Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 701: Refrigeration and Air Conditioning

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand fundamentals of refrigeration systems
2.	To apply knowledge for various applications of refrigeration, air conditioning and cryogenics
3.	To design refrigeration system and compute cooling load
4.	To analyze various refrigeration systems for thermal performance

Course Contents

		Hours
Unit I	**Recapitulation of Fundamentals** Various fundamental methods of refrigeration, Commercial unit, Energy Efficiency Ratios (EER), BEE star rating Reversed Carnot cycle, Limitations of Carnot cycle **Simple Vapour Compression System** Classical development of vapour compression refrigeration system, Use of phase change (evaporator and condenser), Dry versus wet compression, Throttling versus isentropic expansion, Standard VCRS, Representation on P-h, T-s diagram, Actual VCR cycle, Refrigerator and heat pump, their relationship, Reversed Brayton or Reversed Joule or Bell Coleman cycle (numerical treatment), Various Air standard refrigeration cycles used for cooling of aircraft cabins (descriptive treatment)	**06**
Unit II	**Multi Pressure System** Effect of operating conditions: effect of evaporator pressure, effect of condenser pressure, effect of suction vapour superheat, effect of liquid sub cooling (numerical treatment), Multi-evaporator, Multi-compressor, Individual and multiple expansion valves, Flash gas inter-cooling, Removal of flash gas, Need for multi pressure system and cascade system, Dry-ice refrigeration system	**06**

Unit III	**Non-Conventional Refrigeration System** **Vapour Absorption Systems** Need and comparison VCRS, Properties of refrigerant-absorbent pair, Ammonia-Water system, Water-Lithium Bromide absorption system and functioning of each component **Steam Jet Refrigeration System** Schematic component diagram, Sample calculations, Use and limitations **Magnetic Refrigeration System** Introduction, working, scope and limitations **Refrigerants** Classification & ASHRAE nomenclature of refrigerants, Desirable properties of refrigerants. Comparison among commonly used refrigerants, Effect on Ozone depletion and global warming, Alternative refrigerants. Environmental protection protocol and India's commitment	**08**
Unit IV	**Psychrometry** Definition of air conditioning, Psychometric properties of moist air, Use of psychometric tables and charts, Processes, ADP, Sensible heat factor, Bypass factor, Air washer and its applications **Human Comfort** Thermal exchange between human body and environment, Factors affecting comfort, Effective temperature comfort chart, Ventilation requirements	**06**
Unit V	**Load Calculation and Applied Psychometrics** Design of air conditioning systems, Different heat sources, Adiabatic mixing of two air streams, Sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point, Ventilation and infiltration, Inside and outside design conditions Introduction to unitary products viz. Room/Split and packaged air conditioners, Central air conditioning systems	**08**
Unit VI	**Applications of Refrigeration & Air Conditioning System** Cold storage plant, Energy conservations and green buildings, Freeze drying, Pharmaceutical and hospital air conditioning, Textile and car air conditioning (plant layout, system components and design considerations) **Cryogenics** Definition, Methods of producing cryogenic temperature, Liquefaction of gases- N_2, H_2, He, Linde Cycle, Application of Cryogenics: Medical applications, Space applications, production engineering applications, Superconductivity, Magnetic levitation	**06**

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand fundamentals of HVAC systems
2.	Apply knowledge for various applications of refrigeration, air conditioning and cryogenics
3.	Design refrigeration system and compute cooling load
4.	Analyze various refrigeration systems for thermal performance
Text Books:	
1.	C. P. Arora, "Refrigeration & Air-Conditioning", Tata McGraw Hill, 3rd Edition, 2010
2.	Jordan & Priester, "Refrigeration & Air Conditioning", Prentice-Hall India, 2nd edition, 1973
3.	Manohar Prasad, "Refrigeration & Air-Conditioning", New Age Intl. Publications, 3rd 2010
References:	
1.	ASHRAE Handbook, Fundamentals, 2013
2.	Carrier Handbook of Air Conditioning System Design, 2017
3.	Roy J. Dossat, "Principles of Refrigeration", Wiley Eastern Limited, New Delhi
4.	W. P. Jones, "Air Conditioning Engineering", Elsevier,5th Edition
5.	P. N. Ananthanarayan "Basic Refrigeration and Air Conditioning", Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (1981)
6.	W. P. Jones, "Air Conditioning Applications and Design", Elsevier, 2nd Edition

Useful Links:	
1.	http://nptel.ac.in/courses/112105128/
2.	http://nptel.ac.in/downloads/112105129/
3.	http://nptel.ac.in/courses/112107208/
4.	https://www.beestarlabel.com/
5.	http://www.emersonclimate.com/europe/ProductDocuments/CopelandLiterature/SGE127-Emerson-General-Product-Catalogue-2017-EN_1.pdf
6.	http://www.emersonclimate.com/en-US/Brands/Vilter/Pages/brochure.aspx

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**A**	**b**	**c**	**d**	**E**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1				✓					✓		✓				
CO2		✓	✓	✓	✓						✓	✓		✓	✓
CO3	✓	✓	✓	✓	✓						✓	✓			
CO4	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	2	10
Understand	3	3	1	12
Apply	4	4	2	10
Analyze	3	3	2	10
Evaluate	2	2	2	10
Create	0	1	1	08
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME702: Finite Element Analysis

Teaching Scheme			**Examination Scheme**	
Lectures	03hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the Finite Element Analysis fundamentals
2.	To apply finite element formulation techniques and derive the finite element equations for 1D and 2D problems
3.	To create and analyze basic problems in solid mechanics, heat transfer and fluid mechanics
4.	To design model using commercial software to solve basic engineering problems and view results
5.	To develop computer program in MATLAB based on finite element analysis

Course Contents

		Hours
Unit I	**Review of Theory of Elasticity** Stress tensor, Stress and equilibrium, Strain – displacement relations, Stress – strain relations, Plane stress, Plane strain and axisymmetric conditions, Temperature effects, Von-Mises stress **Review of heat transfer and fluid flow** Steady and transient heat transfer equations, Continuity, momentum and energy conservation equations, Concept of domain and boundary conditions, Dependent and independent variables in engineering analysis, etc. **Introduction to finite element method** General steps in FEM using simple 1-D element for stepped bar (axial and torsion loading), Thermal analysis of composite slab, Element stiffness matrix by direct stiffness method, Assembly of the global stiffness matrix (K) and load vector, Properties of K, Band width, Imposing boundary conditions; Calculations for displacements, strains and stresses	07

Unit II	**Introduction to variational and approximate methods for solving differential equations** Functional, extremization of functional, Obtaining the variation from a differential equation, Principle of minimum potential energy, Rayleigh-Ritz method **Weighted residual methods** Galerkins method, Least square method, Collocation method and sub domain method	07
Unit III	**Discretization of problems** Geometrical approximations, Simplification through symmetry, Basic element shapes and behavior, Choice of element type, size and number of elements, Convergence, Element shape and distortion, Node and element numbering, Location of nodes **Interpolation functions** Linear, quadratic and cubic interpolation functions, Constant Strain Triangle (CST) and Linear Strain Triangles (LST), Natural coordinates, Iso-parametric representation	07
Unit IV	**Axisymmetric solids subjected to axisymmetric loading** Modeling rotating flywheel, pressure vessel and stress calculations **Analysis of Trusses** Plane trusses, Local and Global coordinate systems, Formulas for calculating *l* and *m*, element stiffness matrix, Stress Calculations, Assembly of global stiffness matrix	07
Unit V	**Dynamic Analysis** Formulation of finite element model, Element consistent and lumped mass matrices, Evaluation of eigen values and eigen vectors, Free vibration analysis **Modeling scalar Field Problems** Introduction, Steady state heat transfer and fluid flow, One dimensional heat conduction, One dimensional heat transfer in thin fins, Two dimensional steady state heat conduction, Two dimensional fins	07
Unit VI	**Computer Implementation of the Finite Element Method: Pre-processing** Model definition – Nodal coordinates element connectivity,	05

	Material and element type and property definitions, Type of analysis (static/modal), Loading and boundary conditions. Meshing techniques- Free and mapped meshing, Quality checks – Aspect ratio, Warp angle, Skew, distortion, Stretch, Included angle, Taper, Model validity, Accuracy and convergence **Processing** Element level calculations, Equation assembly, Equation solver (sparse solvers, factorization, numerical/computational issues) **Post Processing** Strain and stress recovery (integration and nodal points), Interpretation of results (results validation and data interpretation) and design modification	

Course Outcomes (CO): Upon successful completion of this course the student should be able to:	
1.	Understand the application and characteristics of FEA elements such as bars, beams, plane and isoparametric, and 3-D elements.
2.	Apply the variational methods and weighted residual methods in FEM
3.	Analyze basic problems in solid mechanics, heat transfer and fluid mechanics
4.	Design and develop model using commercial software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer
5.	Develop computer program in MATLAB based on finite element analysis
Text Books:	
1.	S. S. Rao, "Finite Element Method in Engineering", Elsevier Publication, 4th Edition, 2004
2.	P. Seshu, "*Textbook of Finite Element Analysis",* 1st Edition
3.	Chandr Apatala, Belgundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India, 3rd Edition
4.	M. J Fagan, "*Finite Element Analysis- Theory and Practice";* Longman Scientific & Technical, 1st Edition, 1992
References:	
1.	J. N. Reddy, "*An Introduction to Finite Element Method*", Tata McGraw Hill publication co. 2nd Edition, 1993
2.	Logan D. L. "*A first course in Finite Element Method*", Cengage learning, 4th Edition, 2008
3.	S. S. Deshpande, S. V. Bedekar, A. N. Thite, "Practical Finite Element Analysis", N. S. Gokhale, Finite to Infinite Publication

Useful Links:	
1.	http://nptel.ac.in/courses/112104193/
2.	http://feaforall.com/
3.	http://www.open.edu/openlearn/science-maths-technology/introduction-finite-element-analysis/content-section-1.5
4.	http://www.ansys.com/

Mapping of COs with POs

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**A**	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓												✓		
CO2	✓	✓	✓	✓	✓								✓		
CO3	✓	✓	✓	✓	✓			✓					✓		
CO4	✓	✓	✓	✓	✓		✓					✓	✓		
CO5		✓						✓	✓				✓		

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	14
Apply	3	3	2	10
Analyze	4	4	3	14
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 703: Automobile Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the components and layout of automobile
2.	To implement the knowledge obtained in theory towards design and analysis of various automobile systems
3.	To analyze the effect of various factors on subsystems of automobile and remedies can be proposed
4.	To evaluate the performance of automobile

Course Contents		
Hours		
Unit I	**Introduction to Automobile Engineering** Automobile history and development, Current scenario in automobile industries, Classification of automobiles, Automobile subsystems, Role of the automobile industry in national growth. **Automobile Chassis** Types of chassis layout with reference to power plant locations and drive, Vehicle frames, Various types of frames, Constructional details, Loads acting on vehicle frame, Dimensions of automobile	**06**
Unit II	**Automobile transmission system** Classification of clutches, single plate, multi plate, cone, diaphragm spring, centrifugal, Clutch materials, Clutch plate, Electromagnetic clutch, Vacuum operated clutch, Necessity of gear box, Manual gear box-constant mesh, sliding mesh, synchromesh, epicyclic, fluid flywheel, torque convertor, Continuous variable transmission, Electronic transmission control, Overdrive, Propeller shaft, Universal joint, Differential and final drive, Rear axle drives - Hotchkiss drive, torque tube drive, Bearing loads due to lateral forces on the rear axle, Axle housing.	**08**
Unit III	**Front axle and steering mechanism, wheels and tyres** Front Axle, Bearing loads on the front axle, Fundamental condition for true rolling, Function of steering system, Steering	**06**

	geometry, Cornering force, Slip angle, Scrub radius, Steering characteristics, Steering linkages & gearbox, Ackerman steering gear, Davis steering gear, Power steering- hydraulic and electric, Collapsible steering, Reversibility of steering, Four-wheel steering **Wheel and tyres:** Wheel construction, Alloy wheel, Wheel alignment and balancing, Type of tyres, Tyre construction, Tyre materials, Factors affecting tyre life	
Unit IV	**Suspension & Brake System** **Suspension: F**unctions, Types of suspension linkages, Types of spring - leaf, coil, air springs, telescopic shock absorber, Hydro gas suspension, Rubber suspension, Interconnected suspension, Self-leveling suspension advances in suspension system, Air suspension. **Brakes**: Function, Principle, Types, mechanical, hydraulic and pneumatic brakes, Disc and drum types, Air brakes, Servo and power braking, ABS, Brake adjustments, Defects and causes.	**06**
Unit V	**Electrical and Electronics System** **Batteries:** Principles and construction of lead-acid battery, Characteristics of battery, Rating capacity and efficiency of batteries, Various tests on battery condition, Charging methods. **Lighting system & accessories:** Insulated & earth return systems, Positive & negative earth systems, Starter motor, Bendix drive, Solenoid drive, Electrical fuel pump, Speedometer, fuel, oil & temperature gauges, horn, wiper system, trafficator, sensors and actuators, electronic control unit. **Modern trends:** Sensors and actuators, Electronic control unit (ECU), Electronic stability program, Traction control devices, Electrical car layout, Hybrid drives, Hill hold, Cruise control.	**06**

Unit VI	**Performance of automobile** Power for propulsion, Traction and traction effort, Relation between engine revolutions N and vehicle Speed V, **Road performance curves:** Acceleration, gradeability and drawbar pull, Calculation of equivalent weight (W_e), gear ratio for maximum acceleration, distribution of weight, stability of a vehicle on a slope, calculation of maximum accelerations, maximum tractive effort and reactions for different drives, dynamics of a vehicle running on a banked track, stability of a vehicle taking a turn (role over mitigation) **Vehicle safety:** Active & passive safety, Air bags, Seat belt, Types of collisions- front, rear, side, Vehicle interior and ergonomics, Comfort, NVH in automobiles. **Latest trends in automotive electronics (Self-study):** i)The glass cockpit, ii) Driver assistance, iii) Gesture and voice recognition, iv)Engine control, v) Black boxes vi) Electronic ignition and injection for SI and CI engines vii) Turbo chargers (WGT, VGT), viii) Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).	**08**

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Understand components and layout of automobile
2.	Implement the knowledge obtained in theory towards design and analysis of various automobile systems
3.	Analyze the effect of various factors on subsystems of automobile and remedies can be proposed
4.	Evaluate the performance of automobile
Text Books:	
1.	"Automobile Engineering", G.B.S. Narang, Khanna Publication,3rd Edition, 1995
2.	"Automobile Engineering", Dr. Kirpal Singh (Vol. I and II) Standard Publishers, New Delhi 13th edition, 2014
3.	"Automobile Mechanics", N. K. Giri, Khanna Publishers, 2014
4.	"Automobile Engineering", R. B. Gupta, Satya Prakashan, 2014
5.	"Automobile Engineering," P. S. Gill, S. K. Kataria & sons, 2010
6	"Automobile Electrical Equipment", P. S. Kohali, Tata McGraw Hill Publishing House

References:	
1.	K. Newton and W. Seeds, T.K. Garrett, “Motor Vehicle”, 13th Edition, Elsevier publications
2.	“Automobile Mechanics”, W. H. Crouse, Tata McGraw Hill Publishing Co.

Useful Links:	
1.	www.howacarworks.com/basics
2.	https://www.iav.com/us/engineering
3.	http://www.sae.org/automotive/
4.	https://www.araiindia.com/#

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**L**	**m**	**n**	**o**
CO1	✓	✓	✓						✓	✓	✓			✓	
CO2	✓		✓						✓	✓	✓			✓	
CO3	✓	✓	✓						✓	✓	✓			✓	
CO4	✓	✓	✓					✓	✓						

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	5	5	2	10
Understand	4	5	1	16
Apply	6	5	3	10
Analyze	0	0	2	12
Evaluate	0	0	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 704: Mechanical System Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	01 hr/week		**CT2**	15
Total Credits	04		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives

1.	To understand the concept of aesthetics, ergonomics and creativity considerations in product design
2.	Able to design cylinders and pressure vessels and to use IS code
3.	To analyze design of machine tool gearbox
4.	Able to optimization of mechanical systems /elements.

Course Contents

		Hours
Unit I	**Aesthetic and Ergonomic Consideration in Design** Finishes, proportions, Symmetry, Contrast etc., Morgon's color code, Ergonomic considerations, Relation between man, machine and environmental factors, Design of displays and controls, Practical examples of products or equipments using ergonomics and aesthetic design principles, Creativity concept in designing	**07**
Unit II	**Pressure Vessel Design** Thin and thick cylinders; Failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels-Horizontal and vertical; Classification of pressure vessel as per IS 2825, Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening and nozzles in shell and covers. Types of pressure vessel support	**07**
Unit III	**Statistical Considerations in Design** Frequency distribution, Histogram and frequency polygon, Normal distribution, Units of central tendency and dispersion, Standard deviation, Population combinations, Design for natural tolerances, Design for assembly, Statistical analysis of tolerances, Mechanical reliability and factor of safety	**05**
Unit IV	**Design of Gear boxes for Machine Tool Applications** Determination of variable speed range, Graphical	**07**

	representation of speeds, Structure diagram, Deviation diagram, Ray diagram, Selection of optimum ray diagram, Difference between number of teeth of successive gears in a change gear box, Analysis of twelve speed gear box, Compound ray diagram, Synchronized gear box	
Unit V	**Design of I. C. Engine Components** Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin	**06**
Unit VI	**Optimum Design and DFMA** Objectives of optimum design- Johnsons Method of Optimum Design (MOD), Adequate and optimum design. Primary, Subsidiary and Limit equations- Optimum design with normal specifications of simple machine elements like tension bar, transmission shaft, helical spring **DFMA** **Design for manufacture, assembly and safety** General principles of design for manufacture and assembly (DFM and DMFA), Principles of design of castings and forgings, Design for machining, Design for safety	**07**
Tutorials	Teaching assessment of 10 marks will be based on the completion of following assignments/ group projects	
Tutorial I	A detail design report and Auto-CAD drawing of details and assembly of the following a) Design of Machine Tool Gear Box (Three Stage, Twelve speed gear Box) b) Pressure Vessel Design	
Tutorial II	Assignment based on a) Aesthetic and Ergonomic design consideration –case study b) Problems on Optimum design c) Problems on Design of IC Engine components	

Course Outcome (CO): At the end of this course, students will be	
1.	Able to use IS codes, Design data books, Handbooks required for system design.
2.	Able to design industrial product by considering aesthetic & ergonomic.
3.	Able to analyze different systems such as Pressure vessel, , Machine tool Gear box and I. C. Engine Components, etc.
4.	Able to optimize design of various components/systems in mechanical engineering

Text Books:	
1.	"Design of Machine Element", V. B. Bhandari, Mc- Graw Hill Publication, 4th Edition.(2016)
2.	"Mechanical Engineering Design", Shigley and C. R. Miscke, Mc- Graw Hill Publication. 9th Edition (2011)
3.	"Mechanical Design Analysis", M.F. Spotts, Pearson Education , 8th Edition (2011)
4.	"Machine Tools Design and Numerical Control" N.K. Mehta, Tata Mc- Graw Hill Publication, 3rd Edition.(2012)
References:	
1.	I.S.: 2825 Code for Unfired Pressure Vessels, Bureau of Indian Standards (1969)
2.	"Machine Design", Black P.H. and O.Eugene Adams, Mc- Graw Hill Publication, 3rd Edition.
3.	"Design of Machine Tools", S.K. Basu and D.K. Pal Oxford and IBH Publication, 6th Edition. (2014)
4.	"Engineering Design", Dieter G.E., Mc- Graw Hill Publication, 4th Edition (2013)
5.	"Mechanical System Design", S.P.Patil, Jaico Publication House, New Delhi, 2nd Edition.
6.	"Engineering Optimization Theories and Practice", S.S. Rao, John Wiley and Sons Inc, 4th Edition (2013)
7.	**"**Mechanical System Design", Anurag Dixit, Scitech Publications (India) Pvt. Ltd. 1st Edition (2007)
8.	"Theory and Design of Pressure Vessel", Harve, CBS Publishers 2nd Edition (1991)
9	"Mechanical System Design " Siddiqui, New Age International Publishers, 2nd Edition, (2011)

Useful Links:	
1.	http://nptel.ac.in/courses/

Mapping of Cos with Pos (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1			✓	✓	✓		✓			✓					
CO2						✓		✓			✓				✓
CO3	✓		✓		✓				✓						
CO4	✓		✓		✓				✓						

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	2	2	0	5
Understand	2	2	1	7
Apply	3	3	2	12
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	3	3	3	12
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 725: Elective I-Operations Research

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand quantitative techniques in management decision-making and its applications by using mathematical models
2.	To analyze LPP, Assignment and Transportation problem
3.	To evaluate Sequencing and Decision theory problem
4.	To design network by CPM / PERT technique

Course Contents

		Hours
Unit I	**Introduction** Birth of operations research., Methodology, scope and limitations, Types of operations research, Models, applications in Production Management, Use of computers in operations research	02
Unit II	**Linear Programming** Formulation, Graphical method, Simplex algorithm for maximization and minimization problems, Sensitivity analysis, Duality theory and its use in economic interpretation and decision making.	07
Unit III	**Transportation Models** Structure, Industrial and business applications, Transportation problems: Use of various methods for solving transportation problems, Degeneracy and its solution	06
Unit IV	**Assignment Models** Assignment problems: Solution of various types of problems, Traveling Salesman problem	06

Unit V	**Sequencing** Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines **Decision Theory** Pay off and regret tables, Decision rules, Decisions under uncertainty and risk, Decision tree	06
Unit VI	**Project Management** Fundamentals of CPM / PERT networks; CPM – Construction of networks, Critical path, Forward and backward pass, Floats & their significance, Crashing for minimum cost and optimum and minimum duration, Resource allocation and leveling. PERT – Time Estimates, Construction of Networks, Probability of completing projects by given date	09

	TERM WORK
Assignment 1	Formulation of LPP and Graphical Solution.
Assignment2	Assignment on Maximization / Minimization of L. P. problems
Assignment3	Assignment on Transportation problems
Assignment4	Assignment on Assignment problems
Assignment5	Assignment on Sequencing problems
Assignment6	Assignment on Decision theory
Assignment7	Assignment on CPM/PERT problems
Assignment8	Assignment on shortest path models

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Understand quantitative techniques in management decision-making and its applications by using mathematical models
2.	Analyze LPP, Assignment & Transportation Problem
3.	Evaluate Sequencing & Decision Theory Problem

4.	Design network by CPM / PERT technique
Text Books:	
1.	Operations Research – P. SankaraIyer (TMH- Sigma Series, 2008)
2.	Operations Research- Hira Gupta-(S Chand) Reprint Edition 2015
3.	Operations Research – J.K. Sharma. (Mac Millan)2009
4.	Operations Research – Principles & Practice - Ravindran, Phillips & Solberg (John Wily & Sons, Wiley India, 2006)
5.	Introduction to Operations Research-Theory & Applications, - H.S. Kasana & K. D. Kumar, (Springer International Edition, 2005, Springer India)
References:	
1.	Introduction to O.R., 7/e (with CD) – Hamdy A. Taha, (PHI) 2016
2.	Quantitative Techniques in Management, 4/e – N.D. Vora. (TMH) 2016
3.	Introduction to O.R., 7/e (with CD) – Hillier & Lieberman (TMH)2009
4.	Operations Research, 2/e – R. Panneerselvam (PHI) 2009
	Operations Research – Natarajan, A. M.; Balasubramani, P. & Tamilrasi, A. (Pearson Education)2005
5.	Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

Useful Links:	
1.	http://nptel.iitm.ac.in

Mapping of Cos with Pos (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓			✓			✓	✓		✓				✓
CO 2	✓	✓			✓			✓	✓		✓	✓			✓
CO 3	✓	✓			✓			✓	✓		✓	✓			✓
CO 4	✓	✓			✓			✓	✓		✓	✓			✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME735: Total Quality Management

Teaching Scheme			**Examination Scheme**	
Lectures	03hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To acquaint learners with the evolution, scope and basics of TQM
2.	Integration of applications of TQM principles and ISO 9000 systems
3.	Conceptual understanding of Quality movement and implementation of Quality programs with confidence and knowledge.

Course Contents

		Hours
Unit I	**Principle and Approaches to TQM** Evolution of TQM, TQM principles, Leadership and involvement of people, Continual improvement (KAIZEN), Process approach and systems approach, Quality management principles, Applications of TQM, Contributions by Philip Crosby, Deming, Juran & Taguchi bench marking on products, Processes, Systems and services, Cost of poor quality, Case studies	**06**
Unit II	**Controlling Techniques for Quality** Disciplined problem solving process, Data collection and data analysis, Seven QC tools, Process control charts and interpretation, Simple correlation and regression analysis, Reliability engineering, Basic Design of Experiments, Application of SPC in both manufacturing and service Industries, Why-why analysis	**08**
Unit III	**Quality Management Systems** Evolution of quality management systems, ISO 9001:2015 series of QMS, ISO 14000:2015 series of EMS, Introduction to oshas standards, Standard for auditing QMS and EMS, IMS (Integrated Management System), Overview on other industry Specific standards such as ISO/TS:16949	**08**
Unit IV	**Essentials of TQM** Stake holder expectations, Value creation and Support process,	**06**

	Customer satisfaction measures, Functional objectives and measures on targets & goals development and execution of quality plan, Complaints handling and Root Cause Analyses, Cost reduction and Value addition, Bench marking	
Unit V	**Customer Focus** Understanding the service system, Customer segments and Understanding their stated and implied needs, Sector specific Quality systems, Value creation and Support processes bench marking on key performance indicates (KPIs) 'SMART' Principle, Root Cause Analysis, Working towards reduction of costs	**06**
Unit VI	**Tools and Techniques** 7 S, Basics of Jishu Hozen (Autonomous Maintenance) Total Productive Maintenance (TPM), JIT (Just in Time), Kanban, TPS (Toyota Production System), Poka yoke, Lean manufacturing system, Types of muda (Waste), Suggestion scheme, Kaizen and SGIA (Small Group Improvement Activity), Six sigma basics, Overview of National & International quality excellence awards, Overview on world class initiatives, Case studies in Indian context	**08**

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand importance of assuring quality in the service or manufacturing sector and explain Quality assurance system
2.	Identify and solve the quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques
3.	Interpret various quality attributes and discuss the various quality approaches.
4.	Get insight into various success and failure stories of TQM implementation
Text Books:	
1.	Practical Reliability Engineering- Patrick D. T. O'connor, , Wiley India, (ISBN 978-81-265- 1642-1), 4th Edition 2002
2.	Total Quality Management – Text and cases- Jankiraman and Gopal, Prentice Hall India Publication. (ISBN 978-81-203-2995-9) 2006
3.	Total Quality Management- Dr. Suri and Dr. Sharma, Wiley Publication, (ISBN 978-93- 5004-317-2) 2013
4.	Total Quality Management – Dr. Rajaram, Wiley Publication, (ISBN 978-81-

	7722-63-2) 2015
References:	
1.	Total Quality Management- Dale H. Besterfiled, et.al. ,Pearson Education, Asia (ISBN 978- 81-317-3227-4) 2011
2.	Total Quality Management – Dr. Poornima Charantimath Pearson Education, Asia (ISBN 978-81-317-3262-5) ,2nd Edition 2011
3.	Fundamentals of Quality Control and Improvement – Amita va Mitra Pearson Education, Asia 3rd edition 2016
4.	Handbook of Total Quality Management- Dr. R. P. Mohanti, R. R. Lakhe Jaico Publishing House, (ISBN 81-7224-833-44)
5.	Quality Planning and Analysis- Juran J. M and Gryna 3rd edition 1993

Useful Links:	
1.	www.ncqm.com
2.	https://asq.org.in
3.	https://www.juran.com/
4.	https://deming.org/
5.	www.philipcrosby.com

Mapping of Cos with Pos (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓			✓			✓	✓		✓				✓
CO 2	✓	✓			✓			✓	✓		✓	✓			✓
CO 3	✓	✓			✓			✓	✓		✓	✓			✓
CO 4	✓	✓			✓			✓	✓		✓	✓			✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 745: Advanced I. C. Engines (Elective-I)

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To remember the principles of operation of different IC Engines and components
2.	To study the new alternative fuels in I C Engines
3.	To understand recent technologies in I C Engines
4.	To analyze the system based on formation of pollutant

Course Contents

		Hours
Unit I	**Spark Ignition Engines** Mixture requirements, Fuel injection systems, Mono-point, Multi-point & Direct injection, Stages of combustion, Normal and Abnormal combustion, Knock, Factors affecting knock, Combustion chambers	08
Unit II	**Compression Ignition Engines** Diesel Fuel Injection Systems, Stages of combustion, Knocking, Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Fuel Spray behavior, Spray structure and spray penetration, Air motion, Introduction to Turbocharging	08
Unit III	**Pollution Formation and Control** Pollutant, Sources, Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter, Methods of controlling Emissions, Catalytic converters, Selective Catalytic Reduction and Particulate Traps, Methods of measurement, Emission norms and Driving cycles.	08
Unit IV	**Alternative Fuels** Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Properties, Suitability, Merits and Demerits, Engine Modifications.	08

Unit V	**Recent Trends** Air assisted Combustion, Homogeneous charge compression ignition engines, Variable Geometry turbochargers, Common Rail Direct Injection Systems, Hybrid Electric Vehicles, Nox Absorbers, Onboard Diagnostics.	08

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Remember the principles of operation of different IC Engines and components
2.	Study the new alternative fuels in I C Engines
3.	Understand recent technologies in I C Engines
4.	Analyze the system based on formation of pollutant
Text Books:	
1.	Ganesan V, "Internal Combustion Engine", 4th edition, Tata McGraw Hill Education, 2012.ISBN: 1259006190
2.	Mathur, M. L., and Sharma R.P., "A Course in Internal Combustion Engines", Dhanpat Rai Publications Pvt. Ltd.25thEdition, 2014 ISBN: 9788189928469
3.	Rajput R. K, "A textbook of Internal Combustion Engines", 2nd edition, Laxmi Publications Pvt Ltd.
References:	
1.	Ramalingam K. K, "Internal Combustion Engine", Scitech Publication (India) Pvt. Ltd. 2011 ISBN: 9788188429486
2.	Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.

Useful Links:	
1.	http://nptel.ac.in/courses/112104033/
2.	http://nptel.ac.in/syllabus/112104033/

Mapping of Cos with Pos (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓	✓		✓	✓	✓			✓		✓				
CO2	✓	✓	✓							✓	✓	✓		✓	
CO3	✓				✓					✓				✓	
CO4	✓	✓	✓							✓					✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 755:Elective-I- Design of Pressure Vessels

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To study the fundamentals of Pressure vessels and its components.
2.	To apply ASME and IS codes used for the design of pressure vessels.
3.	To analyze creep and fatigue phenomenon in pressure vessel
4.	To design the pressure vessel and its components

Course Contents

		Hours
Unit I	**Introduction** Classification of pressure vessels, Components, Types of shell, Types of supports, nozzles, attachments, Design approach, Various failure modes, Stress evaluation, loads, Stress theories, Stiffener rings, Stresses in various components, Fabrication methods, ASME material codes for pressure vessel.	06
Unit II	**Mechanical Design of Pressure Vessels** Design as per ASME and IS codes, Thickness calculation of various components subjected to internal pressure and external pressure.	05
Unit III	**Nozzles and Bolted Flange design** Types of openings, Size of opening, Nozzle reinforcement, Area compensation ,Need of flanges, types of flanges, design considerations.	06
Unit IV	**Design for Wind and Seismic loads** Design codes and practices, Load cases, comparison, steps in wind and seismic load calculations, effects of wind and seismic loads.	06
Unit V	**Evaluation of Pressure Vessel for various conditions** Design of supports for vertical and horizontal vessels, Saddle design, Design of lifting attachments, Types of transportation, Hydro test, Upsets and transportation conditions.	06

Unit VI	**Creep and Fatigue in Pressure Vessel:** Fracture control and discontinuity stresses Creep: Phenomenon, Creep behavior, Governing Parameters, Creep testing, Fatigue: Background, Phenomenon, fatigue behavior, Design considerations, Buckling of vessels	07

Course Outcome (CO): At the end of this course, students will be able to	
1.	To study the fundamentals of Pressure vessels and its components.
2.	To apply ASME and IS codes used for the design of pressure vessels.
3.	To analyze creep and fatigue phenomenon in pressure vessel
4.	To design the pressure vessel and its components
Text Books:	
1.	John F Harvey, Theory & Design of Pressure Vessels, Van Nostrand Reinhold Company Ltd, 15th Edition 2014
2.	Joshi M.V. and Mahajan V.V., "Process Equipment Design", McMillan, India, 1996.
3.	Somnath Chattopadhyay, Pressure vessels design and practice, CRC Press, Third Edition, 2004
References:	
1.	IS 2825: 1969, Code for Unfired Pressure Vessels.
2.	ASME Section VIII Div-1, 2 & 3, 2010, Addenda 2011a.
3.	"ASHRAE Handbook : Fundamentals", ASHRAE, 1985.
4.	Vincent A. Carucci, Overview of pressure vessel design, ASME International
5.	Brownell and Young, Process equipment design, Wiley, 2009
6.	N K Roy, Review of code for pressure vessels, IS 2825 as compared to ASME/BS/AD Merk blatter, Journal for Process Equipment & Piping Technology, Vol. 1, No 1, June 1994
7.	H. Bednar, Pressure Vessel Design Handbook, Krieger Publishing Company, Second Edition, 1990
8.	Dennis Moss, Pressure Vessel Design Manual, Butterworth-Heinemann, Fourth Edition, 2013
9.	Moss Demis R., "Pressure Vessel Design Manual ", Gulf Publishing Co., Houston, 1987.
10.	"Handbook of Piping Design", CRC Press, 1992.
Useful Links:	
	ftp://122.252.236.67/NPTEL%202016/NPTEL%20MECHANICAL%20ENGG/ENGINEERING%20BOOKS/Pressure%20Vessel%20Design%20Manual.pdf
	https://www.accessengineeringlibrary.com/browse/pressure-vessels-the-asme-code-simplified-eighth-edition

Mapping of Cos with Pos (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓	✓		✓	✓	✓		✓	✓		✓			
CO 2	✓	✓	✓		✓	✓	✓		✓						
CO 3	✓	✓	✓		✓	✓	✓			✓	✓	✓			
CO 4	✓			✓		✓	✓								

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	1	1	1	08
Understand	3	3	1	08
Apply	3	3	2	10
Analyze	3	3	2	12
Evaluate	3	3	2	12
Create	2	2	2	10
Total	15	15	10	60

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 706: Refrigeration and Air Conditioning Laboratory

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**25**

#

Course Objectives:

1.	To study basic refrigeration system
2.	To apply the knowledge of refrigeration for selection of various system components and accessories
3.	To Evaluate performance of Refrigeration and Air Conditioning Systems
4.	To analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering

Course Contents

Term work should consist of any 10 experiments from the following

Experiment 1	Study of various conventional and Nonconventional methods of refrigeration.
Experiment 2	Study or demonstration of dehydration, charging, leak testing of refrigeration system.
Experiment 3	Study of Refrigeration tools.
Experiment 4	Study and demonstration of controls and safety devices in refrigeration and air conditioning.
Experiment 5	Study and trial on vapor compression system.
Experiment 6	Study of refrigerant compressors
Experiment 7	Trial on heat pump test rig.

Experiment 8	Study and trial on cascade refrigeration system.
Experiment 9	Study of Refrigeration Systems (Water Cooler/ Ice Plant/ Cold Storage,)
Experiment 10	Trial on ice plant test rig
Experiment 11	Study and demonstration on air conditioning systems. (Unitary and central air conditioning / system)
Experiment 12	Trial on Air Conditioning Test Rig
Experiment 13	Visit to central air conditioning or cold storage or dairy plant or ice plant related with refrigeration and air conditioning system.

Group Activity: Maximum 3 to 4 students in one group

Market survey of one product related to refrigeration and air conditioning systems / load calculation of specific application, space.

Lab Outcomes:

At the end of course, students will be able to

1.	Study basic refrigeration system
2.	Apply the knowledge of refrigeration for selection of various system components and accessories
3.	Evaluate performance of Refrigeration and Air Conditioning Systems
4.	Analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering

Text Books:

1.	C. P. Arora, "Refrigeration & Air-Conditioning", Tata McGraw Hill, Third Edition, 2004.
2.	Roy J. Dossat, "Principles of Refrigeration", Wiley Eastern Limited, New Delhi.
3.	Manohar Prasad, "Refrigeration & Air-Conditioning", New Age Intl. Publications, Third edition, 2010

References:

1.	ASHRAE Handbook, Fundamentals, 2013.
2.	Jordan & Priester, "Refrigeration & Air Conditioning", Prentice-Hall India, Second edition, 1973.
3.	"ARI Standards"

Mapping of Los with and Pos and PSOs

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓		✓								✓		
LO2	✓	✓	✓		✓						✓		✓		
LO3	✓	✓	✓	✓	✓	✓					✓	✓			✓
LO4			✓						✓			✓			

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Avg.
Task I	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 707 : Finite Element Analysis Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**-**

Course Objectives:

1. To understand the Finite Element Analysis fundamentals
2. To apply finite element formulation techniques and derive the finite element equations for 1D and 2D problems
3. To create and analyze basic problems in solid mechanics, heat transfer and fluid mechanics
4. To design model using commercial software to solve basic engineering problems and view results
5. To develop computer program in MATLAB based on finite element analysis

Course Contents

Term work should consist of any 10 experiments from the following

1.	Finite element analysis of a stepped bar (Three steps)
2.	Finite element analysis of a stepped torsion shaft
3.	Finite element analysis of 1-D steady heat conduction problem (composite slab)
4.	Introduction to any one standard FEA software such as ANSYS, NISA, NASTRAN, HYPERWORK, ABACUS, etc.
5.	One assignment on modeling and meshing – Types of elements, choice of elements, type of meshing – automatic, mapped, meshing in critical areas
6.	Structural analysis of plate with circular hole using any one standard FEA software
7.	Structural analysis of the Bracket in any one standard FEA software
8.	Analysis of Laminar flow in 2-D Duct using any one standard FEA software
9.	Transient Heat Transfer problem using any one standard FEA software (Solidification of molten metal)
10.	Modal analysis of air craft wing using any one standard FEA software

11.	Modal analysis of cantilever Eigen value problem usingany one standardFEA software
Group Activity: Maximum 3 to 4 students in one group 1. Carry out experimental analysis on a steeped bar and compare its results with FEA analysis.	

Lab Outcomes: At the end of course, students will be able to	
1.	Understand the application and characteristics of FEA elements such as bars, beams, plane and isoparametric, and 3-D elements.
2.	Apply the variational methods and weighted residual methods in FEM
3.	Create and analyze basic problems in solid mechanics, heat transfer and fluid mechanics
4.	Design model using commercial software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer
5.	Develop computer program in MATLAB based on finite element analysis
Text Books:	
1.	S. S. Rao, "*Finite Element Method in Engineering*", Elsevier Publication, 4th Edition, 2004
2.	P. Seshu, "*Textbook of Finite Element Analysis",*1st Edition
3.	Chandrapatala, Belgundu, "Introduction to Finite Elements in Engineering", Prentice Hallof India, 3rd Edition.
References:	
1.	J. N. Reddy, "*An Introduction to Finite Element Method*", Tata McGraw Hill publication co. 2nd Edition, 1993
2.	Logan D. L. "*A first course in Finite Element Method*", Cengage learning, 4th Edition, 2008.
3.	S.S. Deshpande, S.V. Bedekar, A. N. Thite, "Practical Finite Element Analysis", N. S. Gokhale, Finite to Infinite Publication

Mapping of Los with and Pos

Programme Outcomes and Programme Specific Outcomes	Anabilitytoapplyknowledgeofmathematics,science,andengineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓		✓	✓	✓						✓	✓	✓		
LO2	✓	✓	✓			✓	✓		✓		✓	✓	✓		✓
LO3	✓	✓	✓			✓	✓				✓	✓	✓		
LO4	✓	✓	✓			✓	✓				✓	✓	✓		
LO5	✓	✓	✓			✓	✓				✓	✓	✓		

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 708: Automobile Engineering Laboratory

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**-**

#

Course Objectives:

1.	Explain components and layout of automobile
2.	To implement the knowledge obtained in theory towards design and analysis of various automobile systems
3.	To analyze the effect of various factors on subsystems of automobile and remedies can be proposed
4.	To evaluate the performance of automobile

Course Contents

Term work should consist of any 08 experiments from the group A and All experiment from group B.

Group A	
Experiment 1	Study and demonstration of four wheeler chassis layout and vehicle components
Experiment 2	Study and Demonstration of working of single plate and multi plate automobile clutch
Experiment 3	Study and demonstration of automatic transmission
Experiment 4	Study and demonstration of final drive and differential
Experiment 5	Study and demonstration of front wheel steering geometry and steering mechanism
Experiment 6	Study and demonstration of suspension system of a four-wheeler
Experiment 7	Study and demonstration of working air braking system
Experiment 8	Study and demonstration of Electronic Ignition system of automobile and MPFI system

Experiment 9	Study and demonstration of fuel supply system of petrol engine
Experiment 10	Study and demonstration of automobile air conditioning system
Group B	
Experiment 01	Experiment on wheel balancing.
Experiment 02	Visit to servicing station for study of vehicle maintenance, repairs and report.
Group Activity: Maximum 3 to 4 students in one group All vehicle details of any one four wheeler or two wheeler with complete specifications.	

Lab Outcomes: At the end of course, students will be able to	
1.	Explain components and layout of automobile
2.	Implement the knowledge obtained in theory towards design and analysis of various automobile systems
3.	Analyze the effect of various factors on subsystems of automobile and remedies can be proposed
4.	Evaluate the performance of automobile
Text Books:	
1.	Automobile Engineering", G. B. S. Narang, Khanna Publication, 3rd Edition
2.	Automobile Engineering", Dr. Kirpal Singh (Vol. I and II) Standard Publishers, New Delhi.
3.	Automobile Mechanics", N K Giri. Khanna Publishers.
References:	
1.	Laboratory manual for Automobile laboratory.

Mapping of LOs with and POs and PSOs

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓		✓	✓						✓	✓	✓		
LO2	✓	✓	✓	✓	✓						✓	✓	✓		✓
LO3	✓	✓	✓	✓	✓						✓	✓	✓		
LO4	✓	✓	✓	✓	✓				✓		✓	✓	✓		

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 709: Seminar

Teaching Scheme			**Examination Scheme**	
Laboratory	01 hrs/week		**TA/CA**	**50**
Total Credit	1		**ESA**	**-**

Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one Faculty. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation.

Course Objectives:

1.	The development of communication skills
2.	The development of intellectual and professional competence
3.	The personal growth of students
4.	Improving the presentation skills
5.	Practice written and oral presentations
6.	Study new subject
7.	Get an overview of the current trends
8.	Learn some part in more details
9.	Learn the research methods used in that specific field

Course Contents

Seminar Report Format:

	Written Work
1.	Structure
2.	Terminology, Background
3.	Questions
4.	Methods
5.	Results, evaluation
6.	References (essential, others)
7.	Concise presentation, independently understandable
8.	Extended abstract

The report should be of 20 to 30 pages. For standardization of the report the following format should be strictly followed.

1.	Page Size: Trimmed A4
2.	Top Margin: 1.00 Inch
3.	Bottom Margin: 1.32 Inches

4.	Left Margin: 1.5 Inches
5.	Right Margin: 1.0 Inch
6.	Para Text: Times New Roman 12 Point. Font
7.	Line Spacing: 1.5 Lines
8.	Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9.	Headings: Times New Roman, 14 Point, Bold Face
10.	Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.

Lab Outcomes:

Upon successful completion of this course, the student will be able to express

1.	Examples of Probing Questions a. Does that always apply? b. How is that relevant? c. Can you give me an example? d. Is there an alternative viewpoint? e. How reliable is the evidence? f. How accurate is your description? g. You say it is x, which particular kind of x? h. What's the underlying principle then? i. In what situation would this rule break down? j. What distinguishes the two cases?
2.	Comprehend the knowledge
3.	Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.

Mapping of LOs with and POs and PSOs

Programme Outcomes and Programme Specific Outcomes		An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes		a	b	c	d	e	f	g	h	i	j	k	l	m	n	O
LO1	**Interpre**	√	√		√	√		√	√		√	√		√		
LO2	**Select**	√	√		√	√		√	√	√	√	√			√	
LO3	**Underst**	√		√	√	√		√	√	√	√	√	√		√	√
LO4	**Compar**	√			√	√		√	√		√	√		√	√	√

Assessment Pattern

The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The end semester assessment shall be done by internal referee one week before the term end. The department shall arrange presentations on seminar done by students and the referee will judge the presentation in accordance with the outcomes of the course by interacting with students and marks will be awarded to student. This presentation will remain open for all students, parents, and other citizens visiting the exhibition.

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 710: Project Phase I

Teaching Scheme			**Examination Scheme**	
Practical	02 hrs/week		**TA/CA**	**50**
Total Credit	4		**ESA**	**50****

** For Project Phase-I ESE is based on the presentation showing progress of the project work

Course Objectives:

1.	To identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
2.	To create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
3.	To design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4.	To use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Contents

Project Phase I Load

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed.

Project Phase I Definition

The project phase I work can be a design project / experimental project and or computer simulation project on Mechanical engineering or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics. The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe.
The project phase I work is to be extended for project phase II at B. E. (Mech.) Sem. VIII with same group working under guidance of same

	Faculty member assigned for project phase I.	
Project Phase I Term Work The term work under project submitted by students shall include		
1.	Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for	
	i.	Searching suitable project work
	ii.	Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
	iii.	Day to day activities carried out related to project work for entire semester.
	iv.	Synopsis
	The group should submit the synopsis in following format	
	a.	Title of Project
	b.	Names of Students
	c.	Name of Guide
	d.	Relevance
	e.	Present Theory and Practices
	f.	Proposed work
	g.	Expenditure
	h.	References
2.	The synopsis shall be signed by the each student in the group, approved by the guide And endorsed by the Head of the Department	
3.	Presentation: The group has to make a presentation in front of the Faculty members of department at the end of semester.	
Project Phase I Report Format Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.		
1.	Page Size: Trimmed A4	
2.	Top Margin: 1.00 Inch	
3.	Bottom Margin: 1.32 Inches	
4.	Left Margin: 1.5 Inches	
5.	Right Margin: 1.0 Inch	
6.	Para Text: Times New Roman 12 Point . Font	
7.	Line Spacing: 1.5 Lines	
8.	Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman	
9.	Headings: Times New Roman, 14 Point , Bold Face	
10.	References: References should have the following format	
For Books: “Title of Book”, Authors, Publisher, Edition		

For Papers: “Title of Paper, Authors, Journal/Conference Details, Year	
Important Notes Project group should continue maintaining a diary for project and should write	
1.	Books referred
2.	Company visited
3.	Person contacted
4.	Computer work done
5.	Paper referred
6.	Creative thinking.
A.	The Diary along with Project Phase I Report shall be assessed at the time of oral examination
B.	One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Lab Outcomes At the end of course, students will be able to	
1.	Improve the professional competency and research aptitude in relevant area.
2.	Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.
3.	Participate in team oriented, open ended activities that prepare them to work in integrated engineering teams both as team members and as leaders and communicate effectively using modern tools.
4.	Pursue higher studies and succeed in academic and research career.

Mapping of LOs with and POs and PSOs

Programme Outcomes and Programme Specific Outcomes	Anabilitytoapplyknowledgeofmathematics,scienc e andengineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓	✓	✓						✓	✓	✓		
LO2	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓
LO3				✓	✓	✓	✓			✓	✓	✓	✓		
LO4	✓								✓		✓	✓	✓		

Assessment Pattern

The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The end semester assessment shall be done by external referee one week before the term end. The department shall arrange exhibition (all department will arrange the exhibition on same day) of the project work done by students and the referee will judge the project work in accordance with the outcomes of the course by interacting with students and marks will be awarded to individual student. This exhibition will remain open for all students, parents, and other citizens visiting the exhibition.

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 711: Industrial Training

Teaching Scheme			Examination Scheme	
Laboratory	-		**TA/CA**	**50**
Total Credit	2		**ESA**	**-**

Course Objectives:

The course aims to:

Familiar the students to realize an industrial work

Course Contents

Execution scheme

Industrial training of minimum two (2) weeks should be done after T.E. (II) in summer vacation and it's assessment will be done in B.E. (I) based on report submitted work load of the assessment can be assigned to the project seminar guide.

Industrial Training

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Mechanical engineering during the semester break after Sixth semester and complete within 15 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester. It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, Process capability evaluation, Industrial automation, Process or machinery modification as identified.

Industrial Training Report Format:

Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one Faculty. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation.

The report should be of 20 to 30 pages. For standardization of the report the following format should be strictly followed.

1. Page Size: Trimmed A4

	2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.32 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Point. Font 7. Line Spacing: 1.5 Lines 8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman 9. Headings: Times New Roman, 14 Point ., Bold Face 10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director. 11. The entire report should be documented as one chapter with details like **a.** "Name of Industry with address along with completed training certificate" **b.** Area in which Industrial training is completed All Students have to present their reports individually.

Course Outcomes:

Upon successful completion of this course, the student will be able to express

1.	Comprehend the knowledge gained in the course work
2.	Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.
3.	Upon successful completion of this course, the student should be able to answer following questions
	1. Which subjects you found useful for this training? 2. Have you seen any chart, tables, and graphs in industry? What was its meaning for you? 3. Can you design any system or part of it from this training? If not what knowledge you feel inadequate? 4. Was this training involved knowledge of electrical, electronics, civil or chemical engineering? 5. Have you come across any technical difficulty in training? If yes write in short. How you solved? 6. What was timing for training? Have you followed it? Were people in industry sincere in their work? 7. Which language s used for communication in industry you visited? Have you talked there? 8. What pollution measures were taken by the industry for their waste disposal?

	9. What is most important part of training you remember? 10. What is current issue in technical field you find most challenging? 11. Do you think this training is useful? What is its use? 12. Is there any scope for research you find while undergoing this training?

Mapping of LOs with and POs and PSOs

Programme Outcomes and Programme Specific Outcomes		An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and [illegible]	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes		a	b	c	d	e	f	g	h	i	j	k	l	m	n	O
LO1	**Interpret**	√	√		√	√		√	√		√	√		√		
LO2	**Select**	√	√		√	√		√	√	√	√	√			√	
LO3	**Understand**	√		√	√	√		√	√	√	√	√	√		√	√
LO4	**Compare**	√			√	√		√	√		√	√		√	√	√

Assessment Pattern

The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The end semester assessment shall be done by internal referee one week before the term end. The department shall arrange exhibition (all department will arrange the exhibition on same day) of the project work done by students and the referee will judge the project work in accordance with the outcomes of the course by interacting with students and marks will be awarded to individual student. This exhibition will remain open for all students, parents, and other citizens visiting the exhibition.

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 801: Mechatronics

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the fundamentals of mechanical engineering, electrical and computer engineering, software engineering, and control systems in a synergistic framework.
2.	To evaluate the operational characteristics of electromechanical actuators (solenoids, motors, etc.)
3.	To develop the PLC program for a certain application
4.	To create the circuits for practical applications of mechatronics

Course Contents

		Hours
Unit I	**Introduction** Introduction to mechatronics, Mechatronics systems, Measurement systems, Multi discipline scenario **Transducers and Sensors**:- Position sensors: limit switch, photoelectric switches, proximity sensors, Pneumatic limit valves and backpressure sensors, Pressure switches, resolvers, Incremental and absolute encoders, decoders and relays. Displacement sensors: Potentiometer sensors, LVDT, capacitive displacement sensors, Velocity sensors: Tacho-generator, Use of encoders, Introduction to VFD.	07
Unit II	**Signal conditioning** Signal conditioning process, Operational amplifier (inverting amplifier, Non-inverting amplifier, summing, integrating amplifier, differentiating amplifier, logarithmic amplifier), protection, filtering, Data acquisition, Multiplexer, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Oscillators to generator sinusoidal, square, triangular and impulse waveforms, 555 timer, Sample and hold, Demultiplexing, Interfacing input output ports, Serial and parallel interfacing requirements, Buffers, handshaking, polling	07

	and interrupts.	
Unit III	**Digital Circuits, Microprocessor and Microcontroller** Digital logic, Number systems, Logic gates, Boolean algebra, Application of logic gates, Sequential logic, Flip flop, D flip flop, JK flip flop, Master slave flip flop. Microcontroller: Comparison between microprocessor and micro controller, Organization of a microcontroller system, Architecture of MCS 51 /atmel /pic controller, Pin diagram of 8051, Addressing modes, Instruction types and set, Selection and applications of microcontroller.	06
Unit IV	**Programmable Logic Controllers (PLC)** Introduction, Definition, PLC system and components of PLC, input output module, PLC advantages and disadvantages. **Ladder Diagram and PLC Programming Fundamentals:** Basic components and other symbols, Fundamentals of ladder diagram, Machine control terminology, Update – Solve ladder – Update, Physical components Vs program components, Light control example, Internal relays, Disagreement circuit, Majority circuit, Oscillator, Holding (sealed or latches) contacts, Always ON always OFF contacts, Nesting of ladders.	08
Unit V	**PLC Programming** PLC Input instructions, Outputs, Coils, Indicators, Operational procedures, Contact and coil input output, Programming example, Fail safe circuits, Simple industrial applications. **PLC Functions** : PLC timer functions – Introduction, Timer functions, Industrial applications, Industrial process Timing applications, PLC control functions – PLC counters and its industrial applications, Introduction to SCADA.	04
Unit VI	**Mechatronics Systems** Traditional Vs Mechatronic Design, Case studies of Mechatronic systems designs, like piece counting system, Pick and place manipulator, Simple assembly task involving a few parts, Part loading / unloading system, Automatic tool and pallet changers etc. Fault finding and troubleshooting,	08

	Introduction to IOT, Raspberry Pi and Arduino.	

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand the fundamentals of mechanical engineering, electrical and computer engineering, software engineering, and control systems in a synergistic framework.
2.	Evaluate the operational characteristics of electromechanical actuators (solenoids, motors, etc.)
3.	Develop the PLC program for a certain application
4.	Create the circuits for systems
Text Books:	
1.	Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications", New Age International Publishers Ltd.
2.	W. Bolton, "Mechatronics", Pearson Education , 4th Edition, 2008
3.	Mahalik, "Mechatronics" , TATA McGraw Hill, 2006
4.	Hackworth, "Programmable Logical Controller", Pearson Education, 2008.
References:	
1.	K. P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)", Wiley, 2008
2.	K. K. Appukuttan, "Introduction to Mechatronics", Oxford University Press, 2007
3.	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier; First edition 2006

Useful Links:	
1.	http://nptel.ac.in/courses/112103174/
2.	http://www.sanfoundry.com/100-plc-programming-examples/

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓	✓	✓	✓							✓	✓	✓		
CO2	✓			✓	✓						✓	✓		✓	
CO3	✓			✓						✓	✓		✓	✓	✓
CO4	✓			✓						✓	✓				

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	14
Apply	3	3	2	14
Analyze	3	3	2	10
Evaluate	2	2	2	12
Create	1	1	1	10
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME802: Noise and vibration

Teaching Scheme			**Examination Scheme**	
Lectures	03hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives

1.	To understand the fundamentals of vibration
2.	To apply the principles of vibration in single degree, two degree and multi degree of freedom systems
3.	To analyze the mechanical system to reduce the vibrations
4.	To develop mathematical model of mechanical system

Course Contents

		Hours
Unit I	**Introduction** Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, damper models, Motion – periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, Static equilibrium position, Vibration classification, Steps involved in vibration analysis, Simple harmonic motion, Vector and Complex method of representing vibration, Fourier series and harmonic analysis	**07**
Unit II	**Two Degree of Freedom Systems** Generalized and Principal coordinates, Derivation of equations of motion, Eigen values and Eigen vectors, Mode shapes, Lagrange's equation, Coordinate coupling, Forced harmonic vibration	**07**
Unit III	**Multi Degree of Freedom Systems** Derivation of equations of motion, Influence coefficient method, Properties of vibrating systems: flexibility and stiffness matrices, normal modes and their properties, reciprocity theorem, Modal analysis: undamped and damped	**07**
Unit IV	**Measurement of Vibration** Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis	**05**
Unit V	**Control of Vibration** Introduction to control of vibration, Vibration control methods, Passive and active vibration control, Reduction of excitation at the source, Control of natural frequency, Vibration isolators, Tunned Dynamic Vibration Absorbers	**05**

Unit VI	**Noise** Fundamentals of noise Sound concepts, Decibel Level, White noise, Weighted sound pressure level, Logarithmic addition, Subtraction and averaging, Sound intensity, Noise measurement, Sound fields, Octave band, Sound reflection, Absorption and transmission, Pass-by-noise, Reverberation chamber, Anechoic Chamber, Noise standards	**09**

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand the fundamentals of vibration
2.	Apply the principles of vibration in single degree, two degree and multi degree of freedom systems
3.	Analyze the mechanical system to reduce the vibrations
4.	Develop mathematical model of mechanical system

Text Books:	
1.	"Mechanical Vibrations", S. S. Rao, Pearson Education, 6th edition, 2011
2.	"Mechanical Vibrations", G. K. Grover, Published by Nemchand and Brothers, Roorkee, 8th edition, 2009
3.	"Fundamentals of Vibrations", Balchandran, Magrab, Cengage Learning, 2nd edition, 2009.
4.	"Mechanical Vibration", Dr. Debabrata Nag, Wiley India Pvt. Ltd, 5th edition, 2011.

References:	
1.	"Mechanical Vibration", Austin Church, Wiely Eastern, 2nd edition.
2.	"Mechanical Vibrations", J.P. Den Hartog, Tata Mc-Graw Hill Book Company Inc., 3rd edition, 2008
3.	"Elements of Vibration Analysis" Leonard Meirovitch, Tata Mc-Graw-Hill, New York, 2nd edition, 1986
4.	"Vibrations and Noise for Engineers", Kewal Pujara Dhanpat Rai and Sons, 4th edition, 2007

Useful Links:	
1.	nptel.ac.in/courses/112104194/
2.	nptel.ac.in/courses/112107087/
3.	nptel.ac.in/courses/112104026/
4.	http://nptel.ac.in/courses/112103112/

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓	✓	✓	✓	✓				✓	✓	✓				✓
CO2	✓	✓	✓		✓					✓	✓				
CO3	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓	✓	✓			✓	✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	2	2	0	10
Understand	4	4	1	16
Apply	4	4	3	16
Analyze	3	3	3	10
Evaluate	2	2	2	08
Create	0	0	1	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME803: Energy and Power Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	03hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To remember the potential of energy sources
2.	To understand new trends in renewable energy sources and its utilization
3.	To apply the knowledge of energy audit & management to practical problems
4.	To analyze and evaluate economics of power plant

Course Contents

		Hours
Unit I	**Solar Radiation and its Measurement** Solar Radiation- The Sun as the source of Radiation, Earth and Solar constant basic, Spectrum distribution of extra terrestrial radiations and its variation, Basic Earth Sun angle, Solar time and equation of time, Depletion of Solar radiation by the atmosphere, Computation of radiation on inclined surfaces, Solar charts, Measurements of diffuse & global & direct radiations, Duration of sunshine hours	**06**
Unit II	**Solar Energy Applications** Application of Solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnaces **Solar Photovoltaic**- Introduction, Fundamentals of Photovoltaic conversion, PV systems - Stand alone, Grid connected and Solar power satellite energy, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking **Solar Energy Collector -** Flat plate collector, Transmissivity of cover plate, Energy balance equation and Collector efficiency, Concentrating collector, Comparison of Flat plate and concentrating collector	**08**
Unit III	**Energy from Wind and Biomass** **Energy from Wind** - Nature of wind energy, Data collection and site selection, Vertical axis wind turbine, Horizontal axis	**06**

	wind turbine, Rotor design, Blade design, Forces on blade, Horizontal axis wind turbine theory, Slip stream theory. (No numerical) **Energy from Biomass** - Introduction, Biomass conversion Technologies, Photosynthesis, Biogas generation, Factors affecting Bio-digestion of gas, Classification of Biogas plants, Selection of site for a Biogas plant	
Unit IV	**Introduction to Power Plant Engineering** Power scenario in India and world, NTPC, NHPC and their role in power development in India, Power generation in private sector, Power distribution, Power grid corporation of India, State grids, Railway grids and International grids, Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear and their characteristics, Combined cycle, Pumped storage, Compressed air storage power plants and their characteristics. Comparison of power plants with respect to various parameters, Issues in Power plants	**06**
Unit V	**Economics of Power Generation** Introduction, Terms and definitions, Principles of power plant design, Location of power plant, Layout of power plant, Cost analysis, Selection of type of generation, Selection of power plant equipment, Economics in plant selection, Factors affecting economics of generation and distribution of power, Useful life of power plant, Economics of Hydro-electric power plants, Economics of Combined Hydro and Steam power plants, Performance and operating characteristics of power plants, Economic load Sharing, Tariff for Electrical energy	**09**
Unit VI	**Energy Audit and Management** Selling and marketing in India, Creating supply chain in India, Successfully working with business and virtual teams in India, Navigating the financial, legal and accounting environment, Human Resources issues, India's business culture in transition	**05**

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Remember the potential of energy sources
2.	Understand new trends in renewable energy sources and its utilization
3.	Apply the knowledge of energy audit & management to practical problems
4.	Analyze and evaluate economics of power plant
Text Books:	
1.	Solar Energy, S. P. Sukhatme and J. K. Nayak, Tata McGraw-Hill, 3rd Edition

	2008
2.	Non-Conventional Energy Sources G. D. Rai.- Khanna Publisher, 4th Edition 2014
3.	Solar Energy. H P Garg and J Prakash Tata McGraw-Hill, 1st revised edition 2000
4.	Power plant Engineering , P K Nag Mc Graw Hill Third Edition, 2010
5.	Power Plant Engineering, R.K.Rajput, Laxmi Publications (P) LTD, 2008
References:	
1.	Solar Energy. H P Garg and J Prakash Tata McGraw-Hill, 1st revised edition 2000
2.	Power Plant Technology, M.M.El Wakil, Tata Mc Graw Hill. Int , 2nd Edition.Reprint, (2010).
Useful Links:	
1.	www.nrgsystems.com
2.	www.ises.org
3.	http://windeis.anl.gov/guide/basics
4.	http://www.awea.org
5.	https://www.nrel.gov

Mapping of COs with POs (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An Ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**J**	**k**	**l**	**m**	**n**	**o**
CO1	✓	✓	✓	✓	✓			✓	✓			✓	✓		
CO2	✓	✓							✓		✓			✓	
CO3	✓	✓	✓		✓			✓	✓			✓	✓	✓	✓
CO4	✓								✓		✓	✓			

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	4	1	16
Apply	4	4	3	10
Analyze	3	4	2	12
Evaluate	2	0	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME814 :Industrial Automation & Robotics

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	2 Hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the basics of automation, its elements and how electronics, circuits and sensors effect automation controls
2.	To create the advanced automation for changing needs of world
3.	To design and implement robotic systems and apply what they learned to the applications in the Automation and Robotics field
4.	To analyze the various subsystems of flexible automation and robot
5.	To develop the programming associated with robo-control

Course Contents

		Hours
Unit I	**Introduction** Automation in Production System, Fixed /programmable/ flexible, Automation, Need of automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations	07
Unit II	**Assembly Automation** Types and configurations, Parts delivery at workstations, Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly, Quantitative analysis of assembly system.	06
Unit III	**Automated Inspection and Testing** Levels of Automated Inspection, Contact and non-contact type inspection, Coordinate Measuring Machines, Machine Vision. Online and offline inspection.	06
Unit IV	**Fundamentals of Industrial Robots** Specifications and Characteristics, Criteria for selection, Robotic Control Systems: Drives, Robot Motions, Actuators, Power transmission systems, Robot controllers, Dynamic	07

	properties of robots-stability, Control resolution, Spatial resolution, Accuracy, Repeatability, Compliance, Work cell control, Interlocks.	
Unit V	**Robotic End Effectors and Sensors** Transducers and sensors- Sensors in robotics and their classification, Touch (Tactile) sensors, Proximity and range sensors, Force and torque sensing, End Effectors- Types, grippers, Various process tools as end effectors; Robot End effectors interface, Active and passive compliance, Gripper selection and design, Transformation, Relative transformation, Direct and inverse kinematics solutions.	06
Unit VI	**Robot Teaching** Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc	08

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand the potential areas for automation and justify need for automation
2.	Apply knowledge of automation tools and other equipments for manufacturing and assembly components
3.	Function in research and development centre for automation
4.	Evaluate efficiencies and limitation and provide in depth evaluation of robotic system for automated manufacturing applications
Text Books:	
1.	"Automation, Production Systems and Computer Integrated Manufacturing", M. P. Groover, Pearson Education.5th edition, 2009.
2.	"Introduction to Robotics", John J. Craig, Addison Wesley Publishing, 3rd edition, 2010
References:	
1.	"Robot Technology Fundamentals", Keramas, James G, Thomson Learning – Delmar ISBN: 981-240-621-2,(1998).
2.	"Robotics for Engineers", Yoram Koren, McGraw Hill International, 1st edition, 1985
3.	"Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition, 2011

Useful Links:	
1.	https://www.electricaltechnology.org/2015/09/what-is-industrial-automation.html
2.	http://nptel.ac.in/courses/108105062/
3.	http://nptel.ac.in/courses/112102011/

Mapping of COs with POs

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating
Course Outcomes	**a**	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	✓	✓	✓	✓							✓	✓
CO2	✓			✓	✓						✓	✓
CO3	✓			✓						✓	✓	
CO4	✓			✓						✓	✓	

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	14
Apply	3	3	2	14
Analyze	3	3	2	10
Evaluate	2	2	2	12
Create	1	1	1	10
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME824: Machine Tool Design

Teaching Scheme			**Examination Scheme**	
Lectures	03hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand design considerations of machine tools
2.	Study of various motions, drives, and transmissions of machine tools
3.	Able to design elements of machine tools
4.	Evaluate various control systems and their application in automation

Course Contents

		Hours
Unit I	**Introduction to Machine Tool Design** Classification of machine tools based on their construction, Precision, Control, Drives and rate of production. Elements of machine tools, General requirements of machine tool design, Engineering design process applied to machine tools, Layout of machine tools, Various motions introduced in machine tools, Parameters defining limits of motions.	**06**
Unit II	**Design of Machine Tool Drives** Requirements of machine tools drives, Mechanical and hydraulic transmission used in machine drives ,their elements ,Selection of speed and feed, Types of Speed and feed regulation, Stepped, step-less, mechanical, electrical, Hydraulic methods of speed regulation and their comparison. Stepped drives of machine tools- Gear drives, Gear box design, Graphical representation of gear box operation with ray diagram (Optimization of gear ratios), Structural diagram, Deviation diagram. Drives for CNC machine tools- AC and DC servomotors, Stepper motors.	**07**
Unit III	**Design of Machine Tool Structures** Functional requirements of machine tool structures, Consideration used in design for strength and rigidity, Design procedure for machine tool structures, Materials for machine tool structures, Design of beds, columns and housings	**07**

Unit IV	**Design of Guide ways, Slide ways, Spindles and Spindle Supports** Function and types of guide ways, Design of slide ways-Shape and Materials, Protecting devices for Slide ways, Force analysis of Lathe guide ways, Guide ways operating under liquid friction conditions, Design of antifriction guide ways, Design of Aerostatic slide ways, Design of Antifriction slide ways, Introduction to design of power screws. Functions of spindle unit and requirements, Materials, Machine tool compliance and machining accuracy, Design calculations of spindles, Bearings for spindles, Sliding bearing used for spindles.	**07**
Unit V	**Dynamics of Machine Tools** Effect of vibrations, Source of vibrations, Self excited vibration, Single degree of freedom chatter, Velocity principle and related models, Regenerative principles, Chatter in lathe, drilling, milling and grinding, Machine tool elastic system, General procedure for assessing Dynamic stability of equivalent elastic system. Finite Element Analysis (FEA) techniques for Vibration analysis of machine tool structure and methods of elimination of Vibrations	**06**
Unit VI	**Machine Tool Control and Automation** **Control Systems:** Functions, requirements and classification, Control systems for speeds and Feeds, Various motions etc. Manual and automatic control systems. Basic principle of control, Hydraulic controls, Fluid controls, Numerical controls, Feed-back systems, Primary systems programming. Design of CNC. **Automation:** Systems such as mechanical, electrical, electronics, optical, pneumatic/hydraulic used for position control, their application in automation, Degree of automation, Semi automation.	**07**

Course Outcome (CO):	
At the end of this course, students will be	
1.	Able to apply the knowledge of various considerations for machine tool design.
2.	Able to evaluate machine tool drives selection.
3.	Able to design machine tool elements.
4.	Able to develop modern machine tools.
Text Books:	
1.	"Machine Tools Design and Numerical Control" N.K. Mehta, Tata Mc- Graw Hill Publication, 3rd Edition, 2012

2.	Principles of Machine Tools" Sen and Bhattacharya, New Central Book Agencies 2nd Edition, 2009
References:	
1.	"Machine Tools Handbook" Design and Operation" P. H. Joshi, Tata McGraw Hill Education, First Edition (2007)
2.	"Machine Tool Engineering", Nagpal G.R., Khanna Publications (1999)
3.	"Design of Machine Tools", S.K.. Basu and D.K. Pal Oxford and IBH Publication, 6th Edition. (2014)
4.	"Machine Tool Design Handbook", CMTI, TMH (2017)
Useful Links:	
1.	http://nptel.ac.in/courses
2.	www.igtr-aur.org/

Mapping of COs with POs (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓			✓					✓		✓				✓
CO2	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓
CO3	✓		✓	✓	✓						✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓						✓	✓	✓		✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	2	2	1	5
Understand	2	2	1	10
Apply	3	3	2	11
Analyze	3	3	2	12
Evaluate	3	3	2	12
Create	2	2	2	10
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME834: Elective II - Computational Fluid Dynamics

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	Provide Fundamental fluid dynamic principles and their applications
2.	Carry out research in the area of Computational Fluid Dynamics
3.	Provide students with the necessary skills to use commercial Computational Fluid Dynamics packages
4.	Introduce the student to widely used techniques in the numerical solution of fluid equations, issues that arise in the solution of such equations, and modern trends in CFD.

Course Contents

		Hours
Unit I	**Introduction to Computational Fluid Dynamics** Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations. Review of Naiver-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy The Governing Equations of Fluid Dynamics and Heat transfer, Models of the flow- Control Volume, Fluid Element, Substantial Derivative, Divergence of Velocity, Continuity Equation Different Models and their Equivalence, Integral versus Differential Form of the Equations, The Momentum Equation, The Energy Equation, Summary Equations for Viscous Flow (the Naiver-Stokes Equations) Equations for Inviscid Flow (the Euler Equations) Forms of the Governing Equations Particularly Suited for CFD.	08
Unit II	**Basic of Discretization and Grid Generation.** Basic aspects of discretization - Discretization techniques Finite difference - Finite volume and Finite element method Comparison of discretization by the three methods,	06

	Transformation of non-uniform grids to uniform grids - General transformation of the equations -Form of the governing equations suitable for CFD - Compressed grids - Boundary fitted co-ordinate systems Elliptic grid generation - Adaptive grids - Modern developments in grid generation.	
Unit III	**Finite Difference Method** Finite Difference Formulations: Introductory remarks, Taylor Series Expansions, Finite difference equations, Central Forward, Backward Numerical error, Explicit, Implicit, Semi-implicit (Crank- Nicholson method), Solution methods Direct, Iterative, Thomas algorithm, Gauss- Jacobi, Gauss- Seidal method, Alternate Directional Implicit, Applications. 1-D examples, 2-D examples	06
Unit IV	**Finite Volume Method** Domain discretization's, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach. For Diffusion Introduction, FVM for 1D steady state Diffusion, FVM for 2 D Diffusion, For Convection Diffusion Introduction, Steady 1-D Convection and Diffusion, Central Differencing, Upwind Differencing, Hybrid Differencing, Power Law Scheme, QUICK scheme	08
Unit V	**Multi phase flow** Introduction, staggered grid, introduction to SIMPLE, SIMLEC, SIMPLER, PISO algorithms, Modelling of multiphase problems, Level set methods, VOF method. Coupled LS+VOF.	06
Unit VI	**Introduction to Turbulence and its Modelling** What is turbulence? Transition from laminar to turbulent flow; Effect of turbulence on time averaged Navier -Stokes equations; Characteristics of simple turbulent flows; Introduction to Turbulent Models like Mixing length Model, k-epsilon model, Reynolds stress equation models, Algebraic stress equation models; Some recent Advances, introduction to LES, DNS	06

Course Outcome (CO): At the end of this course, students will be able to	
1.	**Knowledge:** The course provides the student with knowledge about: I. Understand of the basic theory of Computational Fluid Dynamics, including discretization, accuracy and stability. II. Capable of writing a simple solver and using a sophisticated commercial CFD package.
2.	**Skills:** I. Develop programming skills to solve some specific CFD problems.
3.	**General competence:** I. Ability to assess fluid mechanics problems commonly encountered in industrial and environmental settings, construct and apply computational models, determine critical control parameters and relate them to desired outcomes and write reports.
Text Books:	
1.	"Computational Fluid Mechanics the Basics with Applications", Anderson J. D. Jr. Tata McGraw Hill Education Pvt. Ltd Indian Edition 2017.
2.	"An Introduction to Computational Fluid Dynamics the Finite Volume Method" H. K. Versteeg and W. Malalasekera, II Edition, Pearson Publication.
References:	
1.	"Numerical Heat Transfer Fluid Flow", Suhas V. Patankar,Taylor and Francis, Reprint 2017.
2.	Introduction to Computational Fluid Dynamics", Pradip Niyogi, S. K. Chakrabarthy, M. K. Laha , 2005, Pearson Publication.
3.	"Computational Fluid Dynamics: A Practical Approach", Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, Butterworth – Heinemann, 2012
4.	"Computational Fluid Dynamics", T. J. Chung, Cambridge University Press, 2010
5.	"Introduction to Computational Fluid Dynamics",Anil W. Date, Cambridge University Press, 2005.
Useful Links:	
1.	http://www.thermalfluidscentral.org/e-books/book-viewer.php?b=37&s=2
2.	http://www.elsevier.com/books/advances-in-heat-transfer
3.	http://www.ecs.umass.edu/mie/faculty/rothstein/mie606_fall02.pdf

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓														
CO2	✓	✓	✓	✓	✓										
CO3	✓	✓	✓	✓	✓			✓							
CO4	✓	✓	✓	✓	✓							✓			

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	14
Understand	4	4	1	16
Apply	3	*3*	3	12
Analyse	2	2	2	08
Evaluate	2	2	2	08
Create	1	1	1	02
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 844: Elective-II-Tool Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	03 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the design procedure for tooling (Jigs and Fixtures) and die design for presswork
2.	To apply the principles of designing fixtures and dies for industrial applications
3.	To analyze the measures for standardizing tools and tooling elements, components of Jigs & Fixtures, Dies & Moulds, Press Tools and other tools
4.	To design the tools, Jigs & fixture, dies & moulds, press tools, using CAD/CAM and CNC techniques
5.	To develop the tools for advanced processes

Course Contents

		Hours
Unit I	**Introduction to Jigs and Fixtures** Necessity, applications and types, Basic concept of jigs and fixtures for different manufacturing processes, Dependency of jig and fixture design on operation sequence. **Location & Clamping System** Principles, types, applications, Locating pins, pads, diamond pins, adjustable supports, Vee & post locators, Clamping system - principle, types, screw clamp, strap, lever, hinge type, cam operated, toggle clamps, centralizer & equalizer clamp, multiple clamping, quick acting clamps, pneumatically operated clamps. **Indexing System** Necessity, different indexing systems for jigs and fixtures.	08
Unit II	**Design of Jigs** Principles of jig design, types of jigs- plate, Template, box, channel, sandwich, latch, tumble, turn-over, tumble jig etc., Types of bushes, Selection of bushes and liners, Construction of jig and fixture bodies, Use of standard parts	05

Unit III	**Design of Fixtures** Principles of fixture design, Types of fixtures- gang, Straddle, vertical, slot, string milling fixture etc, Selection of the suitable type, Design of milling fixtures, Use of setting block, tennons, T-bolts etc, Design of turning fixture for lathe, Interactive Computer Aided Fixture Design (I-CAFD) structure.	05
Unit IV	**Introduction to Press Tools** Dies, punches, Types of presses, Types of dies, Simple, compound, combination and progressive dies, Press tools for operations like blanking, piercing, drawing, shaving, trimming, etc.	06
Unit V	**Design of Die Set for Cutting Operations** Theory of metal cutting, Cutting force estimation, Punch and die clearance, Scrap strip layout, Design of punches, Design of dies, pilots, strippers, stock stops, finger stops, auto stops, Center of pressure, Selection of die set.	06
Unit VI	**Design of Drawing Die** Blank size determination, no. of draws, Stage wise achievement of drawn component, Stage wise component drawings, Drawing radii and clearance, Drawing forces, Defects in drawing.	06

Course Outcome (CO) At the end of this course, students will be able to	
1.	To understand the design procedure for tooling (Jigs and Fixtures) and die design for presswork
2.	To apply the principles of designing fixtures and dies for industrial applications
3.	To analyze the measures for standardizing tools and tooling elements, components of Jigs & Fixtures, Dies & Moulds, Press Tools and other tools
4.	To design the tools, Jigs & fixture, dies & moulds, press tools, using CAD/CAM and CNC techniques
5.	To develop the tools for advanced processes
Text Books:	
1.	A Text Book of Production Engineering, P. C. Sharma, S. Chand-2015
2.	Jigs and Fixture, P. H. Joshi, Tata Mc-Graw Hill Pub. Co -2004
3.	Rong, Yeming; “Computer Aided Fixture Design”, -2011
4.	Dies for Plastic Extrusion – M.V. Joshi – McMillan-2012
5.	Marcel Dekker, Metal Forming Handbook – Schuler, Springer- Verlag Berlin
6.	Tool Design, Donaldson, (TMH) 2008

7.	Tool Design, Pollock, Reston Pub. Co. Inc.2005
References:	
1.	An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS) 2009
2.	Fundamentals of Tool Design, Ed. Frank Wilson, ASTME (TMH) 2010
3.	Jigs and Fixture Design Manual, Henirkson (Industrial Press, NY) 2008
4.	Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc.2007
5.	Techniques of Press Working of Metals by Eary and Reed 2009
6.	Jigs and Fixture Design 5e E.G. Hoffman CENGAGE Learning 2008
7.	A.Y. C. Nee, K. Whybrew & A. Senthilkumar, Advanced Fixture Design for FMS, Springer 2009
8.	Design of Jigs and Fixtures – Hoffman (Pearson) 2009
9.	Handbook of Die Design- Suchy, (McGraw Hill) 2010
10.	ASM Handbook – Forming – ASME
11.	CMTI Machine Tool Design Handbook, (TMH)
12.	Design Data Handbook –PSG College of Tech., Coimbtore

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓			✓
CO 2	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓			✓
CO 3	✓		✓	✓	✓			✓	✓	✓	✓	✓		✓	✓
CO 4	✓	✓	✓	✓	✓					✓	✓	✓			✓
CO 5	✓	✓	✓	✓	✓					✓	✓	✓			✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 854: Elective-II- Process Equipment Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the fundamentals of shell and tube heat exchangers.
2.	To apply the standards and codes used in the design of shell and tube heat exchangers and piping systems to practical problems
3.	To analyze process of design of distillation column and storage tank
4.	To design shell and tube heat exchangers for different applications

Course Contents

		Hours
Unit I	**Introduction** Introduction, Scope of shell-and-tube heat exchanger, Components of shell and tube heat exchangers (shell, shell cover, tubes, tube sheet, baffles and nozzles), Construction, TEMA standards, TEMA terminology, ASME codes Sec VIII Div 1, and WRC 107	06
Unit II	**Shell and Tube heat exchangers** Tinker's, Kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers	06
Unit III	**Mechanical Design of Heat Exchangers** Design standards and codes, Key terms in heat exchanger design and thickness calculation for major components such as tube sheet, shell and tubes	06
Unit IV	**Column and Tower internals** Introduction, Criteria of selection, Selection of equipment for distillation, Distillation column design, Selection of key components for multi component distillation, Determination of operating pressure for distillation column, Advantages & disadvantages of vacuum distillation, Determination of nos. of theoretical stages for binary distillation by McCabe Thiele method Determination of nos. of theoretical stages for multi-component distillation by Fenskey- Underwood-Gilliland's	07

	method, Selection of trays, Calculations for tower diameter & pressure drop of sieve tray tower, Checking of conditions for weeping, down comer flooding, liquid entrainment, etc, tray efficiency, Jet Flooding & down comer Flooding, Different types of weirs & down comers of tray tower, their selection criteria, Process design of Batch distillation, simple batch distillation & batch distillation with rectification.	
Unit V	**Agitators and Reaction Vessels** Types of agitators, their selection, applications, baffling, power consumption which includes twisting moment, equivalent bending moment, design of blades etc. Reaction vessels- Introduction, classification, heating systems, design of vessels, study and design of various types of jackets like plain, half coil, channel, limpet oil. Study and design of internal coil reaction vessels, Heat transfer coefficients in coils	08
Unit VI	**Mechanical design of Storage Tank** Classification of storage tank as per IS-803, Capacity of storage tank, its diameter & height, Design of shell and bottom plate for storage tank, Design of Self supported conical roof, Design of structured supported conical roof as per API 620, Selection of column, girders and rafters, Roof curb angel, Floating roof	07

Course Outcome (CO)

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

1.	To understand the fundamentals of shell and tube heat exchangers.
2.	To apply the standards and codes used in the design of shell and tube heat exchangers and piping systems to practical problems
3.	To analyze process of design of distillation column and storage tank
4.	To design shell and tube heat exchangers for different applications

Text Books:

1.	R. K. Sinnott, Coulson & Richardson's Chemical Engineering: Chemical Engineering Design (volume 6), Butterworth-Heinemann, 3rd ed. 1999.
2.	D. Q. Kern, Process Heat Transfer, McGraw-Hill Book Company, Int. Edition, 1965.
3.	Dutta B. K. 'Heat Transfer-Principles and Applications', PHI Pvt. Ltd., New Delhi, 1st Edition, 2006.
4.	"Introduction to Process Engineering and Design" by S B Thakore and B I Bhatt, Tata McGraw Hill, 1st Edition, 2007.
5.	S. D. Dawande, Process Equipment Design, Denett & Co, 2009
6.	M.V. Joshi, V. V. Mahajani, Process Equipment Design, Macmillan India.
7.	B.C. Bhattacharya, Introduction to Chemical Equipment Design, CBS

	Publications, 1985.
References:	
1.	Ramesh K. Shah and Dusan P. Sekulic, “Fundamentals of Heat Exchanger Design” JohnWiley& sons Inc., 2003.
2.	Sadik Kakac and Hongton Liu, “Heat Exchangers: Selection, Rating and Thermal Design” CRC Press, 1998.
3.	T. Kuppan, “Hand Book of Heat Exchanger Design”.
4.	“T.E.M.A. Standard”, New York, 1999.
5.	WRC 107
6.	Applied Process Design for Chemical and Petrochemical plants,Vol. 1to 3 by E.E. Ludwig, Gulf Publishing Company
7.	S. M. Walas, Chemical Process Equipment: Selection and Design, Butterworth-Heinemann, 1990.
8.	L. E. Brownell, E. H. Young, Process Equipment Design - Vessel Design, John Wiley and Sons, Inc., 1959.
Useful Links:	
	http://www-unix.ecs.umass.edu/~rlaurenc/Courses/che333/Reference/exchanger.pdf
	http://my.chemeng.queensu.ca/courses/integratedDesign/Resources/documents/CourseNotes-HeatExchangers2008.pdf
	http://nptel.ac.in/courses/103103027/pdf/mod1.pdf

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Outcomes Programme Specific	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓													
CO 2	✓	✓	✓		✓	✓									
CO 3	✓	✓	✓		✓	✓	✓		✓				✓		
CO 4	✓	✓	✓		✓	✓	✓		✓			✓	✓		

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	2	2	1	8
Understand	2	2	1	8
Apply	3	3	2	12
Analyze	3	3	2	12
Evaluate	3	3	2	12
Create	2	2	2	08
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

Elective-III ME 815: Casting & Welding Processes

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs30 min		**ESE**	60

Course Objectives	
1.	To understand fundamentals of advanced casting & welding processes
2.	To apply knowledge of solidification and melting practice
3.	To analyze the metallurgical failures in casting & welding processes
4.	To design gates and risers for casting

Course Contents		**Hours**
Unit I	**Metal Casting – Overview and Solidification** Introduction to types of casting processes: Sand casting, Investment casting and gravity die casting, pressure die casting, centrifugal casting, vacuum casting, revision of ferrous and non-ferrous materials. Solidification of Casting: Concept of solidification of metals. Homogenous and heterogeneous nucleation, Growth Mechanism, Solidification of pure metals and alloys, Mechanism of columnar and dendritic growth. Solidification time and Chvorinov's rule, Concept of progressive and directional solidifications.	**07**
Unit II	**Principles of Gating and Risering** Design of the gating System, Numerical on gating system design. Functions of the riser, Types of risers. Design of the riser - its shape, Size and location, Use of insulating material and exothermic compounds in risers.	**07**
Unit III	**Design of Casting** Design of Casting: Factors to be considered in casting design. Software package for the design and production of castings. Design consideration in pattern making: Selection of pattern materials, Types of patterns, Pattern allowances. Hot spots in casting and modification in casting geometry to overcome them, Casting Quality Control: Casting defects and factors responsible for them, Salvaging methods of defective casting.	**06**

Unit IV	**Melting Practices for Different Alloys** Melting Practices and Furnaces for Ferrous and Non- ferrous Alloys: Melting practices of Al alloys: Drossing, Gas absorption, Fluxing & flushing, Grain refinement, pouring temperature Melting practices of Mg – alloys: Gas absorption, General melting practice, Refinement, alloying, Melting practices of Cu - based alloys: Metal charge, Melting furnace, Pouring practice. Melting practices of steel: Furnaces, gas content Special treatment of melt: Refining and inoculation, Gases in metals. Degassing, Desulphurization, inoculation practice, de-oxidation and alloy additions; Principle of working of thermocouples, spectrometers, and C.E. meters −applications; use of pyrometers for temperature measurement and control, energy saving in melting practices	**07**
Unit V	**Review of Welding** Principle working of following welding methods: Electric arc welding, Resistance welding, Soldering & brazing. Significance of fluxes and electrodes in welding. Welding Metallurgy: Metallurgical factors affecting welding, heat affected zone, heat treatment after welding, solidification of weld, Controlling weld cracks, weld joint design, welding process selection, welded connections, welding fixtures, distortion control tools, automation in welding.	**06**
Unit VI	**Weld Quality and Defects** failure of welds, inspection and testing of welds, I.S. code for welding and weld-ments, destructive tests for welds, microstructure for weld joints, welding defects and remedies. **Modern welding processes: Principle working, advantages, limitations, equipment of:** EBW, LBW, diffusion bonding, ultra sonic welding, pulsed current welding processes, friction welding. Welding of ceramics, plastics and composites.	**07**

Course Outcome (CO):

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

1.	Understand basic casting design procedure.
2.	Understand fundamental knowledge of Welding metallurgy.
3.	Design of castings for different application.
4.	Understand failure analysis for welded components.

Text Books:

1. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal "Principles of Metal

	Castings", 2nd Edition Tata McGraw hill Publication.
2.	P.L. Jain "Principles of Foundry Technology", 4th Edition Tata McGraw hill Publication.
3.	V. D. Kodgire "Material science and Metallurgy for Engineers", Everest Publishing House
4.	O. P. Khanna "Text Book of Foundry Technology", Dhanpat Rai and Sons Publications.
5.	Phillip. F. Ostwald, J. Munoz "Manufacturing Processes and Systems", 9th Edition, John Wiley & Sons Publications.
6.	O. P. Khanna "Text Book of Welding Technology", Dhanpat Rai and Sons Publications.
7.	P. C. Sharma "Text book of Manufacturing Technology-I", S. Chand Publications.
References:	
1.	"The Institute of Indian Foundry men", Foundry Journal.
2.	"ASM Handbook Volume 15: Casting", ISBN: 978-0-87170-711-6 ASM International Publisher
3.	T.V. Ramana Rao "Metal Castings – Principles and Practice". New Age International (P) Ltd. Publishers, ISBN:81-224-0843-5
4.	P.C. Mukherjee "Fundamentals of Metal Casting Technology", 2nd Edition, Oxford & IBH Publication.
5.	John R. Brown "Foseco Ferrous Foundry man's Handbook", Elsevier Ltd. Publication, ISBN:978-0-7506-4284-2
6.	John Campbell "Castings", 2nd Edition , Butterworth-Heinemann Publications
7.	Richard L. Little, "Welding and Welding Technology." McGraw-Hill Companies Publication
8.	Schwartz M.M., "Metal Joining Manual", John Wiley & Sons Inc (December 1969) ISBN-10: 0471766151, ISBN-13: 978-0471766155
9.	Welding Handbook – 9thEdition, Volume 1
10.	Hauldcraft P.T, "Welding Process Technology", Cambridge University Press, 1985

	Useful links
1.	https://swayam.gov.in/course/3555-principles-of-casting-technology/
2.	E-Foundry: Free Online Learning Resources inCasting Design and Simulation, by B. Ravi Indian Institute of Technology Bombay, Mumbai
3.	AWS Online Courses | American Welding Society Education Online https://awo.aws.org/online-courses/
4.	https://swayam.gov.in/course/3558-joining-technologies-for-metals/

Mapping of COs with POs (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓				✓				✓		✓				
CO2	✓	✓	✓	✓	✓						✓	✓			✓
CO3	✓		✓		✓						✓	✓			✓
CO4	✓	✓	✓	✓	✓				✓		✓	✓			

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 825: Industrial Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the concept of industrial engineering
2.	Acquainting learners with tools and technique of industrial engineering.
3.	Analyze and design new method of performing job.
4.	Understand work measurement techniques

Course Contents

		Hours
Unit I	**Introduction** Definition and scope of industrial engineering, Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer, Use of software in IED	**06**
Unit II	**Productivity and Work Study** Productivity concept and definition: Introduction, definitions of productivity, Productivity measurement at national, industrial and enterprise level, Benefits of higher productivity. Productivity in the individual enterprise: Introduction, Productivity measurement approaches at the enterprise level, Productivity of materials, Productivity of land, buildings, machines and manpower, Factors contributing to productivity improvement, Techniques for productivity improvement: Introduction, Work content and ineffective time, Improving productivity by reducing work content, and ineffective time, Management of productivity, Issues in implementing work study in Indian organizations	**08**
Unit III	**Work Study** Introduction, basic procedure, prerequisites of conducting a	**08**

	work study, The human factor in application of work study: Introduction, management and supervisor; their role in work study, The influence of working conditions on work study: Introduction, factors affecting working conditions, occupational safety and health, layout and housekeeping, lightning and climate conditioning, noise and vibrations, ergonomics, SWCC	
Unit IV	**Method Study** Introduction to method study and the selection of job: Introduction, definition and objective of method study, procedure of method study. Flow and handling of materials: Introduction, plant layout, developing the new layout, the handling of materials, Tools for recording the movement of worker: Introduction, string diagram, flow process chart; man type, travel chart, multiple activity chart. Introduction, the principles of motion economy, classification of movements, the two handed process chart, SIMO chart.	**08**
Unit V	**Work Measurement** Purpose of work measurement, the basic procedure, the techniques of work measurements, Work sampling: Introduction, basic concept and procedure, Time study: rating: Introduction, stop watch time study, the average worker, standard rating and standard performance. Predetermined time standards (PTS): Introduction, definition, advantages of PTS system, Criticisms of PTS system, different forms of PTS system, use of PTS system, and application of PTS system, Introduction to MOST	**08**
Unit VI	**Work Design** Operator engagement, Concept of job enlargement, job enrichment and job rotation, effective job design consideration, technological and behavioural factors, Work environment design, **Ergonomics** Introduction to ergonomics, consideration in designing man machine systems with special reference to design of displays and controls	**04**

Course Outcome (CO) At the end of this course, students will be able to	
1.	Understand significance of productivity in an industrial set up
2.	Analyze and design new method of performing job.
3.	Measure and estimate standard time for a job by performing time study.
4.	Apply ergonomics concepts in work environment
Text Books:	
1.	Industrial Engineering and Management- O.P. Khanna, Dhanpat Rai Publisher, 2010
2.	Industrial Engineering and Production Management - Martand Telsang, S. Chand Publisher, 2006
3.	Industrial Engineering and Management- S. B. Patil
4.	Industrial Engineering- M. I. Khan, New Age International, 2004
References:	
1.	Work study- ILO, Second Edition, Oxford and IBH Publishing2010
2.	Handbook of Industrial Engineering: Technology & Operations Management- Gavriel Salvendy
3.	Ergonomics- a System Approach – Isabel L. Nunes
4.	Industrial Engineering Handbook- Maynard

Useful Links:	
1.	https://www.isixsigma.com/topic/most-maynard-operation-sequence-technique/
2.	https://www.nitie.edu/
3.	iiie-india.com/
4.	www.ilo.org

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	Anabilitytoapplyknowledgeofmathematics,science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓			✓			✓	✓		✓				✓
CO 2	✓	✓			✓			✓	✓		✓	✓			✓
CO 3	✓	✓			✓			✓	✓		✓	✓			✓
CO 4	✓	✓			✓			✓	✓		✓	✓			✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 835: Advanced Refrigeration

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To study multistage refrigeration cycles.
2.	To analyze various system components and accessories of refrigeration and air-conditioning systems.
3.	To evaluate the performance of refrigeration systems
4.	To design the various refrigeration systems by imparting advanced knowledge to present situations

Course Contents

		Hours
Unit I	**Multistage Systems and Analysis** Multi-evaporator system; Multi expansion system; Cascade systems; Study of P-h; T-s charts for various refrigeration cycles, Heat Pump.	**04**
Unit II	**Vapor Absorption Systems and Analysis** Practical Aqua Ammonia system, Lithium Bromide absorption system, Enthalpy-Concentration charts for Aqua Ammonia and Li-Br- H_2O solutions, Analysis of Vapor Absorption System on enthalpy - concentration chart, Three fluid absorption systems.	**07**
Unit III	**Non-Conventional Refrigeration Systems** Thermoelectric refrigeration, Thermo-acoustic refrigeration, Adsorption refrigeration, Steam jet refrigeration, Vortex tube refrigeration, Pulse tube refrigeration and Magnetic refrigeration. **Refrigerants** Refrigerant recycling, Reclaim and charging, Alternative eco-friendly refrigerants and their properties, Refrigerant-lubricant mixture behavior, Synthetic Lubricants, Blending of refrigerants, Secondary refrigerants, Natural refrigerant, flammable refrigerants; GWP and ODP, carbon footprint calculations, Various Protocols and International treaty	**08**
Unit IV	**Refrigeration Equipment** **Compressors:** Study and selection of Reciprocating, Screw,	**07**

	Scroll and Centrifugal compressor based on applications. **Motor Selection:** Selection of single phase, three phase, starters, Constant speed and variable speed drive. **Evaporators:** Design and selection, types, Thermal design, Effect of lubricants accumulation, Draining of lubricants, Selection and capacity control. **Condenser:** Design and selection, Types, Thermal design, Purging, Selection and capacity control, Selection of expansion devices	
Unit V	**Control and Instrumentation** Refrigeration system controller, High pressure receiver, Thermal design of low pressure receiver, accumulator, filters, driers, oil separators, relief valves, safety valves, high and low pressure cut out, Thermostats with range and differential setting, Water regulators, System controller. Design of refrigerant piping, Refrigeration system controls and safety devices, Solenoid valves, Suction and evaporator pressure regulators	**07**
Unit VI	**Refrigeration Applications** Selection and design of various components for Industrial refrigeration applications: Cold storage. textile, pharmaceuticals, chemical, transport, food preservation, dairy etc. International codes for Refrigeration systems.	**07**

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Apply knowledge of the subject to bridge the gap between academics and industry
2.	Analyze various system components and accessories of refrigeration and air-conditioning systems.
3.	Evaluate the Performance of Refrigeration Systems
4.	Design the various refrigeration systems by imparting advanced knowledge to present situations
Text Books:	
1.	C. P. Arora, "Refrigeration & Air-Conditioning", Tata McGraw Hill, 3rd Edition, 2004.
2.	Arora & Domkundwar, "Course in Refrigeration & Air-Conditioning", Dhanpat Rai Publications, 8th edition, 2013
3.	Roy J. Dossat, "Principles of Refrigeration", Wiley Eastern Limited, New Delhi.
4.	Manohar Prasad, "Refrigeration & Air-Conditioning", New Age Intl.

	Publications, 3rd edition, 2010
References:	
1.	ASHRAE Handbook, Fundamentals, 1993.
2.	Stoecker and Jones, "Refrigeration and Air-conditioning".
3.	Jordan & Priester, "Refrigeration & Air Conditioning", Prentice-Hall India, Second edition, 1973.
4.	W.F. Stoecker "Industrial Refrigeration Handbook", McGraw-Hill.
5.	Wang, "Refrigeration Handbook", Mc Graw Hill, Int.
6.	John A. Corinchock "Technician's guide to Refrigeration Systems" ,McGraw-Hill.
7.	"ARI Standards"
Useful Links:	
1.	http://nptel.ac.in/courses/112105128/
2.	http://nptel.ac.in/downloads/112105129/
3.	http://nptel.ac.in/courses/112107208/

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓			✓					✓		✓				✓
CO2	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓
CO3	✓		✓	✓	✓						✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓						✓	✓	✓		✓

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME845: Engineering Economics & Financial Management

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives

1.	Systematic evaluation of the costs and benefits involved in Managerial decisions.
2.	The learner will be exposed to the concepts of the "time value of money" and the methods of discounted cash flow.
3.	Students will be prepared to make decisions regarding money as capital within a technological or engineering environment.

Course Contents

		Hours
Unit I	**Fundamentals of Economics** Scarcity and efficiency market, Command and mixed Economics. Basic elements of supply and demand, Law of demand – Elasticity of demand.	**06**
Unit II	**Demand and Supply Analysis** Demand and supply analysis, Methods of demand forecasting, Determinants of supply, Supply elasticity, Unusual supply curves	**06**
Unit III	**Cost Analysis** Cost concepts and its types, Determinants of cost, Short and long run cost curves, Cost output decision, Cost estimation, Significance of cost in managerial decisions, Time value of money, Variable and Fixed over heads	**08**
Unit IV	**Price Analysis** Pricing determinants, Price determination under different market structures, Pricing policy and strategic pricing, Pricing methods in practice, Break-even analysis, Profit-volume analysis, Concept of ROI	**08**

Unit V	**Accounting System, Statement And Financial Analysis** Accounting concept and classification, Trial balance, P&L account, Balance sheet, Ratio analysis, Fund flow and cash flow analysis, Risks and returns evaluation of financial decisions, Basic concepts of capital budgeting	**08**
Unit VI	**Concepts of Financial Management** Working capital management - Introduction, Components of current assets and liabilities, Concepts of working capital, operating cycle, Determinants of working capital, Approaches for working capital management, Estimation of working capital, Introduction to portfolio management, Share market and sensex	**06**

Course Outcome (CO):	
At the end of this course, students will be able to	
1.	Use EXCEL spreadsheets and financial functions to model and solve engineering economic analysis problems.
2.	Define and provide examples of the time value of money.
3.	Demonstrate the effects of depreciation, taxes, inflation and price changes in engineering economic analysis problems.
4.	Solve economical problems involving comparison and selection of alternatives by using variety of analytical techniques
Text Books:	
1.	Economics – Paul A. Samuelson and William D. Nordhaus.
2.	Engineering Economics – Vol. 1 – Tara Chand.
3.	Financial Management – S. N. Maheswari.
4.	Essentials of Management – Koontz and O' Donnel.
References:	
1.	Basic Financial Accounting for Management- Paresh Shah, Oxford University Press, New Delhi, 2007.
2.	Managerial Economics in a global economy- Salvatore Dominick, Thomson South Western, 4thEdition, 2001.
3.	Engineering Economic Analysis. - Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. (2012). New York: Oxford University Press
4.	Managerial Economics- Applications, Strategy and Tactics- Mc Guigan, Moyer and Harris, Thomson South Western, 10th Edition, 2005.

5.	Fundamentals of Financial Management- Prasanna Chandra. Tata Mcgraw Hill Publishing Ltd, 4th edition, 2005.

Useful Links:	
1.	https://msande.stanford.edu/
2.	https://uwaterloo.ca/management-sciences/
3.	https://www.crcpress.com/Economic-and-Financial-Analysis-for-Engineering-and-Project-Management/Ardalan/p/book/9781566768320

Mapping of COs with POs (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓			✓					✓		✓				✓
CO2	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓
CO3	✓		✓	✓	✓						✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓						✓	✓	✓		✓

Assessment Pattern

Knowledge Level	**CT1**	**CT2**	**TA**	**ESE**
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyze	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
Total	15	15	10	60

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 855: Elective-III- Piping and Pipeline Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	03 hrs/week		**CT1**	15
Tutorial	-		**CT2**	15
Total Credits	03		**TA**	10
ESE Duration	02 hrs 30 min		**ESE**	60

Course Objectives	
1.	To understand the scope and industrial applications of piping system
2.	To study Subsea and buried pipelines
3.	To analyze the piping system layout
4.	To evaluate the design considerations related to pipe supports, valves and auxiliaries
5.	To design the piping systems and its components

Course Contents

		Hours
Unit I	**Fundamentals of Piping and Pipeline Engineering** Brief history of piping technology, scope of Piping and Pipeline Codes standards and practices, Mechanical Design Fundamentals, Mechanical design of piping system, Wall thickness, Piping size selection, Piping elements and specialties, Pipe representation, Welded and flanged fittings	06
Unit II	**Piping and Equipment Layout** Layout Rules of Good Practice, Piping layout, Equipment Layout, Process Piping Layout, Pipe flow sheets, plan and isometric representation of piping system, plot plan	05
Unit III	**Pipe Supports** Spacing of Pipe Supports, Selection of pipe supports, Load on structural supports, supporting structures on pipelines, pipe supports – design considerations, platforms and ladders, foundations, supporting span of overhead pipelines, stiffening ribs, flexible hanger support	06
Unit IV	**Valves - Requirement and Testing** Overview and types of valves, Valve material and method of construction, Pressure drop in valves, valve size, type of valves, fittings, Pressure relief devices, Design of pressure relief system	06

Unit V	**Design of piping requirements** Mechanical Piping Design: Nominal pipe size, Pipe sizing by internal diameter, Choosing the final pipe size, Piping drawings, Piping stress design, Internal or external fluid pressure stresses, expansion effect and compensation methods. Stress analysis: Type of loads, code compliance, thermal effects, fatigue loads, flexibility analysis and introduction to dynamic analysis, software for stress analysis	08
Unit VI	**Applications of Piping and Pipeline Engineering** Subsea pipelines: Subsea Pipeline Safety, Design Process, Internal Pressure, External Pressure, Pipe Lowering, On-Bottom Stability its objectives and Static Analysis, Pipeline Flotation, Fatigue Design Buried pipe: To Bury or not to Bury, Internal Pressure, Soil Loads, Surface Loads, Thermal Expansion and Contraction, Ground Movement, Seismic considerations	07

Course Outcome (CO): At the end of this course, students will be able to	
1.	Understand the scope and industrial applications of piping system
2.	Analyze the piping system layout
3.	Evaluate the design considerations related to pipe supports, valves and auxiliaries
4.	Design the piping systems and its components
Text Books:	
1.	Ed. Bausbacher and Roger Hunt, Process Plant Layout and Piping Design, Pearson Prentice Hall, 1993
2.	G K Sahu, Handbook of piping design, New Age international publisher, Second Edition, 2009
3.	Sabin Crocker, Piping Handbook, McGraw Hill Publication, Fifth Edition, 1968
4.	George A. Antaki ‘Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity, and Repair’
References:	
1.	Mohinder L. Nayyar, Piping Handbook, McGrawHill, Seventh Edition, 1999
2.	ASME Piping Code B 31 (Power piping) and 33 (Process piping)
3.	Pipe Supports, Catalog PH-82A NHK Spring Co. Limited, Yokohoma, JAPAN
Useful Links:	
1.	http://www.crcnetbase.com/isbn/9780203911150
2.	http://www.nptel.ac.in/courses

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Outcomes Programme Specific	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Course Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO 1	✓	✓	✓	✓	✓	✓		✓	✓				✓		
CO 2	✓	✓		✓											
CO 3	✓	✓	✓		✓		✓	✓	✓						
CO 4	✓	✓				✓	✓								

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	0	8
Understand	3	2	1	9
Apply	3	3	2	12
Analyze	3	3	2	12
Evaluate	3	3	2	12
Create	0	2	3	07
Total	15	15	10	60

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 806 : Mechatronics Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**--**

Course Objectives:

1.	To understand the fundamentals of mechatronics systems
2.	To evaluate the mechatronics systems for troubleshooting
3.	To create the circuits for practical applications of mechatronics
4.	To develop PLC programs for industrial applications
5.	To design and implement intelligent engineered products and processes

Course Contents

Term work should consist of any 10 experiments from the following

Experiment 1	Trial on sensors (minimum four),
Experiment 2	Assignment on Microprocessor and Microcontroller.
Experiment 3	Microprocessor programming (Minimum four programs)
Experiment 4	Microcontroller programming (Minimum four programs)
Experiment 5	Control of stepper motor using microprocessor/microcontroller
Experiment 6	PLC Programming on Industrial Applications based on Timers
Experiment 7	PLC Programming on Industrial Applications based on Counters
Experiment 8	PLC Programming on Industrial Applications based on Internal Relays
Experiment 9	Assignment on PLC Data handling and Fault finding,
Experiment 10	Experiments on raspberry Pi and arduino uno/mega (Minimum two Programs)
Experiment 11	Industrial visit to study Mechatronic system application and submission of visit report.

Group Activity: Maximum 3 to 4 students in one group

1. Fabrication of Simple Mechatronics working project using hardware and suitable software.

Lab Outcomes: At the end of course, students will be able to	
1.	Understand to maintain and troubleshoot mechanical and electrical systems.
2.	Create Program for microcontroller and microprocessors
3.	Design and rebuild interdisciplinary projects
4.	Develop PLC logic for industrial applications
Text Books:	
1.	Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications", New Age International Publishers Ltd.
2.	W. Bolton, "Mechatronics",Pearson Education , 4th Edition, 2008
3.	Mahalik, "Mechatronics", TATA McGraw Hill, 2006
References:	
1.	K.P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)", Wiley, 2008
2.	K. K. Appukuttan, "Introduction to Mechatronics", Oxford University Press, 2007
3.	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier; First edition 2006

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science, and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
LO1	✓		✓	✓	✓						✓	✓
LO2	✓	✓	✓	✓					✓	✓	✓	
LO3	✓	✓	✓	✓	✓					✓	✓	✓
LO 4	✓			✓							✓	

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME807 Noise and vibration Laboratory

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**25**
			Total	**50**

Course Objectives:

1.	To understand the principles of vibration and vibrational behavior of systems
2.	To evaluate the frequency response curve of various mechanical systems
3.	To analyze the behavior of mechanical system using professional software
4.	To evaluate noise measurement of the system

Course Contents

Term work should consist of any 10 experiments from the following

Experiment 1	Experiment on equivalent spring mass system.
Experiment 2	Experiment on study of forced vibration characteristics.
Experiment 3	Determination of logarithmic decrement for single DOF damped system.
Experiment 4	Experiment on torsional vibration of two rotor without damping
Experiment 5	To determine resonance frequency of transverse vibration of beam.
Experiment 6	Experiment on free vibration of a coupled pendulum and/or double pendulum
Experiment 7	Use of different types of exciters for vibration analysis
Experiment 8	Measurement of vibration parameters using vibration measuring instruments
Experiment 9	Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.
Experiment10	Case study in detail based on Conditioning Monitoring and Fault Diagnosis
Experiment11	Measurement of Noise by using noise measuring instruments
Experiment12	Vibration analysis of mechanical system using MATLAB

Lab Outcomes:

At the end of course, students will be able to

1.	Carryout measurement of various vibration parameters
2.	Analyze the vibration response of the mechanical system
3.	Measure the sound intensity level
4.	Find out resonance frequency of torsional, transverse and damped vibration

Text Books:

1.	"Mechanical Vibrations", Singiresu S.Rao, Pearson Education,
2.	"Mechanical Vibrations", G. K. Grover, Published by Nemchand and Brothers, Roorkee.
3.	"Mechanical Vibration", Dr. Debabrata Nag, Wiley India Pvt. Ltd

References:	
1.	"Mechanical Vibration", Austin Church, Wiely Eastern.
2.	"Mechanical Vibrations", J.P. Den Hartog, Tata McGrawhill Book Company Inc.
3.	"Elements of Vibration Analysis" Leonard Meirovitch, Tata McGrmv-Hill, New York.

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	Anabilitytoapplyknowledgeofmathematics,scienc eandengineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓									✓		✓	
LO2	✓			✓	✓		✓	✓	✓	✓		✓		✓	
LO3	✓	✓		✓	✓									✓	✓
LO4	✓	✓	✓	✓											✓

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Avg.
Task I	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 808 : Industrial Automation & Robotics Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**--**

Course Objectives:

1.	To understand the basics of technologies involved in robotic
2.	To understand the basics of automation, its elements and how electronics, circuits and sensors effect automation controls
3.	To create the advanced automation for changing needs of world
4.	To design and implement robotic systems and apply what they learned to the applications in the Automation and Robotics field
5.	To analyze the various subsystems of flexible automation and robot
6.	To develop the programming associated with robo-control

Course Contents

Term work should consist of any 10 experiments/assignments from the following

Experiment 1	Study of part delivery system at work stations in automated assembly.
Experiment 2	Quantitative analysis of transfer line and assembly line
Experiment 3	Study of sensors and actuators used in automation.
Experiment 4	Study of control systems used in automation
Experiment 5	Demonstration of automated guided vehicle and automated storage and retrieval system.
Experiment 6	One Programming exercise on lead through programming.
Experiment 7	Two Programming exercises using various commands of VAL II
Experiment 8	Demonstration of various robotic configurations
Experiment 9	Robot programming for pick and place application

Experiment 10	Integration of robot for automated production system
Experiment 11	One Industrial visit for Industrial automation and robotic application

Lab Outcomes: At the end of course, students will be able to	
1.	**identify different types automation, technological and economic issues involved in automatic manufacturing of products.**
2.	**understand programmable or flexible manufacturing and its suitability for various manufacturing environments.**
3.	**Analyse robot motion planning and control as encountered in typical robotized industrial processes.**
Text Books:	
1.	"Automation, Production Systems and Computer Integrated Manufacturing", M. P. Groover, Pearson Education.5th edition, 2009.
2.	"Introduction to Robotics", John J. Craig, Addison Wesley Publishing, 3rd edition, 2010
References:	
1.	"Robot Technology Fundamentals", Keramas, James G, Thomson Learning – Delmar ISBN: 981-240-621-2, (1998).
2.	"Robotics for Engineers", Yoram Koren, McGraw Hill International, 1st edition, 1985
3.	"Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition, 2011.

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
LO1	✓		✓	✓	✓						✓	✓
LO2	✓	✓	✓	✓					✓	✓	✓	
LO3	✓	✓	✓	✓	✓					✓	✓	✓

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME818: Machine Tool Design Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**--**

Course Objectives	
1.	Understand condition monitoring of cutting tools
2.	Able to design machine tool gearbox
3.	Analyze machine tool structures
4.	Able to develop CNC program.

Course Contents		
		Hours
1	Selection of Machine Tool Drives	1
2	Design of machine tool gearbox with AutoCAD drawing	2
3	FEA analysis of machine tool structure	2
4	Assignment on design of guide ways, slide ways, spindles and spindle supports	1
5	Condition monitoring of cutting tools	2
6	CNC programming and machining of job	2

Course Outcome (CO): At the end of this course, students will be	
1.	Able to Perform experiments on CNC program.
2.	Able to evaluate Machine tool drives selection
3.	Able to Design a machine tool gearbox to meet the desired needs such as manufacturability and sustainability
4.	Able to Analyze machine tool structures using Ansys

Text Books:	
1.	"Machine Tools Design and Numerical Control" N.K. Mehta, Tata Mc- Graw Hill Publication, 3rd Edition (2012)
2.	Principles of Machine Tools" Sen and Bhattacharya, New Central Book Agencies 2nd Edition.(2009)

References:	
1	"Machine Tools Handbook" Design and Operation" P. H. Joshi, Tata McGraw Hill Education, First Edition (2007)
2	"Machine Tool Engineering", Nagpal G.R., Khanna Publications (2010)
3.	"Design of Machine Tools", S.K. Basu and D.K. Pal Oxford and IBH Publication, 6th Edition (2014)

4.	"Machine Tool Design Handbook", CMTI, TMH (2017)
Useful Links:	
1.	http://nptel.ac.in/
2.	www.igtr-aur.org/

Mapping of LOs with POs (a to l) and PSOs (m,n,o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
CO1	✓			✓					✓		✓				✓
CO2	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓
CO3	✓		✓	✓	✓						✓	✓	✓		✓
CO4	✓	✓	✓	✓	✓						✓	✓	✓		✓

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 828 : Elective-II- Computational Fluid Dynamics Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**25**

Lab Objectives:

1.	**Execute**: To understand and execute experiments
2.	**Measure**: To understand measuring Equipments and apply.
3.	**Analyse**: Analyse the data from experiment and correlate to basic
4.	**Apply**: To apply learning in evaluating heat exchanger performance

Course Contents

Term work should consist of any 9+1 experiments from the following

Experiment 1	Simulate and solve simple problem from 2D Steady.
Experiment 2	Simulate and solve simple problem from 2D Unsteady
Experiment 3	Simulate and solve simple problem from 3D Steady
Experiment 4	Simulate and solve simple problem from 3D Unsteady
Experiment 5	Write codes for 1-d steady flows.
Experiment 6	Write codes for 2-d steady flows and do the post processing to verify with analytical results.
Experiment 7	Simulate a aerofoil problem and verify experimentally on wind tunnel
	Additional Information:
	Solve above simulations using any commercial CFD package like Ansys-FLUENT, STAR CCM, FLUIDYNE, and Ansys-CFX etc.

Lab Outcomes:

At the end of course, students will be able to

1.	Student will able to interpret results
2.	Student will able to set process for experimentation.

3.	Student will able to understand basics of subject by experience
4.	Student will able to compare, select and analyse right mode of heat transfer

Text Books:	
1.	"Computational Fluid Mechanics the Basics with Applications", Anderson J. D. Jr, Tata McGraw Hill Education Pvt. Ltd Indian Edition 2017.
2.	"An Introduction to Computational Fluid Dynamics the Finite Volume Method" H. K. Versteeg and W. Malalasekera, II Edition, Pearson Publication.
References:	
1.	"Numerical Heat Transfer Fluid Flow", Suhas V. Patankar ,Taylor and Francis, Reprint 2017.
2.	Introduction to Computational Fluid Dynamics", Pradip Niyogi, S. K. Chakrabarthy, M. K. Laha , 2005, Pearson Publication.
3.	"Computational Fluid Dynamics: A Practical Approach", JiyuanTu, Guan Heng Yeoh, Chaoqun Liu, Butterworth – Heinemann, 2012
4.	"Computational Fluid Dynamics", T. J. Chung, Cambridge University Press, 2010
5.	"Introduction to Computational Fluid Dynamics", Anil W. Date, Cambridge University Press, 2005.

Useful Links:	
1.	http://www.thermalfluidscentral.org/e-books/book-viewer.php?b=37&s=2
2.	http://www.elsevier.com/books/advances-in-heat-transfer
3.	http://www.ecs.umass.edu/mie/faculty/rothstein/mie606_fall02.pdf

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	√	√		√	√		√	√		√	√		√		
LO2	√	√		√	√		√	√	√	√	√			√	
LO3	√		√	√	√		√	√	√	√	√	√		√	√
LO4	√			√	√		√	√		√	√		√	√	√

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg.
Task I	15	15	15	15	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 838 Elective II-Tool Design Laboratory

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**-**

LAB Objectives:

1.	To understand the design procedure for tooling (Jigs and Fixtures) and die design for presswork
2.	To apply the principles of designing fixtures and dies for industrial applications
3.	To analyze the measures for standardizing tools and tooling elements, components of Jigs & Fixtures, Dies & Moulds, Press Tools and other tools
4.	To design the tools, Jigs & fixture, dies & moulds, press tools, using CAD/CAM and CNC techniques
5.	To develop the tools for advanced processes

Course Contents

	TERM WORK
Experiment 1	Study of various elements of jigs and fixtures
Experiment 2	Design and drawing of two drilling / reaming jigs.
Experiment 3	Design and drawing of two milling fixtures
Experiment 4	Design and drawing of one progressive die Or Design and drawing of one drawing die.
Experiment 5	Industrial visit to study industrial practices related to the Jigs & Fixtures and submission of the visit report.
Experiment 6	Industrial visit to study industrial practices related to the Dies and submission of the visit report.

Lab Outcomes:

At the end of course, students will be able to

1.	Understand the design procedure for tooling (Jigs and Fixtures) and die design for presswork
2.	Apply the principles of designing fixtures and dies for industrial applications
3.	Analyze the measures for standardizing tools and tooling elements, components of Jigs & Fixtures, Dies & Moulds, Press Tools and other tools
4.	Design the tools, Jigs & fixture, dies & moulds, press tools, using CAD/CAM and CNC techniques
5.	Develop the tools for advanced processes

Text Books:	
1.	Operations Research – P. Sankara Iyer (TMH- Sigma Series, 2008)
2.	Operations Research- Hira Gupta
3.	Operations Research – J. K. Sharma. (Mac Millan)
4.	Operations Research – Principles & Practice - Ravindran, Phillips & Solberg (John Wily & Sons, Wiley India, 2006)
5.	Introduction to Operations Research-Theory & Applications, - H. S. Kasana & K. D. Kumar, (Springer International Edition, 2005, Springer, India)
References:	
1.	Introduction to O. R., 7/e (with CD) – Hamdy A. Taha, (PHI)
2.	Quantitative Techniques in Management, 4/e - N.D. Vora. (TMH)
3.	Introduction to O. R., 7/e (with CD) – Hillier & Lieberman (TMH)
4.	Operations Research, 2/e – R. Panneerselvam (PHI)
	Operations Research – Natarajan, A.M.; Balasubramani, P. & Tamilrasi, A. (Pearson Education)
5.	Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

Mapping of COs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓		✓			✓	✓	✓	✓	✓			✓
LO2	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓
LO3	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓
LO4	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Avg.
Task I	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME848 : Elective-II- Process Equipment Design Lab

Teaching Scheme			**Examination Scheme**	
Laboratory	02 hrs/week		**TA/CA**	**25**
Total Credit	1		**ESA**	**-**

Course Objectives:

1.	To understand the fundamentals of design of ST Heat Exchangers using different methods.
2.	To apply the design concepts used for distillation column, agitators and storage tank.
3.	To design the ST Heat Exchangers components as per requirement.

Course Contents

Term work should consist of any 8 experiments from the following

Experiment 1	Design of Shell and Tube heat exchangers using Tinker'smethod.
Experiment 2	Design of Shell and Tube heat exchangers using Kern'smethod.
Experiment 3	Design of Shell and Tube heat exchangers using Bell Delaware'smethod.
Experiment 4	Assignment on thickness calculation for major components such as tube sheet, shell, and tubes.
Experiment 5	Assignment on determination of operating pressure for distillation column.
Experiment 6	Assignment on Determination of nos. of theoretical stages for multi-component distillation.
Experiment 7	Assignment on design of Agitators and Reaction Vessels.
Experiment 8	Estimation of various design parameters for mechanical storage tank.
Experiment 9	Industrial visit to study Shell and Tube Heat Exchanger Plant application and submission of visit report.

Lab Outcomes: At the end of course, students will be able to	
1.	Use the knowledge to design ST Heat exchanger.
2.	Design the ST Heat exchanger components for given conditions.
3.	Design the distillation column using various methods.
4.	Apply the mechanical design concepts for agitators and storage tank.
Text Books:	
1.	R. K. Sinnott, Coulson & Richardson's Chemical Engineering: Chemical Engineering Design (volume 6), Butterworth-Heinemann, 3rd ed. 1999.
2.	D. Q. Kern, Process Heat Transfer, McGraw-Hill Book Company, Int. ed. 1965.
3.	Dutta B. K. 'Heat Transfer-Principles and Applications', PHI Pvt. Ltd., New Delhi, 1st ed. 2006.
4.	"Introduction to Process Engineering and Design" by S B Thakore and B I Bhatt, Tata McGraw Hill, 1st Edition, 2007.
5.	S. D. Dawande, Process Equipment Design, Denett & Co, 2009
6.	M.V. Joshi, V. V. Mahajani, Process Equipment Design, Macmillan India. 2010
7.	B.C. Bhattacharya, Introduction to Chemical Equipment Design, CBS Publications, 1985.
References:	
1.	Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
2.	Sadik Kakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
3.	T. Kuppan, "Hand Book of Heat Exchanger Design", 2001
4.	"T. E. M. A. Standard", New York, 1999
5.	WRC 107 1965
6.	Applied Process Design for Chemical and Petrochemical plants, Vol. 1 to 3 by E.E. Ludwig, Gulf Publishing Company
7.	S. M. Walas, Chemical Process Equipment: Selection and Design, Butterworth-Heinemann, 1990
8.	L. E. Brownell, E. H. Young, Process Equipment Design - Vessel Design, John Wiley and Sons, Inc., 1959
Useful Links:	
	http://www-unix.ecs.umass.edu/~rlaurenc/Courses/che333/Reference/exchanger.pdf
	http://my.chemeng.queensu.ca/courses/integratedDesign/Resources/documents/CourseNotes-HeatExchangers2008.pdf
	http://nptel.ac.in/courses/103103027/pdf/mod1.pdf

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	An ability to apply knowledge of mathematics, science and engineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓		✓			✓	✓	✓	✓	✓			✓
LO2	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓
LO3	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓
LO4	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓		✓

Assessment Pattern

Skill Level (as per CAS Sheet)	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5	Exp. 6	Avg.
Task I	15	15	15	15	15	15	15
Task II	05	05	05	05	05	05	05
Task III	05	05	05	05	05	05	05
CA	25	25	25	25	25	25	25

Government College of Engineering Karad

Final Year B. Tech. Mechanical

ME 809 Project Phase II

Teaching Scheme			**Examination Scheme**	
Practical	05 hrs/week		**TA/CA**	**100**
Total Credit	8		**ESA**	**100****

** ESE based on the demonstration of the project work

Course Objectives:

1.	To identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
2.	To create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
3.	To design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4.	To use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

Course Contents

Project Phase II Load

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Same groups of Seventh Semester shall work under same faculty member of department.

Project Phase II Definition:

Project phase-II is a continuation of project phase-I started in the seventh semester. Before the end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Phase II Term Work:

The term work under project submitted by students shall include

	1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for a. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project. c. Brief report of feasibility studies carried to implement the conclusion. d. Rough Sketches / Design Calculations / Testing reports / Experimentation results.
	Project Phase II Report Format Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed. 1. Page Size: Trimmed A4 2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.32 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Point. Font 7. Line Spacing: 1.5 Lines 8. Page Numbers: Right Aligned at Footer. Font 12 Point Times New Roman 9. Headings: Times New Roman, 14 Point Bold face 10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal /Director 11. Index of Report: i) Title Sheet ii) Certificate iii) Acknowledgement iv) Table of Contents. v) List of Figures vi) List of Tables 1. Introduction 2. Literature Survey/ Theory 3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation. 4. Observation Results 5. Discussion on Result and Conclusion 12. References: References should have the following format **For Books:** "Title of Book", Authors, Publisher, Edition **For Papers:** "Title of Paper, Authors, Journal/Conference Details, Year 13. The Project report shall be signed by the each student in the

	group, approved by the guide and endorsed by the Head of the Department 14. Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.
	Important Notes • Project group should continue maintaining a diary for project and should write (a) Books referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creative thinking. • The Diary along with Project Report shall be assessed at the time of oral examination • One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

Course Outcomes:

At the end of course, students will be able to

1.	Improve the professional competency and research aptitude in relevant area.
2.	Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.
3.	Participate in team oriented, open ended activities that prepare them to work in integrated engineering teams both as team members and as leaders and communicate effectively using modern tools.
4.	Pursue higher studies and succeed in academic and research career.

Mapping of LOs with POs (a to l) and PSOs (m, n, o)

Programme Outcomes and Programme Specific Outcomes	Anabilitytoapplyknowledgeofmathematics,scienc e andengineering	An ability to design and conduct experiments, as well as to analyze and interpret data	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	An ability to function on multidisciplinary teams	An ability to identify, formulate, and solve engineering problems	An understanding of professional and ethical responsibility	An ability to communicate effectively	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	A recognition of the need for, and an ability to engage in life-long learning	A knowledge of contemporary issues	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Conduct independent research to solve industrial problems through locating & articulating	An ability to perform basic structural, thermal and fluid flow analysis with conventional and CAE tools, and documentation of results	An ability to operate, test, diagnose faults and maintain equipment, machinery and basic mechanical systems	An ability to select/specify materials, tool, machinery and manufacturing processes for different applications
Lab Outcomes	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
LO1	✓	✓	✓	✓	✓						✓	✓	✓		
LO2	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓
LO3				✓	✓	✓	✓			✓	✓	✓	✓		
LO4	✓								✓		✓	✓	✓		

Assessment Pattern

The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The end semester assessment shall be done by external referee one week before the term end. The department shall arrange exhibition (all department will arrange the exhibition on same day) of the project work done by students and the referee will judge the project work in accordance with the outcomes of the course by interacting with students and marks will be awarded to individual student. This exhibition will remain open for all students, parents, and other citizens visiting the exhibition.