edition. [T4] Nagrath & Kothari, “Electrical Machines”, Tata Mc Graw [T5]Electrical Machines, R. K. Rajput, Laxmi Publications, 2002 [T6] Ajay Deshmukh, ‘Microcontrollers Theory and Applications’, TATA McGraw Hill [T7]Arduino microcontroller processing for everyone-Steven F Barret,Morgan and Claypool Publisher. [T8] C programming with ardino-Warwick Smith Elektor Publication.</p>

Reference:

[R1] Electrical Machines, Lowe, Nelson Publications.

[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, Tata McGraw Hill Publication Ltd. Fifth Edition.

[R3] Permanent Magnet Synchronous and Brushless DC Motor Drives, R. Krishnan, CRC press.

[R4] Smarajit Ghosh, “Electrical Machines”, Pearson Education, New Delhi.

[R5] Kenneth J. Ayala, ‘The 8051 Microcontroller’, Cengage Learning.

[R6] Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.

[R7] Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)

[R8] Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media.

[R9] Application notes from “ATMEL micro controller data book.”

[R10]

Web References

- 1) www.alldatasheet.com
- 2) www.atmel.com/products

Unit	Textbooks	Reference books
1	T1,T2,T3,T4	R1,R2,R4
2	T1,T2,T3,T4,T5	R1,R2,R4
3	T1,T2,T3,T4	R1,R2,R3,R4
4	T6,T7,T8	R5,R6,R7,R10
5	T7,T8	R6,R7,R8,R9,R10
6	T7,T8	R6,R7,R8,R9,R10

List of Practicals:**(Any 4 out of 1 to 6 and any 4 out of 7 to 12)****Electrical Engineering**

- 01) Speed control of DC shunt motor.
- 02) Brake test on DC shunt motor.
- 03) No load and blocked rotor test on 3 phase Induction Motor.
- 04) Load test on 3 phase Induction Motor.
- 05) Load test on single phase Induction Motor.
- 06) Study of starters for AC and DC motors.

Electronics Engineering

- 07) Interfacing of LED to blink after every 1 sec.
- 08) Display data using serial communication.
- 09) Interfacing of LCD to display the message and interface with keypad to display the key pressed.
- 10) Interfacing of temperature sensor (LM35) and show output on LCD/serial terminal.
- 11) Interfacing of strain gauge sensor and LVDT to measure the parameters.
- 12) Study of interfacing accelerometer to change the speed of DC Motor.

Guidelines for Instructor's Manual

Practical Sessions -

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used(if any)

Guidelines for Student's Lab Journal**For Electrical Practical**

1. Lab journal should be hand written
2. All the diagrams should be drawn on graph paper
3. Specifications of the instrument used for conduction of practical should be mentioned in respective write up.

For Electronics Practical:

1. Title of the program.
2. The program has to be written in the following format.
Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on separate page.

Guidelines for Lab /TW Assessment

1. There is **Term Work** for the subject, so continuous assessment should be carried out such as checking of previous experiment.
2. While assessment, teacher should put the remark by writing word "Complete" and not simply "C". Put the signature along with date at the end of experiment and in the index.
3. Assign 10 marks for each experiment as per following format.

Timely completion = 03 marks

Neat and clean writing = 02 marks

Depth of understanding = 03 marks

Regular attendance = 02 marks

Maintain continuous assessment sheet. At the end of semester, convert these marks out of as prescribed in syllabus structure.

Guidelines for Laboratory Conduction

Electrical Engineering Practicals

1. Check whether the MCB / ELCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked within the week.

Electronics Engineering Practicals

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.
2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
3. Each student within the group has to enter and execute the program turn wise.
4. Staff member has to check the result of all the groups after the execution of the program.

203153 : Machine Shop - I

Teaching Scheme:		Credits	Examination Scheme:	
TH:	-- hr/week	Th/Tut:--	TH	In-Sem
				[Online]: --
				End-Sem: --
PR:	02 hrs/week	PR/OR/TW:01	PR:	--
			OR:	--
			TW:	25

List of Practical's:

1. Manufacture of spur gear on milling machine using indexing head.
2. Surface grinding using table grinder.
3. Manufacturing any one sheet metal component involving minimum three different operation (use dies and press).
4. Any two plastic component like bottle, bottle caps, machine handles, etc.

SAVITRIBAI PHULE PUNE UNIVERSITY



FACULTY OF ENGINEERING

**SYLLABUS FOR
T. E. (MECHANICAL ENGINEERING)
(2015 Course)**

WITH EFFECT FROM YEAR 2017-2018

Savitribai Phule Pune University
T.E. Mechanical Engineering 2015 – Course
T. E. (Mechanical) (2015 Course) Semester – I

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In- Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302041	Design of Machine Elements-I	4	-	2	30@	70@	50	-		150	4	1
302042	Heat Transfer*	4	-	2	30	70		50	-	150	4	1
302043	Theory of Machines-II [§]	3	1		30	70	25	-	25	150	3	1
302044	Turbo Machines	3	-	2	30	70	-	-	25	125	3	1
302045	Metrology and Quality Control [§]	3	-	2	30	70	-	-	25	125	3	1
302046	Skill Development	-	-	2	-	-	25	25	-	50	-	1
Total		17	1	10	150	350	100	75	75	750	17	6
											23	

T. E. (Mechanical) (2015 Course) Semester – II

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In- Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302047	Numerical Methods and Optimization*	4	-	2	30	70	-	50	-	150	4	1
302048	Design of Machine Elements-II	4	-	2	30@	70@	25	-	25	150	4	1
302049	Refrigeration and Air Conditioning	3	-	2	30	70	-	-	25	125	3	1
302050	Mechatronics [%]	3	1		30	70	-	-	25	125	3	1
302051	Manufacturing - Process-II [§]	3	-	-	30	70	-	-	-	100	3	-
302052	Machine Shop-II [§]	-	-	2	-	-	50	-	-	50	-	1
302053	Seminar [§]	-	-	2	-	-	25	-	25#	50	-	1
302054	Audit Course*	--	--	--	--	--	-	-	-	-	-	-
Total		17	1	10	150	350	100	50	100	750	17	6
											23	

Though it is under Oral head Internal Panel to be appointed by Principal and HOD.

Examination schedule will not be prepared at University level.

* Marked subjects are common with TE (Auto. Engg.) and TE Mech. Sandwich

§ Marked subjects are common with TE (Auto. Engg.) only

% Marked subjects are common with TE Mech. Sandwich only

@ Examination time for Insem examination 1 Hr 30 Min. and Endsem examination 3Hrs.

Savitribai Phule Pune University, Pune
Third Year of Mechanical
(2015 Course)

Course Code: 302041

Course Name : Design of Machine Elements – I

Teaching Scheme:	Credits	Examination Scheme:
TH: -- 4 Hrs/ Week	TH:--04	TH In-Sem: -- 30
PR: - 2 Hrs/ Week	TW:--01	End-Sem: -- 70
		TW: -- 50

Course Objective:

1. Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
2. The student shall learn to choose proper materials for different machine elements depending on their physical and mechanical properties. They will learn to apply the knowledge of material science in real life situations.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. They will be conversant with various failure theories and be able to judge which criterion is to be applied for a particular situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcome:

1. Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.
2. Ability to design Shafts, Keys and Coupling for industrial applications.
3. Ability to design machine elements subjected to fluctuating loads.
4. Ability to design Power Screws for various applications.
5. Ability to design fasteners and welded joints subjected to different loading conditions.
6. Ability to design various Springs for strength and stiffness.

Course Contents**UNIT 1: Design of Simple Machine Elements (10 hrs)**

Machine Design, Design cycle, Design considerations - Strength, Rigidity, Manufacture, Assembly and Cost, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, lever for safety valve, bell crank lever, and components subjected to eccentric loading.

UNIT 2: Design of Shafts, Keys and Couplings (08 hrs)

Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design. Transmission shaft:- Theoretical treatment only. Design of keys and splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.

UNIT 3: Design for Fluctuating Load (08 hrs)

Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses:- Theoretical treatment only.

UNIT 4: Power Screws (06 hrs)

Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self locking screw, Collar friction torque, Stresses in power screws, design of a C-Clamp. Design of screw jack, Differential and Compound Screw and Re-circulating Ball Screw (Theoretical treatment only).

UNIT 5: Threaded joints and Welded joints s **(10 hrs)**

Basic types of screw fasteners, Bolts of uniform strength, I.S.O. Metric screw threads, Bolts under tension, eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base, design of Turn Buckle. Welding symbols, Stresses in butt and fillet welds, Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments.

UNIT 6: Mechanical Springs **(06 hrs)**

Types, applications and materials for springs, Stress and deflection equations for helical compression Springs, Style of ends, Design of helical compression and tension springs, Springs in series and parallel, Concentric helical springs, Surge in springs, Design of Multi-leaf springs. Helical torsion Spring (Theoretical treatment only).

Books:**Text:**

- 1) Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
- 2) Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.
- 3) Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
- 4) Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons

References:

- 1) Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
- 2) William C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
- 3) Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series.
- 4) C. S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
- 5) D. K. Aggarwal & P. C. Sharma, Machine Design, S.K Kataria and Sons
- 6) P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
- 7) Design Data - P.S.G. College of Technology, Coimbatore.
- 8) Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
- 9) K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.
- 10) Kanhhia, Design of Machine Elements-1, Scitech Publications

Term-Work

Term work shall consist of

1. Two design projects on Assemblies covering above syllabus.

The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students.

Project 1 shall be based on any one of the following topics-

- i) Cotter joint/ knuckle joint/turn buckle for a specified application.
- ii) Transmission Shaft/Machine tool spindles/coupling for specified application.
- iii) Hand or foot operated levers/lever for safety valve.

Project 2 shall be based on any one of the following topics-

- i) Bench vice/Machine vice for specified applications.
- ii) Bottle type/toggle jack for vehicles.
- iii) Lead screw for machine tool/other applications.

Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.

Drawings of design project should be done manually.

2. Assignments

The assignment shall be internally presented in the form of power point presentation, by a group of three to five students. A report of assignment (Max 8 to 10 pages) along with print out of ppt is to be submitted. Each student shall complete any two of the following assignments, with Assignment

(a) compulsory.

a. Use of dimensional tolerances, Geometrical tolerances and surface finish symbols in machine component drawings.

A. Selection of materials using weighted point method.

B. Selection of manufacturing methods for machine elements designed in any one of the above design projects.

C. Theories of failures and their applications.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302042

Course Name : HEAT TRANSFER

Teaching Scheme:	Credits	Examination Scheme:
TH: - 4 Hrs/ Week	TH:--04	TH In-Sem: -- 30
		End-Sem: -- 70
PR: - 2 Hrs/ Week	PR:--01	PR: -- 50

Course Objectives:

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyze the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Determine the radiative heat transfer between surfaces.
6. Describe the various two phase heat transfer phenomenon. Execute the effectiveness and rating of heat exchangers.

Course Outcomes:

CO 1: Analyze the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.

CO 2: Implement the general heat conduction equation to thermal systems with and without internal heat generation and transient heat conduction.

CO 3: Analyze the heat transfer rate in natural and forced convection and evaluate through experimentation investigation.

CO 4: Interpret heat transfer by radiation between objects with simple geometries.

CO 5: Analyze the heat transfer equipment and investigate the performance.

Course Contents

UNIT 1:	(10 hrs)
<p>Introduction and Basic Concepts: Application areas of heat transfer, Modes and Laws of heat transfer, Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity, Thermal diffusivity, Thermal contact Resistance</p>	
<p>Boundary and initial conditions: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition.</p>	
<p>One dimensional steady state heat conduction without heat generation: Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance and conductance, three dimensional heat conduction equations in cylindrical and spherical coordinates (no derivation) and its reduction to one dimensional form, critical radius of insulation for cylinders and spheres, economic thickness of insulation.</p>	
UNIT 2:	(08 hrs)
<p>One dimensional steady state heat conduction with heat generation: Heat conduction with uniform heat generation in plane wall, cylinder & sphere with different boundary conditions.</p>	
<p>Heat transfer through extended surface: Types of fins and its applications, Governing Equation for constant cross sectional area fins, solution for infinitely long & adequately long (with insulated end) fins, efficiency & effectiveness of fins.</p>	
UNIT 3:	(06 hrs)
<p>Thermal Insulation – Types and selection, Economic and cost considerations, Payback period</p>	
<p>Transient heat conduction: Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, Transient heat analysis using charts.</p>	
UNIT4:	(08hrs)
<p>Convection</p>	
<p>Fundamentals of convection: Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers.</p>	
<p>Forced convection: Dimensionless numbers and their physical significance, empirical correlations for external & internal flow for both laminar and turbulent flows.</p>	
<p>Natural convection: Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.</p>	
UNIT 5: Radiation	(08 hrs)
<p>Fundamental concepts, Spectral and total emissive power, real and grey surfaces, Stefan Boltzmann law, Radiation laws – Planks, Wiens, Kirchoff's and Lambert's cosine law with simple applications, Irradiation and radiosity, Electrical analogy in radiation, Radiation shape factor, radiation heat exchange between two black and diffuse gray surfaces, radiation shield.</p>	

UNIT 6: Heat Transfer Equipments**(08 hrs)**

Condensation and Boiling: Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation (simple numerical treatment).

Heat exchangers: Classification and applications, heat exchanger analysis – LMTD for parallel and counter flow heat exchanger, effectiveness– NTU method for parallel and counter flow heat exchanger, cross flow heat exchanger, LMTD correction factor, design criteria for heat exchanger, Introduction to TEMA standards.

Introduction to heat pipe, Introduction to electronic cooling - Discussion on active and passive methods.

Books:**Text:**

1. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley.
2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
4. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
6. M. M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
7. V. M. Domkundwar, Heat Transfer,

References:

1. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
2. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
3. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
4. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
5. B.K. Dutta, Heat Transfer-Principles and Applications, PHI.
6. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science.
7. Databook, SPPU provided by the Exam Center

LIST OF EXPERIMENTS

Any eight experiments (1-11) and two assignments (12-14) from the following list

1. Determination of Thermal Conductivity of metal rod
2. Determination of Thermal Conductivity of insulating powder
3. Determination of Thermal Conductivity of Composite wall
4. Determination of Thermal Contact Resistance
5. Determination of heat transfer coefficient in Natural Convection
6. Determination of heat transfer coefficient in Forced Convection
7. Determination of temperature distribution, fin efficiency in Natural / Forced Convection
8. Determination of Emissivity of a Test surface
9. Determination of Stefan Boltzmann Constant
10. Determination of effectiveness of heat exchanger
11. Study of pool boiling phenomenon and determination of critical heat flux
12. Assignment on 1-D transient heat transfer program using finite difference methods.
13. Assignment to solve transient heat transfer problem using Heisler and Grober charts.
14. Assignment on multi-pass / cross-flow heat exchanger using effectiveness charts.

Savitribai Phule Pune University, Pune

TE Mechanical and TE Automobile (2015 course)

Course Code: 302043

Course Name : Theory of Machine – II

Teaching Scheme:	Credits	Examination Scheme:	
TH: -- 03 Hrs/week	TH:--03	TH	In-Sem: -- 30
			End-Sem: --70
Tut.:- 01 Hr /week	TW/OR:--01		
			OR: -- 25
			TW: -- 25

Course Objectives:

1. To develop competency in understanding of theory of all types of gears.
2. To understand the analysis of gear train.
3. To develop competency in drawing the cam profile.
4. To make the student conversant with synthesis of the mechanism.
5. To understand step-less regulations.
6. To understand mechanisms for system control – Gyroscope.

Course Outcomes:

1. Student will be able to understand fundamentals of gear theory which will be the prerequisite for gear design.
2. Student will be able to perform force analysis of Spur, Helical, Bevel, Worm and Worm gear.
3. The student to analyze speed and torque in epi-cyclic gear trains which will be the prerequisite for gear box design.
4. Student will be able to design cam profile for given follower motions and understand cam Jump phenomenon, advance cam curves.
5. The student will synthesize a four bar mechanism with analytical and graphical methods.
6. *a.* The student will analyze the gyroscopic couple or effect for stabilization of Ship
Aeroplane and Four wheeler vehicle.
b. Student will choose appropriate drive for given application (stepped / step-less).

Course Contents

Unit – I: Spur Gear

(08 hrs)

Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, interference and under cutting – Methods to avoid interference. Minimum number of teeth on gear and pinion only, Force analysis and Friction in gears.

<p>Unit – II: Helical, Bevel, Worm and Worm Wheel</p> <p>Helical and Spiral Gears: terminology, geometrical relationships, tooth forces, torque transmitted and efficiency, virtual number of teeth for helical gears Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted. Bevel Gear: Theoretical treatment only</p>	<p>(06 hrs)</p>
<p>Unit – III Gear Trains</p> <p>Types of Gear Trains, analysis of epicyclic gear trains, Holding torque – Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel epicyclic Gear train.</p>	<p>(06 hrs)</p>
<p>Unit –IV Cam and Follower</p> <p>Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (up to 3-4-5 Polynomial cam only)</p>	<p>(08 hrs)</p>
<p>Unit –V Synthesis of Mechanism</p> <p>Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Three position synthesis of four bar mechanism using Freudenstein’s equation. Analytical synthesis using kinematic coefficient in four bar mechanism.</p>	<p>(06 hrs)</p>
<p>Unit –VI Step–Less-Regulation (Theoretical Treatment only) & Gyroscope</p> <p>Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. Gyroscopes, Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four wheel vehicle moving on curved path.</p>	<p>(06 hrs)</p>
<p>Books:</p>	
<p>Text:</p> <ol style="list-style-type: none"> 1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi. 2. Bevan T, Theory of Machines, Third Edition, Longman Publication. 3. A. G. Ambekar, Mechanism and Machine Theory, PHI. 4. N. K. Mehta, Machine Tool Design and Numerical Control, Tata McGraw Hill Publication, 5. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD. 	

References:

1. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
2. Hannah and Stephans, Mechanics of Machines, Edward Arnold Publication.
3. R L Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
4. Sadhu Singh, Theory of Machines, Pearson
5. D.K. Pal, S.K. Basu, Design of Machine Tools, Oxford & Ibh Publishing Co Pvt. Ltd.
6. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
7. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI.

Tutorial (Term-work) shall consist of**Part A: Compulsory**

1. To study manufacturing of gear using gear generation with rack as a cutter and to generate involute profile
2. Kinematic analysis of synchromesh, machine tool gear box, differential gear box (Self Study)
3. Speed and torque analysis of epicyclic gear train to determine holding torque
4. To draw the cam profile and study variation in pressure angle with respect to change in base circle diameter and draw pitch circle for both the cases.(Half imperial drawing sheet)
5. To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points. (Half imperial drawing sheet)
6. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect.
7. Study of Continuous Variable Transmission and Infinite Variable Transmission.

Part B: Any two from the following

1. To draw conjugate profile for any general type of gear tooth. (Half imperial drawing sheet)
2. To verify the cam jump phenomenon for an eccentric cam.
3. Synthesis a four bar mechanism based on Freudenstein's equation using any programming Language.
4. To measure the range of speeds obtained using any one type of continuously variable transmission device.
5. Industrial visit to understand Machines and Mechanisms.

Savitribai Phule Pune University, Pune

T.E Mechanical (2015 course)

Course Code: 302044

Course Name : Turbo Machines

Teaching Scheme:	Credits:	Examination Scheme:
TH: -- 03 hrs/week	TH:-- 03	TH In-Sem: -- 30
PR: -- 02 hrs/week	OR:-- 01	End-Sem: -- 70
		OR: -- 25

Course Objectives:

1. To provide the knowledge of basic principles, governing equations and applications of turbo machine.
2. To provide the students with opportunities to apply basic thermo-fluid dynamics flow equations to Turbo machines.
3. To explain construction and working principle and evaluate the performance characteristics of Turbo Machines.

Course Outcomes:

On successful completion of the course, the student will be able to,

1. Apply thermodynamics and kinematics principles to turbo machines.
2. Analyze the performance of turbo machines.
3. Ability to select turbo machine for given application.
4. Predict performance of turbo machine using model analysis.

Course Contents

Unit – I: Introduction to Turbo Machinery**(08hrs)**

Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines, Different losses associated with turbo-machinery, Applications of Turbo machines.

Impact of Jet

Impulse momentum principle and its applications, Force exerted on fixed and moving flat plate, hinged plate, curved vanes, series of flat plates and radial vanes, velocity triangles and their analysis, work done equations, vane efficiency.

Unit –II: Impulse Water Turbines**(06hrs)**

Introduction to Hydro power plant, classification of hydraulic turbines construction, principle of working, velocity diagrams and analysis, design aspects, performance parameters, performance characteristics, specific speed, selection of turbines, multi-jet Pelton wheel.

Unit –III: Reaction Water Turbines**(08 hrs)**

Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction, performance characteristics.

Draft tubes: types and analysis, causes and remedies for cavitation phenomenon

Governing of turbines, Similitude and dimensional analysis of hydraulic turbines

Unit –IV: Steam Turbines**(08 hrs)**

Steam nozzles: types and applications, Equation for velocity and mass flow rate [No numerical treatment].

Steam Turbines: Classifications, construction details, compounding of steam turbines, velocity diagrams and analysis of Impulse and reaction turbines (single & multi stage), governing, dimensional analysis, performance characteristics. Losses in steam turbines, selection of turbines.

Unit –V: Centrifugal Pumps**(08 hrs)**

Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thoma's cavitation factor, priming of pumps, installation, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, system resistance curve, selection of pumps.

Dimensional and Model analysis of hydraulic machines

Unit –VI: Centrifugal & Axial Compressor**(07 hrs)**

Centrifugal compressor: Classification of compressors, Construction, velocity diagram, flow process on T-S Diagram, Euler's work, actual work input, performance characteristics, various losses in centrifugal compressor.

Axial Compressor: Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, stage losses and efficiencies, performance characteristics. [No numerical treatment]

Books:**Text:**

1. Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
2. Turbomachines, B. U. Pai, Wiley India
3. Fluid mechanics and hydraulic machines, Dr. R.K. Bansal
4. Hydraulic Machines, Dr. J. Lal, Metropolitan Book Co. Pvt. Ltd., Delhi.
5. Hydraulics, Fluid Mechanics and Machinery, Modi P N & Seth S N, Standard Book House, New Delhi.
6. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, VII edition, Central Publ. house

References:

1. William W. Perg, Fundamentals of Turbomachinery, John Wiley & Sons.
2. Thermal Turbomachines, Dr. Onkar Singh, Wiley India
3. V. P. Vasandani, Theory of Hydraulic Machinery, Khanna Publishers, Delhi.
4. Karassik, Hand Book of Pumps, Tata McGraw Hills Ltd., New Delhi.
5. S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966.

Term-Work

List of Experiments

1. Verification of impulse momentum principle
2. Study and trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and trial on any one hydraulic reaction turbine (Francis/Kaplan) and plotting of main and operating characteristics
4. Study and trial on centrifugal pump and plotting operating characteristics
5. Study and trial on centrifugal air compressor and plotting its characteristics
6. Visit to hydro/steam power plant and report to be submitted.
7. Study of different types of nozzles and trial on convergent-divergent air/steam nozzle.
8. Study of axial flow compressors/ centrifugal air blower.
9. Study of multi-staging of steam turbines.
10. Design of pumping system installation using manufacturers' catalogue, specific to housing or industrial application.
11. Visit to pumping station and report to be submitted.

Notes

1. Eight experiments from above list should be performed; out of which at least four trials should be conducted. Data from any one trial performed should be analyzed by using suitable software.
2. One Experiment out of Expt. no. 10 and 11 is compulsory.
3. Visit to Hydro or Steam power plant is compulsory.

Savitribai Phule Pune University, Pune

TE Mechanical and TE Automobile (2015 course)

Course Code: 302045

Course Name : Metrology And Quality Control

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hrs/week	TH:--03	TH In-Sem: -- 30
PR: 02 Hrs/week	OR:--01	End-Sem: -- 70
		OR: -- 25

Course Objectives:

Students are expected to –

1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
2. Calibrate measuring instruments and also design inspection gauges.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
4. Select and apply appropriate Quality Control Technique for given application.
5. Select and Apply appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).

Course Outcomes:

The student should be able to –

1. Understand the methods of measurement, selection of measuring instruments / standards of measurement, carryout data collection and its analysis.
2. Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design
3. Understand and use/apply Quality Control Techniques/ Statistical Tools appropriately.
4. Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.

Course Contents

Unit – I Measurement standards and Design of gauges

(06 hrs)

Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability,

Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate.

Design of Gauges: Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).

Unit –II Comparators, Thread and Gear Metrology, Surface Roughness Measurement

(08 hrs)

Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).

Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle and Pitch, Floating Carriage Micrometer (Numerical).

Gear Metrology: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications

Surface Roughness Measurement: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf.

Unit – III Advances in Metrology

(06 hrs)

Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes

Machine Vision Systems: vision system measurement – Multisensory systems.

Interferometer: Principle, NPL Interferometer

Laser Metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications

Unit – IV Introduction to Quality and Quality Tools**(06 hrs)**

Concept of Quality: Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old New Seven Tools, Quality Circles.

Importance of Quality deployment at Design and Manufacturing Engineering: Opportunities for improvement product design, Importance of– initial planning for quality, concept of controllability: self-controls – defining quality responsibilities on the factory flow – self inspection.

Unit –V Statistical quality control**(08 hrs)**

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production Part Approval Method (PPAP).

Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)

Unit –VI Total Quality Management**(06 hrs)**

TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications.

Quality Management System

Need for quality management system – design of quality management system - quality management system requirements – ISO 9001, TS-16949, ISO-14000, Quality Audit.

Books:**Text:**

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. I. C. Gupta, Engineering Metrology, Dhanpath Rai.
3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.
4. Juran J. M., Quality Handbook, McGraw Hill Publications.
5. Grant S.P., Statistical Quality Control, Tata McGraw hill Publication.

References:

1. Narayana K.L., Engineering Metrology.
2. Galyer J.F & Shotbolt C.R., Metrology for engineers
3. Gupta I.C., Engineering Metrology, Dhanpatrai Publiartions
4. Judge A.W., Engineering Precision Measurements, Chapman and Hall
5. Francis T. Farago, Mark A. Curtis, Handbook of dimensional measurement.
6. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.
7. Connie Dotson, Fundamentals of Dimensional Metrology, Thamson Publ., 4th Edition.
8. Basterfield D. H., Quality control, Pearson Education India, 2004.
9. Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication.
10. Harrison M. Wordsworth, Stefeen Godfrey, Modern Methods for Quality control and Improvement, Willy Publication.

Online Education resources: viz. NPTEL web site:

- (1) nptel.ac.in/courses/112106179;
- (2) www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;
- (3) www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/;
- (4) freevideolectures.com › Mechanical › IIT Madras
- (5) nptel.ac.in/courses/112107143/37;

Term-Work

LIST OF EXPERIMENTS

Part: A] Experiment no. 1, 4 and 6 are mandatory. Perform any three from experiment no. 2 to 5 & any three from experiment no. 7 to 10.

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, (MSA: Gauge R & R).
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
7. Determination of geometry and dimensions of given composite object / single point tool, using profile projector and tool maker's microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

Part: B] Statistical Quality Control (SQC) (Any Two)

Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application. Submission of these assignments USING STANDARD FORMATS.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

Part: C] Industrial visit to:

Calibration lab /Quality control lab / CMM Lab / Gear Inspection Unit

OR

QA/QC Unit of Automotive Industry / Engineering Industry.

Savitribai Phule Pune University, Pune
Third Year of Mechanical
(2015 Course)

Course Code: 302046

Course Name: Skill Development

Teaching Scheme:	Credits	Examination Scheme:
PR: -- 2 Hrs/ Week	TW/PR:--01	
		TW:-- 25
		PR:-- 25

COURSE OBJECTIVES

1. To develop the skill for required in shop floor working.
2. To have knowledge of the different tools and tackles used in machine assembly shop.
3. Use of theoretical knowledge in practice.
4. Practical aspect of the each component in the assembly of the machine.

Course Contents

List of Experiments

1. Tail stock assembly
2. Valve Assembly (PRV, Sluice valve, Steam stop valve)
3. IC engine of Two Wheeler (4 stroke single cylinder)
4. Hermetically sealed compressor
5. Hydraulic actuator
6. Industrial Gear box
7. Sheet drawing (Sheet will be given per group and a group consist of 04 students. The sheet will be drawn manually by every student)

Note: 1-6 experiments are for assembly and disassembly only

Term-Work

1. Sheet drawing of assembly, which should contain the display of Geometric tolerances, Limits, Fits, BOM, Dimensional measurements techniques. Special Operations.. Students should make process sheet of each assembly. (One topic per four students group will be given for sheet drawing and each student should draw the sheet manually)

Practical Examination

Practical examination will be based on opening and closing of any assembly. In addition to this some questioning will be asked to the student based on assembly drawing, GD&T Sequencing and tools and tackles. For this the assemblies and their drawings should be provided to students for examination

Note: Term work will carry 25 Marks and practical examination will carry 25 marks.

- A. The assessment has to be carried out based on close monitoring of involvement and intellectual contribution of student.
- B. The student should maintain the record of work in the form of diary and has to be submitted at the end of semester.
- C. The batch teacher should assess the concerned student

SEM-II

Savitribai Phule Pune University, Pune

TE Mechanical, Mechanical Sandwich and Automobile (2015 course)

Course Code: 302047 Course Name : Numerical Methods and Optimization

Teaching Scheme:	Credits	Examination Scheme:
TH: -04 hrs/week	TH:--04	TH In-Sem: -- 30
		End-Sem: --70
PR: 02 hrs /week	PR:--01	PR: -- 50

Course Objectives:

Students are expected to –

- 1 Recognize the difference between analytical and Numerical Methods.
- 2 Effectively use Numerical Techniques for solving complex Mechanical engineering Problems.
- 3 Prepare base for understanding engineering analysis software.
- 4 Develop logical sequencing for solution procedure and skills in soft computing.
- 5 Optimize the solution for different real life problems with available constraints.
- 6 Build the foundation for engineering research.

Course Outcomes:

The student should be able to –

1. Use appropriate Numerical Methods to solve complex mechanical engineering problems.
2. Formulate algorithms and programming.
3. Use Mathematical Solver.
4. Generate Solutions for real life problem using optimization techniques.
5. Analyze the research problem

Course Contents

Unit – I: Roots of Equation and Error Approximations (08 hrs.)

Roots of Equation

Bisection Method, Newton Raphson method and Successive approximation method.

Error Approximations

Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.

Unit – II: Simultaneous Equations (08 hrs.)

Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tri-diagonal Matrix, Jacob iteration method.

<p>Unit – III: Optimization (08 hrs.)</p> <p>Introduction to optimization, Classification, Constrained optimization (maximum two constraints): Graphical and Simplex method, One Dimensional unconstrained optimization: Newton’s Method. Modern Optimization Techniques: Genetic Algorithm (GA), Simulated Annealing (SA).</p>
<p>Unit – IV: Numerical Solutions of Differential Equations (10 hrs.)</p> <p>Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using RungeKutta2nd order method.</p> <p>Partial Differential Equations [PDE]: Finite Difference methods Introduction to finite difference method, Simple Laplace method, PDEs- Parabolic explicit solution, Elliptic-explicit solution.</p>
<p>Unit – V: Curve Fitting and Regression Analysis (08 hrs.)</p> <p>Curve Fitting Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation.</p> <p>Regression Analysis Introduction to multi regression analysis, Lagrange’s Interpolation, Newton’s Forward interpolation, Inverse interpolation (Lagrange’s method only).</p>
<p>Unit – VI: Numerical Integration (06 hrs.)</p> <p>Numerical Integration (1D only) Trapezoidal rule, Simpson’s 1/3rdRule, Simpson’s 3/8thRule, Gauss Quadrature 2 point and 3 point method.</p> <p>Double Integration Trapezoidal rule, Simpson’s 1/3rdRule.</p>
<p>Books:</p>
<p>Text:</p> <ol style="list-style-type: none"> 1. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4/e, Tata McGraw Hill Editions 2. Dr. B. S. Garewal, Numerical Methods in Engineering and Science, Khanna Publishers,. 3. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientist, Tata Mc-Graw Hill Publishing Co-Ltd 4. Rao V. Dukkipati, Applied Numerical Methods using Matlab, New Age International Publishers

References:

1. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education Asia
2. E. Balagurusamy, Numerical Methods, Tata McGraw Hill
3. P. Thangaraj, Computer Oriented Numerical Methods, PHI
4. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.

Term-Work

1. Program on Roots of Equation (Validation by suitable solver, all three compulsory)
a) Bisection Method, b) Newton Raphson method c) Successive approximation method
2. Program on Simultaneous Equations (Validation by suitable solver, all three compulsory)
a) Gauss Elimination Method, b) Thomas algorithm for tridiagonal matrix, c) Gauss-Seidal method.
3. Demonstration of optimization technique using suitable solver.
4. Program on ODE(Validation by suitable solver, all three compulsory)
a) Euler Method, b) Runge-Kutta Methods- fourth order, c) Simultaneous equations.(Runge-Kutta 2nd order: *One step only*).Simple pendulum equation or Spring mass damper equation
5. Program on PDE(Validation by suitable solver): Laplace equation
6. Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory)
a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation
7. Program on Interpolation(Validation by suitable solver, all three compulsory)
a) Lagrange's Interpolation, b) Newton's Forward interpolation,
8. Program on Numerical Integration(Validation by suitable solver, all four compulsory)
a) Trapezoidal rule, b) Simpson's Rules (1/3rd, 3/8th) [In one program only], c) Gauss Quadrature Method- 2 point, 3 point. [In one program only], d) Double integration: Trapezoidal rule

NOTE:

1. Solver is compulsory for all above programs and compared with actual solution.
2. Manual solution for each problem.
3. Algorithms and Flowcharts are compulsory for all programs.

GUIDELINES TO CONDUCT PRACTICAL EXAMINATION

Any one program from each set A & B with flowchart and solver: **Duration: 2 hrs.**

Set A: (Weightage – 60 %)

- a) Simultaneous Equation,
- b) Partial Differential Equation (Laplace equation with solver)
- c) Interpolation: Lagrange's interpolation, Newton's Forward interpolation (Any one)

Set B: (Weightage – 40 %)

- a) Roots of Equations, b) Curve Fitting, c) Ordinary Differential Equations, d) Integration

Savitribai Phule Pune University, Pune
Third Year of Mechanical (2015 Course)

Course Code: 302048

Course Name : Design of Machine Elements – II

Teaching Scheme:	Credits	Examination Scheme:
TH: -- 4 Hrs/ Week	TH:--04	TH: In-Sem: -- 30
PR: - 2 Hrs/ Week	TW/OR:--01	End-Sem: -- 70
		TW: -- 25
		OR: -- 25

Course Objective:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements required in transmission systems.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications
4. Inculcate an attitude of team work, critical thinking, communication, planning and scheduling through design projects
5. Create awareness amongst students about safety, ethical, legal, and other societal constraints in execution of their design projects
6. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcome:**The student should be able to –**

CO 1: To understand and apply principles of gear design to spur gears and industrial spur gear boxes.

CO 2 : To become proficient in Design of Helical and Bevel Gear

CO 3: To develop capability to analyse Rolling contact bearing and its selection from manufacturer's Catalogue.

CO 4: To learn a skill to design worm gear box for various industrial applications.

CO 5: To inculcate an ability to design belt drives and selection of belt, rope and chain drives.

CO 6: To achieve an expertise in design of Sliding contact bearing in industrial applications.

Course Contents**Unit –I Spur Gears****(08 hrs)**

Introduction to gears: Gear Selection, material selection, Basic modes of tooth failure, Gear Lubrication Methods.

Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.

Unit –I Helical and Bevel Gears**(08 hrs)**

Types of helical and Bevel gears, Terminology, Virtual number of teeth, and force analysis of Helical and Straight Bevel Gear. Design of Helical and Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. Mountings of Bevel Gear. (**No numerical on force analysis of helical & Bevel Gear**)

Unit – III Rolling Contact Bearings**(08 hrs)**

Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation,

Equivalent bearing load, Load- life relationship, Selection of bearing life Selection of rolling contact bearings from manufacturer's catalog, Design for cyclic loads and speed, bearing with probability of survival other than 90%

Taper roller bearing: Force analysis and selection criteria. (Theoretical Treatment only)

Unit - IV:

Worm and worm gear terminology and proportions of worm and worm gears, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive, Types of failures in worm gear drives, Methods of lubrication

Unit - V:

Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition,

Selection of Flat and V-belts from manufacturer's catalog, belt tensioning methods, relative advantages and limitations of Flat and V- belts, construction and applications of timing belts.

Wire Ropes (Theoretical Treatment Only): Construction of wire ropes, lay of wire rope, stresses in wire rope, selection of wire ropes, rope drums construction and design.

Chain Drives (Theoretical Treatment Only): Types of chains and its Geometry, selection criteria for chain drive, Polygon effect of chain, Modes of failure for chain, Lubrication of chains

UNIT VI:

Classification of sliding contact bearing.

Lubricating oils: Properties, additives, selection of lubricating oils, Properties & selection of bearing materials.

Hydrodynamic Lubrication: Theory of Hydrodynamic Lubrication, Pressure Development in oil film, 2DBasic Reynolds Equation, Sommerfeld number, Raimondi and Boyd method, Thermal considerations, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness.

Books:**Text:**

- 1) Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
- 2) Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.
- 3) Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
- 4) Juvinal R.C, Fundamentals of Machine Components Design, John Wiley and Sons.

References:

1. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
2. William C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
3. Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series
4. C.S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
5. D. K. Aggarwal & P.C. Sharma, Machine Design, S.K Kataria and Sons
6. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
7. Design Data - P.S.G. College of Technology, Coimbatore.
8. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
9. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers

Term-Work

Term work shall consist of

1. One design project based on either Design of a Two Stage Gear Box (the two stages having different types of gear pair) or single stage worm gear box.

The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components.

Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components

Note:

1. Design project should be assigned to group of 5 to 7 students.
2. Assembly drawing of project should be drawn using any CAD software.
3. Detailed parts of project should be drawn manually.

Design projects should be practical oriented, below is the list of practical applications:

- i) Design of gearbox for wind mill application
 - ii) Design of gearbox for sluice gate application.
 - iii) Design of gearbox for machine tool applications like Lathe, Drilling, Milling machines etc.
 - iv) Design of in-line gearbox for Automobile application.
 - v) Design of gearbox for building Elevator
 - vi) Design of gearbox for Hoist.
 - vii) Design of gearbox for 2 wheeler .
 - viii) Design of gearbox for Tumbling barrel (Mixer).
 - ix) Design of gearbox for Cannon adjustment mechanism (Military application).
 - x) Design of gearbox for Worm gear box for Sugar Industry.
2. Presentation (PPT/slides) (on following topics (Any Two):
 - i) Application of belt drive and its selection method for Industrial application. (By using Manufacturer's Catalog).
 - ii) Application of chain drive and its selection method for Automobile application. (By using Manufacturer's Catalog).
 - iii) Mounting of machine elements on transmission shaft (like Bearings, gears, Pulley, Sprocket, etc).
 - iv) Selection of Bearing from Manufacturer's Catalog.
 - v) Construction and details of Gears.

Savitribai Phule Pune University, Pune

TE Mechanical (2015 course)

Course Code: 302049

Course Name : Refrigeration and Air Conditioning

Teaching Scheme:	Credits	Examination Scheme:
TH : 03 hrs/week	TH:-- 03	TH In-Sem: -- 30
PR : 02 hrs/ week	OR:- 01	End-Sem: -- 70
		OR: -- 25

Prerequisites:

Basic Thermodynamics- Laws of thermodynamics, Ideal gas processes, Thermodynamic cycles, Properties of pure substance, Mollier Charts, Basic Psychrometry terms and process, Fluid properties, Fluid dynamics, Modes of heat transfer, Governing Equations in Heat Transfer, Extended Surfaces, Condensation and Boiling, Heat Exchangers.

Course Objectives:

- Learning the fundamental principles and different methods of refrigeration and air conditioning.
- Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
- Comparative study of different refrigerants with respect to properties, applications and environmental issues.
- Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
- Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Course Outcomes:

At the end of this course the students should be able to

- Illustrate the fundamental principles and applications of refrigeration and air conditioning system
- Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
- Present the properties, applications and environmental issues of different refrigerants
 - Calculate cooling load for air conditioning systems used for various
 - Operate and analyze the refrigeration and air conditioning systems.

Course Contents**Unit I: Applications of Refrigeration and Air Conditioning and Refrigerants [8 hrs]****Applications**

Domestic Refrigerator, Domestic Air Conditioners, Automotive Air Conditioners, Evaporative coolers, water coolers, Commercial Refrigeration- Dairy, Cold storage, Ice plant, Commercial Air Conditioning-Multiplex, Hospitals.

Refrigerants

Classification of refrigerants, Designation of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant: recovery reclaims, recycle and recharge.

Unit II: Vapour Refrigeration Systems [8 hrs]**Vapour compression systems**

Working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC, actual VCC, methods of improving COP using flash chamber, sub-cooling, liquid vapour heat exchanger, comparison of VCC with Reverse Carnot cycle.

Vapour absorption systems

Introduction, Working of simple vapour absorption system (VAS), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VAS, comparison between VCC and VAC

Unit III: Multiple pressure Refrigeration Systems [8 hrs]

Introduction, need of multistage system, Intermediate pressure, two stage compression with flash gas removal and liquid intercooler, single compressor with multiple evaporator: individual and multiple expansion valves, individual compressors, cascade system: application and numerical(numerical only by using p-h chart),

Introduction to cryogenics (Linde - Hampson cycle) and applications (no numerical treatment)

Unit IV: Psychrometry and Air conditioning load estimation	[8 hrs]
<p>Psychrometry Basic Psychrometry and processes, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Factors contributing to cooling load, Numerical based on load analysis</p> <p>Human Comfort Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements,</p>	
Unit V: Air Conditioning Systems	[8 hrs]
<p>Air Conditioning Systems Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning.</p> <p>Components of refrigeration and air conditioning systems Working of reciprocating, screw and scroll compressors, working of air cooled, water cooled and evaporative condensers, working of DX, Flooded, Forced feed evaporators, Expansion devices – Capillary tube, TXV, EXV, operating and safety controls.</p>	
Unit VI	[8 hrs]
<p>Air Distribution Systems</p> <p>Part A] Ducts Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, Methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design)</p> <p>Part B] Air handling unit Air handling unit, Fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke).</p>	
<p>Books:</p>	
<p>Text:</p> <ol style="list-style-type: none"> 1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill 2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983 3. McQuiston, — Heating Ventilating and air Conditioning: Analysis and Design 6th Edition, Wiley India 4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi 5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi, 1994. 6. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992 	

References:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi.
4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications
5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance
6. ASHRAE & ISHRAE handbook

Term-Work

The term work shall consist of minimum eight experiments out of the following (It should include the visit to cold storage plant or central air-condition plant) :

1. Test on Domestic Refrigerator for evaluation of EER
2. Test on vapour compression test rig
3. Test on air conditioning test rig
4. Test on ice plant test rig
5. Test on Heat Pump test rig
6. Test/visit on Vapour absorption refrigeration test rig
7. Estimation of cooling load of simple air conditioning system (case study)
8. Visit to cold storage plant.
9. Visit to any air conditioning plant
10. Thermal analysis of refrigeration cycle using suitable software
11. Installation and servicing of split air conditioner.

Savitribai Phule Pune University, Pune

TE Mechanical and Mechanical Sandwich (2015 course)

Course Code: 302050

Course Name : Mechatronics

Teaching Scheme:	Credits	Examination Scheme:
TH: -- 03 hrs/week	TH:--03	TH In-Sem: -- 30
Tut.: - 01 hr/week	OR:- 01	End-Sem: --70
		OR: --25

Course Objectives:

- Understand key elements of Mechatronics system, representation into block diagram
- Understand concept of transfer function, reduction and analysis
- Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
- Understand the system modeling and analysis in time domain and frequency domain.
- Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications

Course Outcomes:

On completion of the course, students will be able to –

- Identification of key elements of mechatronics system and its representation in terms of block diagram
- Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
- Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
- Time and Frequency domain analysis of system model (for control application)
- PID control implementation on real time systems
- Development of PLC ladder programming and implementation of real life system.

Course Contents	
UNIT 1: Introduction to Mechatronics, Sensors & Actuators	(08 Hrs)
Introduction to Mechatronics and its Applications; Measurement Characteristics: Static and Dynamic; Sensors: Position sensors- Potentiometer, LVDT, incremental Encoder; Proximity sensors-Optical, Inductive, Capacitive; Temperature sensor-RTD, Thermocouples; Force / Pressure Sensors-Strain gauges; Flow sensors-Electromagnetic; Actuators: Stepper motor, Servo motor, Solenoids; Selection of Sensor & Actuator.	
UNIT 2: Block Diagram Representation	(08 Hrs)
Introduction to Mechatronic System Design; Identification of key elements of Mechatronics systems and represent into Block Diagram; Open and Closed loop Control System; Concept of Transfer Function; Block Diagram & Reduction principles; Applications of Mechatronic systems: Household, Automotive, Industrial shop floor.	
UNIT 3: Data Acquisition	(08 Hrs)
Introduction to Signal Communication & Types-Synchronous, Asynchronous, Serial, Parallel; Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency; Interfacing of Sensors / Actuators to Data Acquisition system; 4 bit Successive Approximation type ADC; 4 bit R-2R type DAC; Current and Voltage Amplifier.	
UNIT 4: Programmable Logic Control	(08 Hrs)
Introduction to PLC; Architecture of PLC; Selection of PLC; Ladder Logic programming for different types of logic gates; Latching; Timers, Counter; Practical examples of Ladder Programming.	
UNIT 5: Frequency Domain Modelling and Analysis	(08 Hrs)
Transfer Function based modeling of Mechanical, Thermal and Fluid system; concept of Poles & Zeros; Stability Analysis using Routh Hurwitz Criterion; Bode Plots: Introduction to Bode Plot, Gain Margin, Phase Margin, Relative Stability Analysis, Frequency Domain Parameters-Natural Frequency, Damping Frequency and Damping Factor; Mapping of Pole Zero plot with damping factor, natural frequency and unit step response.	
UNIT VI: Control System	(08 Hrs)
Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems in parallel form; Unit step Response analysis via Transient response specifications: Percentage overshoot, Rise time, Delay time, Steady state error; Manual tuning of PID control; Linear Quadratic Control (LQR).	
Books:	
Text:	
<ul style="list-style-type: none"> • K.P. Ramchandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008 • Bolton, Mechatronics - A Multidisciplinary approach, 4th Edition, Prentice Hall, 2009. 	

References:

- Alciatore & Hristand, Introduction to Mechatronics and Measurement system, 4th Edition, Mc-Graw Hill publication, 2011
- Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006
- Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi
- C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi

Term Work shall consist of following assignments:

The common minimum submission mentioned in point 1 and 2 should comprise of the following. From the table below: Submission No. 04, 05, 10, 11 and 12 are mandatory; any one from 01 to 03, any one from 06 or 07, any one from 08 or 09.

Submission No	Title
01	Measurement of Load / Force using a suitable sensor
02	Measurement of Temperature using a suitable sensor
03	Measurement of Position using a suitable sensor
04	Demonstration of any one of the following applications: <ul style="list-style-type: none">• Water Level Indicator• Bottle Filling Plant• Pick and Place Robot• Any other suitable application which comprises of components of Mechatronic system
05	Interfacing of suitable sensor with Data Acquisition system
06	Ladder Diagram simulation, using suitable software, for logic gates
07	Real time application of PLC using Ladder logic
08	Real time control of Temperature / Flow using PID control
09	Real time control of speed of DC motor using PID control
10	PID control Design, Tuning using suitable Simulation Software
11	Study of Modeling and Analysis of a typical Mechanical System (Estimation of poles, zeros, % overshoot, natural frequency, damping frequency, rise time, settling time)
12	Case Study: Design of Mechatronic System (to be performed in a group of 4)

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302051

Course Name : MANUFATCURING PROCESS – II

Teaching Scheme:

Credits

Examination Scheme:

TH: -- 3 Hrs/ Week

TH:03

TH In-Sem: -- 30

End-Sem: -- 70

Course Objective:

1. To analyze and understand the metal cutting phenomena.
2. To select process parameter and tools for obtaining desired machining characteristic
3. To understand principles of manufacturing processes.

Course Outcome:

1. Student should be able to apply the knowledge of various manufacturing processes.
2. Student should be able to identify various process parameters and their effect on processes.
3. Student should be able to figure out application of modern machining.
4. Students should get the knowledge of Jigs and Fixtures for variety of operations.

Course Contents

Unit – I Theory of Metal cutting

(07hrs)

Single point cutting tool: Tool geometry, Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on machining.

Merchant's circle of forces (analytical) Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation, Calculation of Total power and Specific energy. Introduction to tool dynamometers.

Machinability - Factors affecting machinability, Tool life, Tool wear, Types of tool wear and remedial actions, Cutting fluid and their types, Effect of process parameters on tool life, Taylor's tool life equation (Derivation along with numerical).

Unit – II Machine tools and their application

(07 hrs)

Drilling machine: Types of drills and operations. Twist drill geometry, Types of drilling machine, Tool holder. Machining time calculations.

Milling machine: Types of milling machines, Cutter-types and geometry and their applications. Universal dividing head, Methods of Indexing: Simple, Compound, Differential. (Numericals based on simple and compound Indexing).Machining time calculations

Broaching: Introduction to broaching, Broach tool geometry, Planner and Boring Machines: Introduction.

<p>Unit – III Finishing processes (07hrs)</p> <p>Grinding machines</p> <p>Introduction: Types and Operations of grinding machines.</p> <p>Grinding wheel – Shapes, Designation and selection, Mounting, Balancing and Dressing of grinding wheels, Machining time calculation for cylindrical and plunge grinding.</p> <p>Super-finishing processes – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)</p>
<p>Unit – IV Advanced Machining Processes (07 hrs)</p> <p>Introduction, classification of advanced machining processes.</p> <p>Principles, Working, Process Parameters, Advantages, Limitations and Application for following processes:</p> <p>Electric Discharge Machining (EDM), LASER Beam Machining (LBM), Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM) and Electro Chemical Machining (ECM)</p> <p>Introduction to micro machining.</p>
<p>Unit –V CNC Technology (07 hrs)</p> <p>Introduction, Classification, Construction and working of NC, CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC)</p> <p>CNC Programming: Word address format (WAF) –ISO Standards, G & M codes, Type of CNC Control systems, Manual part programming (plain milling and Turning), Subroutine, Canned cycles.</p>
<p>Unit –VI Jigs and fixtures (07 hrs)</p> <p>Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs and fixtures, advantages of jig and fixtures</p> <p>Jigs: Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch type jig.</p> <p>Fixtures: Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Introduction to Assembly and Inspection fixtures. Indexing fixtures.</p> <p>Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures.</p>
<p>Books:</p>
<p>Text:</p> <ol style="list-style-type: none"> 1. S. K Hajra Choudhury , Elements of workshop technology – Vol. II., Media Promoters And Publishers, Mumbai 2. Amitabh Ghosh and Asok kumar Mallik, Manufacturing science, Ellis Horwood Ltd 3. Mikell. P. Grover, Fundamentals of Modern Manufacturing, Pearson Publications 4. P. C. Sharma, Production Engineering, S. Chand Publication.

References:

1. Production technology –HMT, Tata McGraw Hill publication
2. Lindberg, Roy A., Processes and materials of manufacture, P H I Learning
3. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson Education, Fourth Edition.
4. G. K Lal, Fundamentals of Design and Manufacturing, Alpha Science International Ltd(2005)
5. M.C Shaw, Metal Cutting Principles, Oxford university press
6. Yoram Koren , Numerical Control of Machine Tools Khanna Publication
7. P. K Mishra, Non- conventional machining, Narosa Publishing House
8. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi
9. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS
10. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill
11. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education, Third Edition.
12. Cyrll Donaldson, George H. LeCain and V. C. Goold, Tool design, Tata McGraw- Hill. Third Edition

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302052

Course Name : MACHINE SHOP – II

Credits	Examination Scheme:
PR: -2 Hrs/ Week	
TW:-01	TW: 50

Course Objective:

1. To set the manufacturing set-up appropriately and study the corresponding set up parameters.
2. To select appropriate process parameter for obtaining desired characteristic on work piece.
3. To understand the operational problems and suggest remedial solution for adopted manufacturing process.

Course Outcome:

1. Ability to develop knowledge about the working and programming techniques for various machines and tools

Term-Work

Each student must complete and submit following term work:

I. Jobs (Both the following jobs should be completed individually)

- a. Any one marketable assembly consisting of at least three components with tolerance involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement.
- b. Development and execution of one simple turning job on CNC (Trainer)

machine.

II. Journal consisting of following assignments.

- a. Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)
- b. Process planning sheets for job 1.a and 1.b.
- c. Report based on industrial visit to manufacturing plant.

Note: - Practical are to be performed under the guidance of concerned faculty member.
Job drawing essentially consisting of Geometric Dimensioning and Tolerance

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302053

Course Name : SEMINAR

Teaching Scheme:

Credits

Examination Scheme:

PR:-- 2 Hrs/Week

OR:--01

TH In-Sem: --

End-Sem: --

TW: -- 25

OR: -- 25

Prerequisites:

Course Objective:

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Course Outcome:

With this seminar report and presentation, the student is expected to learn/achieve the following:

- Establish motivation for any topic of interest and develop a thought process for technical presentation.
- Organize a detailed literature survey and build a document with respect to technical publications.
- Analysis and comprehension of proof-of-concept and related data.
- Effective presentation and improve soft skills.
- Make use of new and recent technology (e.g. Latex) for creating technical reports

Course Contents:

The evaluation of the seminar report is proposed with the following stages.

Stage-I

In this stage the student is expected to deliver the following:

1. Topic selection
2. Literature review
3. State of the art related to the topic of interest

Stage-II

1. Problem statement
2. Methodology
3. Scope and objectives

A review of the student's progress should be made after In-Sem examination, within a week. During this review, the student is expected to complete Stage-1 and Stage-2.

Stage-III

1. Quantification of results
2. Concluding remarks or summary

Stage-IV

3. Final report
4. Final presentation/viva

The final presentation/viva will be assessed by a committee including an expert (preferably from industry with minimum 5 years experience) and an internal panel. The internal panel will consist of the seminar guide and two subject experts, approved by the HOD and the principal of the institute.

Examination schedule will be prepared at institute level (and not at University level), though it is under Oral head. The appointment of the internal panel and the external (industrial) expert will be taken care by the respective institute. The seminar presentation will be held after the term end and before university external viva

Contents of the Seminar report

The contents of the seminar report as mentioned in section-3 are expected to include the following:

- Abstract/Summary
- Introduction: Scope and Methodology
- Literature review: The review should be conducted from at least five research papers published during last five year.
- Case study
- References

Instructions for seminar report writing

It is important that the procedures listed below be carefully followed by all the students.

1. Prepare two spiral bound copies of your Seminar report.
2. Limit your seminar report to preferably 20 to 25 pages only.
3. Header For e.g. Title of the seminar.
4. The footer For e.g. page numbers
5. Institute Name, Mechanical Engineering and centrally aligned.
6. The report shall be prepared using LateX preferably (default font throughout) with double spacing throughout on A4 page.

Page	Left margin	Right margin	Top margin	Bottom margin
A-4 (8.5 11 inch)	1.5"	1"	1"	1"

7. Section titles should be bold typed in all capital letters and should be left aligned.
8. Sub-Section headings should be aligning at the left, bold and Title Case (the first letter of each word is to be capitalized).
9. Figure No. and Title at bottom with 10 pt; Legends below the title in 10 pt
10. Please use SI system of units only.
11. References should be either in order as they appear in the report or in alphabetical order by last name of first author.
12. Symbols and notations if any should be included in nomenclature section only

The report will be made in the following order:

1. Cover page and Front page as per specimen on separate sheet
2. Certificate from Institute as per specimen on separate sheet
3. Acknowledgement
4. List of Figures
5. List of Tables
6. Nomenclature
7. Contents
8. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, and for subheadings 1.1, 1.2, etc and section subheadings 2.1.1, 2.1.2, etc.
9. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it. Please follow the following procedure for references

Reference Books: Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3 rd ed., Oxford University Press, UK, 1996, pp. 110 112.

Papers from Journal or Transactions:

1. Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 98.
2. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 505.

Papers from Conference Proceedings:

1. Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 40.

Reports, Handbooks etc.

1. United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent: Patent no, Country (in parenthesis), date of application, title, year.

Web-links: www.(Site) [Give full length URL]

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054

Course Name : Audit Course I :- Fire & Safety Technology

Teaching Scheme:	Credits	Examination Scheme: Audit (P/F) Written and MCQ	
PR:	Th/Tut:--	TH	In-Sem: --
			End-Sem: --
Tut:	TW:		PR: --
			OR: --

Description:

To generate, develop and sustain a voluntary movement on Fire & Safety Engineering at the National Level aimed at educating and influencing society to adopt appropriate policies, practices and procedures that prevent and mitigate human suffering and economic loss arising from all types of accidents.

Course Objective:

On completion of this Basic Fire Safety Course, participants will be able to:-

- Describe the chemistry of fire
- Identify fire hazards in the workplace
- Follow evacuation procedures
- Select and use appropriate firefighting equipment

Course Outcome:**• Students will be able**

1. To create and sustain a community of learning in which students acquire knowledge in fire, safety and hazard management and learn to apply it professionally with due consideration for ethical, human life & property safety issues.
2. To pursue research and development in fire safety engineering, hazard management and disseminate its findings.
3. To meet the challenges of today and tomorrow in the most effective, efficient and contemporary educational manner.
4. To help in building national capabilities in fire safety engineering, disaster management, hazard management, industrial safety education through practical training to ensure a fire safe nation.

Course Contents:

1. Fire & Safety Overview

Fire & safety legislation, Safety Personnel Supplier for construction sites/commissioning of plants. Understanding the physics and chemistry of fire. Development and spread of fire. Action in the event of fire

2. Fire Fighting Techniques

Means of raising alarm, means of summoning the fire brigade, action on hearing the fire alarm
Evacuation procedures Practical demonstration in the use of foam and CO₂ fire extinguishers using our state of the art gas fired training system.

3. Fundamentals of Fire Engineering Science

Fire Tech & Design, Fire Risk Assessment, Fire Control Technology, Fire Fighting Drills, Fire Tender with Crew on Hire. Fire & Safety Audit. Fire & Safety Consultancy Services.

4. Industrial Aspects of Fire & Safety

Industrial Training on Fire & Safety and Disaster Management. Repair of all kinds of Fire Equipment including Flooding System. Repair of Fire Tender including Pump and power take-off systems.

5. Maintenance of Fire Safety Equipments

AMC of Fire System. Refilling of Fire Extinguishers. Ultrasonic Thickness Test of Extinguishers, Vessels and Pipe lines. Hydro Testing of Fire Extinguishers, Vessels and Pipe Lines. Supply of Fire & Safety Equipment and Spares.

Case Study & Group Work:

- Identification of fire & safety technology
- To study the Fire Fighting Properties of Foam Concentrate
- Case Studies of Salvage operations in different types of occupancy
- Design and drawing of parts contained in the syllabus
- Compilation of Results & Presentation
- Case Study on the projects (products or processes) carried out by your institution or an organization in your vicinity, for safety.

Books:**References:**

1. Accident Prevention manual for Industrial Operations, NSC, Chicago 1982.
2. The manual of fire ship – 6 – A by HMSO
3. Electricity Fire Risks – G.S. Hodges
4. Fire Pumps and Hydraulics: I.E. Ditts and T. M. Harris.
5. Fire Service Manual (Volume 2) Fire Service Operations – Petrochemical Incidents
6. The Principles and Practice of Fire Salvage Operation by Fire Salvage association.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054

Course Name : Audit Course II - Entrepreneurship Development

Teaching Scheme:	Credits	Examination Scheme: Audit (P/F) Written and MCQ	
PR:	Th/Tut:--	TH	In-Sem: --
			End-Sem: --
Tut:	TW:		PR: --
			OR: --

Description:

EDP is a program meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

This course will help in developing the awareness and interest in entrepreneurship and create employment for others. Students get familiar with the characteristics and motivation of successful entrepreneurs. Students learn how to identify and refine market opportunities, how to secure financing, how to develop and evaluate business plans and manage strategic partnerships. Students learn various concepts including the basics of management, leadership, motivation, decision-making, conflict management, human resource development, marketing and sustaining an organization. Students also get basic knowledge of accounting practices and finance. The core course in Entrepreneurship Development & Management equips students with skills and knowledge required to start and sustain their own business.

Course Objective:

- To impart basis managerial knowledge and understanding;
- Develop and strengthen entrepreneurial quality, i.e., motivation or need for achievement.
- To analyze environmental set up relating to small industry and promoting it.
- Collect and use the information to prepare project report for business venture.
- Understand the process and procedure involved in setting up small units.
- Develop awareness about enterprise management.

Course Outcome:**The students will be able to**

- Appreciate the concept of Entrepreneurship
- Identify entrepreneurship opportunity.
- Develop winning business plans

Course Contents:

Entrepreneurship- Definition; Growth of small scale industries in developing countries and their positions large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries Government policy for small scale industry; stages in starting a small scale industry, requirements to be an entrepreneur, SWOT Analysis.

Projects: Identification and Selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Market Assessment and Product feasibility

Marketing -Concept and Importance Market Identification,
Customer needs assessment, Market Survey Product feasibility analysis

Business Finance & Accounts

Business Finance: Costing basics, Sources of Finance, Break Even Analysis,

Business Accounts: Preparation of balance sheets and assessment of economic viability, decision, making, expected costs, planning and production control, quality control, marketing, Book Keeping, Financial Statements, Financial Ratios and its importance, Concept of Audit.

Project Planning and control:

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.

Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations, E-Commerce: Concept and process, government policies for small scale enterprises.

Case Study & Group Work:

- Assess yourself-are you an entrepreneur?
- Prepare a Project Report for starting a small scale business.
- An Interview with an Entrepreneur.

Books:**References:**

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Khanka, S. S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
4. Badhai, B 'Entrepreneurship for Engineers', Dhanpat Rai & co. (p) Ltd.
5. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
6. Gupta and Srinivasan, 'Entrepreneurial Development', S. Chand & Sons, New Delhi.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054

Course Name : Audit Course III - Intellectual Property Right

Teaching Scheme:	Credits	Examination Scheme: Audit (P/F) Written and MCQ	
PR:	Th/Tut:--	TH	In-Sem: --
			End-Sem: --
Tut:	TW:		PR: --
			OR: --

Objective:

Intellectual property refers to the rights which are attached to the creation of the mind and which take the form of a property. Though intangible in nature, intellectual property has become the driving force of many companies today. Fortune 500+ companies undoubtedly are the best examples of what a company can achieve through the proper understanding and management of IPR.

Thus the study of intellectual property rights is inevitable for managers, considering the fact that India is fast emerging as an economy with considerable investment in cutting-edge research and development. India is also emerging as an economy where foreign companies propose to invest considerably, both technically and financially, provided proper protection is guaranteed to their intangible assets which form the cornerstone of their business.

Topics:

1. Introduction

- Concepts of IPR
- The history behind development of IPR
- Necessity of IPR and steps to create awareness of IPR

2. IP Management

- Concept of IP Management
- Intellectual Property and Marketing
- IP asset valuation

3. Patent Law

- Introduction to Patents
- Procedure for obtaining a Patent
- Licensing and Assignment of Patents
 - Software Licensing
 - General public Licensing
 - Compulsory Licensing
- Infringement of Patents
- Software patent US and Indian scenario

4. Copyrights

- Concept of Copyright Right
- Assignment of Copyrights
- Registration procedure of Copyrights
- Infringement (piracy) of Copyrights and Remedies
- Copyrights over software and hardware

5. Designs

- Concept of Industrial Designs
- Registration of Designs
- Piracy of registered designs and remedies

6. Trademark Law

- Concept of trademarks
- Importance of brands and the generation of “goodwill”
- Trademark registration procedure
- Infringement of trademarks and Remedies available
- Assignment and Licensing of Trademarks

Case Study & Group Work:

- Identify the projects (products or processes) carried out by your institution or an organization in your vicinity, which have been patented.
- A case study on significance of patents for a developing nation like India.
- Group discussion on creative / novel ideas and the feasibility of converting the idea into product or process.
- Discussion on Correlation between IPR and Entrepreneurship in the backdrop of Make in India Initiative.

References:

1. Ganguli Prabuddha, 'Intellectual Property Rights: Unleashing the knowledge economy', Tata McGraw Hill, New Delhi
2. Wadehra R. L., 'Law Relating to patents, trademarks, copyrights, designs and geographical indicators – 2nd', Universal Law Publishing.
3. Narayan P. S. 'Intellectual Property Law in India', Asia Law House Hyderabad.

<p style="text-align: center;">Savitribai Phule Pune University, Pune Third Year of Mechanical, Mechanical Sandwich & Automobile (2015 Course)</p>			
Course Code: 302054		Course Name : Audit Course IV - Lean Management	
Teaching Scheme:	Credits	Examination Scheme: Audit (P/F) Written and MCQ	
PR:	Th/Tut:--	TH	In-Sem: --
			End-Sem: --
Tut:	TW:		PR: --
			OR: --
Course Objective:			
<ul style="list-style-type: none"> • To learn Lean Thinking and its applications • To get knowledge of Tools & Techniques used in Lean Management • To understand Business Impact of Lean Management 			
Course Outcome: Students			
<ul style="list-style-type: none"> • Will be able to do practice Lean Management at the workplace • Will be able to contribute in Continuous Improvement program of the Organization 			
Course Contents:			
<ul style="list-style-type: none"> • Brief History of Lean Thinking • Toyota Production System • Five Steps to Lean • Seven Types of MUDA – Waste in Manufacturing • MURA – Unevenness / Fluctuation • MURI – Overburden, Physical Strain • Lean Tools & Techniques • Value Stream Mapping • Five ‘S’ • Visual Management • Plan-Do-Check-Act (PDCA) • Kanban • Lean Distribution • Various Lean Management Systems • Just In Time Production • Total Quality Management (TQM) • Total Productive Maintenance (TPM) • Problem Solving Techniques • A3 Reporting Technique 			

Books:**References:**

1. Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Second Edition James P. Womack and Daniel T. Jones, Free Press, June 2003, ISBN: 0743249275
2. Learning to See: Value Stream Mapping to Create Value and Eliminate Muda Mike Rother and John Shook, Lean Enterprise Institute, June 2003, ISBN: 0966784308
3. Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Second Edition Pascal Dennis, Productivity Press Inc, September 2007, ISBN: 9781563273568
4. Gemba Kaizen: A Commonsense, Low-Cost Approach to Management Masaaki Imai, McGraw-Hill, March 1997, ISBN: 0070314462
5. World of Kaizen : By Shyam Talawadekar Paperback Publisher: Kaizen Publisher; 4 th edition (2016) ISBN-10: 819326780X ISBN-13: 978-8193267806

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054

Course Name : Audit Course V - Smart Manufacturing

Teaching Scheme:	Credits	Examination Scheme: Audit(P/F) Written and MCQ	
PR:	Th/Tut:--	TH	In-Sem: --
			End-Sem: --
Tut:	TW:		PR: --
			OR: --

Description:

Smart Manufacturing is an amalgamation of Information Technology, Cloud Computing & traditional Mechanical, Production Engineering towards achieving excellence in manufacturing. Maximum results with minimum resources being used. The course will introduce the concepts of Smart Manufacturing, how various technologies can be leveraged to achieve minimum breakdowns, First Time Right Production, 100% Delivery on Time with minimum turnaround time. Nine Pillars of Smart Manufacturing will be explained to the Students.

The course will make the students aware of developments in Technology those are going to alter the Traditional Manufacturing scenario. The following topics may be broadly covered in the classroom. The practical will be in the form of Group Discussion based on Case Study.

Course Objective:

- To know more about Smart Manufacturing & Industry 4.0
- To get knowledge of various converging Technologies
- To prepare ourselves for the ever changing Manufacturing Techniques

Course Outcome: The students will be

- Comfortable with terminology and practices in Smart Manufacturing
- Able to face the challenges in Industry & also contribute towards advancement.
- Active part of Industry 4.0 (Fourth Industrial Revolution)

Course Contents:

- Introduction to Industry 4.0
- Historical Background
- Nine Pillars of Smart Manufacturing
- Big Data & analytics
- Autonomous Robots
- Simulation
- Universal System Integration
- IIOT – Industrial Internet of Things
- 3 D Printing – Additive Manufacturing
- Cloud Computing
- Augmented Reality
- Convergence of Nine Pillars
- Business Propositions delivered with Smart Manufacturing
- Adding Smartness to Manufacturing – Adoption & Scaling
- Economic Aspects
- Ecosystem Required for Smart Manufacturing
- Skill set Required for Smart Manufacturing
- Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing

References:

1. Smart Manufacturing by Shoukat Ali; Publisher: LAP LAMBERT Academic Publishing (10 August 2016)Language: EnglishISBN-10: 3659933554ISBN-13: 978-3659933554
2. Industry 4.0: The Industrial Internet of Things 2016by Alasdair Gilchrist (Author)
Publisher: Apress; 1st ed. edition (30 July 2016)
Language: English
ISBN-10: 1484220463
ISBN-13: 978-1484220467
3. Industry 4.0 Data Analytics31 July 2016 by Rajesh Agnihotri and Samuel New
Publisher: CreateSpace Independent Publishing Platform (31 July 2016)
Language: English
ISBN-10: 1534778284
ISBN-13: 978-1534778283
4. 3D Printing: The Next Industrial Revolution4 May 2013by Christopher Barnatt
Publisher: Createspace Independent Publishing Platform (4 May 2013)
Language: English
ISBN-10: 148418176X
ISBN-13: 978-1484181768
5. Augmented Reality: Principles and Practice by Dieter Schmalstieg and Tobias Hollerer
Publisher: Pearson Education; First edition (5 October 2016)
Language: English
ISBN-10: 9332578494
ISBN-13: 978-9332578494

LIST OF EXPERIMENTS / CASE STUDIES

Case Study & Group Work:

- Identification of areas where Smart Manufacturing can flourish
- Business Goals achieved through Smart Manufacturing
- Compilation of Results & Presentation

SavitribaiPhule Pune University
B. E. (Mechanical) (2015 Course) Semester – I

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Theory	TW/Pr /OR
402041	Hydraulics and Pneumatics	3	-	2	30	70	25	-	25	150	3	1
402042	CAD CAM Automation	3	-	2	30	70	25	50	-	175	3	1
402043	Dynamics of Machinery	4	-	2	30	70	25	-	25	150	4	1
402044	Elective-I	3	2	-	30	70	25	-	-	125	3	1
402045	Elective-II	3	-	-	30	70	-	-	-	100	3	-
402046	Project-I	-	-	4	-	-	25	-	25	50	-	2
Total		16	2	10	150	350	125	50	75	750	16	6
											22	

B. E. (Mechanical) (2015 Course) Semester – II

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Theory	TW/Pr /OR
402047	Energy Engineering	3	-	2	30	70	25	-	25	150	3	1
402048	Mechanical System Design	4	-	2	30 (1.5 hours)	70 (3 hours)	25	-	50	175	4	1
402049	Elective-III	3	-	2	30	70	25	-	--	125	3	1
402050	Elective-IV	3	-	-	30	70	-	-	-	100	3	1
402051	Project-II	-	-	12	-	-	100	-	100	200	-	6
Total		13	-	18	120	280	175	-	175	750	13	9
											22	

Code	Elective-I	Code	Elective-II	Code	Elective-III	Code	Elective-IV
402044 A	Finite Element Analysis	402045 A	Automotive	402049 A	Tribology	402050 A	Advanced Manufacturing Processes
402044 B	Computational Fluid Dynamics	402045 B	Operation Research	402049 B	Industrial Engineering	402050 B	Solar & Wind Energy
402044 C	Heating Ventilation and Air Conditioning	402045 C	Energy Audit and Management	402049 C	Robotics	402050 C	PDD
		402045 D	Open Elective**			402050 D	Open Elective**

****:** Open Elective – Board of studies (BoS) – Mechanical and Automobile Engineering will declare the list of subjects, which can be taken under open electives or any other Electives that are being taught in the current semester, to the same level, as Elective – II and Elective -IV under engineering faculty or individual college and Industry can define new elective with proper syllabus using defined framework of Elective II and Elective IV and GET IT APPROVED FROM BOARD OF STUDIES AND OTHER NECESSARY STATUTORY SYSTEMS IN THE SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE, BEFORE 30th NOVEMBER of previous academic year in which the subject to be introduced . Without prior approval from University statutory system, no one can introduce the open elective in curriculum.