Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME 2501: Open Elective -Operations Research

Teaching Scheme		Examination Scheme	
Lectures	03 Hrs/week	CT – 1	15
Tutorials	--	CT – 2	15
Total Credits	03	TA	10
		ESE	60
		Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	Understand quantitative techniques in management decision-making and its applications by using mathematical models
2.	Analyse LPP, Assignment and Transportation problem
3.	Evaluate Sequencing and Decision theory problem
4.	Design network by CPM / PERT technique

	Course Contents	Hours
Unit 1	**Introduction** Birth of Operations Research, Methodology, scope and limitations, Types of Operations Research, Models, applications in production management, Use of computers in Operations research.	**(3)**
Unit 2	**Linear Programming** Formulation of problem, Graphical method, Simplex algorithm for maximization and minimization problems, Sensitivity analysis, Duality theory and its use in economic interpretation and decision making.	**(7)**
Unit 3	**Transportation Models:** Structure, Industrial and business applications, Transportation problems and various methods to solve transportation problems, Degeneracy and its solution.	**(7)**
Unit 4	**Assignment Models** Assignment problems, solution of various types of problems, Travelling Salesman problem	**(7)**
Unit 5	**Sequencing** Sequencing of n jobs and 2 and 3 machines, 2 jobs and n machines **Decision Theory** Pay off and regret tables, Decision rules, Decision under certainty and risk, Decision tree.	**(7)**
Unit 6	**Project Management** Fundamentals of CPM/ PERT networks, CPM- construction of networks, Critical path, Forward and backward pass, Floats and their significance, PERT- Time estimates, construction of networks, probability of completing projects by given date.	**(9)**

Text Books

1.	Operations Research – P. Sankara Iyer (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)

Reference Books

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
5.	Operations Research – Natarajan, A.M.; Balasubramani, P. &Tamilrasi, A. (Pearson Education)2005
6.	Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	3	3	1	2	1	-	-	1	-	1	2	2	2	3
CO 3	3	2	3	-	2	-	-	-	1	-	-	2	2	2	3
CO 4	3	3	1	-	3	-	-	-	-	-	-	2	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	3	2	10
.	3	3	1	16
Apply	4	4	3	10
Analyse	3	3	2	12
Evaluate	2	2	2	12
Create	0	0	0	00
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem –V) B. Tech. Mechanical Engineering

ME 2502: Metrology and Quality Control

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To explain and demonstrate working principle, construction of measuring instruments and comparators
2.	Explain and perform inspection of geometrical parameters according to a drawing
3.	To explain quality control and quality assurance concept
4.	To explain use of control charts and sampling plans in industry

	Course Contents	Hours
Unit 1	**Introduction** Need of metrology, precision, accuracy, methods and errors in measurement, calibration **Linear Measurements** International standards of length, line and end measurement, characteristics of measuring instruments, slip gauges. **Angular Measurement** Bevel protractor, spirit level, angle gauges, sine bar, sine centre, angle dekkor, auto collimator, standard balls and rollers for angle measurement	**(5)**
Unit 2	**Limits, Fits and Tolerances** Importance of limits system in mass production, IS specifications of limits, unilateral and bilateral tolerances, cost-tolerance relationship, types of fits (including numerical), types of assembly **Limit Gauges** Importance of limit gauging, types, Taylor's principle, design of plug and ring limit gauges (including numerical), three types of limit gauges **Comparators** Need for comparator Principle of operation, its uses in inspection and characteristics of i. Mechanical (dial indicator, sigma comparator) ii. Optical (optical profile projector, Toolmaker's microscope) iii. Electrical comparator iv. Pneumatic comparator **Interferometry** Principle of interferometry and application for checking flatness	**(8)**
Unit 3	**Geometric parameters** Geometric characteristics of **form** (straightness, flatness, roundness, cylindricity), **orientation** (parallelism, perpendicularity, angularity), **location** (position, concentricity, coaxiality, symmetry) and **run-out** (circular run-out, total run-out) (ISO- 1101) **CMM Machine** Principle of Coordinate Measuring Machines (CMM), different configurations of CMM, error involved, calibration, probing system, automated inspection system	**(6)**
Unit 4	**Surface Roughness** Components of surface textures, numerical assessment of surface roughness, surface finish symbols, sampling length, grades of roughness, instruments used in surface roughness assessment (Tomlinson surface meter, Mitutoyo surface roughness tester) **Measurement of Screw Threads** Screw thread terminology, measurement of forms of thread with profile projector, pitch measurement, measurement of thread diameters with standard wire, screw thread micrometer, different errors in screw threads **Gears**	**(6)**

	Measurement of tooth thickness measurement, run out checking, pitch measurement, profile checking, backlash checking, alignment checking, checking of composite errors, errors in gears	
Unit 5	**Quality Control** Concept of quality, role of quality, Deming's approach, Juran's approach, quality control and quality assurance, specification of quality, factors controlling quality of design and conformance, cost of quality, balance between cost and quality and value of quality **Quality Assurance** Seven QC tools, Quality Circles, Kaizen, six sigma, 5S system, Introduction to Business Process Reengineering (BPR)	**(7)**
Unit 6	**Statistical Quality Control** Importance of statistical method in quality control, ND curve, Control charts- Attribute (P, nP, C, U) and variable (X bar, R chart and X and R chart), their constructions, interpretation and applications, process capability index (C_p, C_{pk}), methods of determining C_p and C_{pk} **Acceptance Sampling** Basic concept of sampling inspection, operating characteristic curves (OC curve), conflicting interests of consumer and producer, producer and consumers risks, single and double sampling plans	**(8)**

Text Books	
1.	"Engineering Metrology", I. C. Gupta, Dhanpat Rai Publications, 7th Edition
2.	"Engineering Metrology", R. K. Jain, Khanna Publications, 17th Edition
3.	"Statistical Methods", S. P. Gupta, Danpat Rai and Sons, New Delhi, 2007
Reference Books	
1.	"Engineering Metrology and Measurements", N. V. Raghvendra and L. Krishnamurthy, Oxford publication, 2013 Edition
2.	"Practical Engineering Metrology", Sharp K.W.B., Pitman, London, 1966
3.	"Statistical Quality Control", A. L. Grant, Tata McGraw Hill International, New York. 6th Edition
4.	"Statistical Quality Control", R. C. Gupta, 9th Edition
5.	"Engineering Metrology", Hume K. G., M. C. Donald, Technical and Scientific, London, 2nd Edition.
6.	"Quality Control and Industrial Statistics", Duncon A. J., Publisher- R. D. Irwin, 4th Edition
Useful Links	
1.	**NPTEL Lecture:** http://www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html
2.	**Video of Metrology:** https://cosmolearning.org/courses/mechanical-measurements-and-metrology/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	2	2	1	08
Understand	4	4	1	16
Apply	3	3	3	12
Analyse	2	2	3	08
Evaluate	2	2	2	08
Create	2	2	1	08
TOTAL	15	15	10	60

Government College of Engineering, Karad				
Third Year (Sem –V) B. Tech. Mechanical Engineering				
ME2503: Heat Transfer				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	To familiarize the students with fundamental principles/laws of heat transfer by conduction, convection, and radiation and mass transfer by diffusion and convection.
2.	To provide a technical **understanding** of common engineering processes and significance of different dimensionless numbers related with heat and mass transfer
3.	To impart skills to **remember** modelling and analysing simple heat and mass transfer problems using **computer software**
4.	To familiarize the students wit**h current developments** such as ...in the field of heat and mass transfer to cope up with **requirements of industry**.

	Course Contents	**Hours**
Unit 1	**Introduction to Heat Transfer** Modes of Modes/laws of heat transfer, thermo-physical properties, Electrical Analogy in conduction, derivation of Generalized heat conduction equation in Cartesian coordinates, Fourier, Laplace and Poisson's equation. Generalized heat conduction equation in cylindrical and spherical co-ordinates. (no derivation).	**(8)**
Unit 2	**Heat conduction** through a plane wall, cylindrical wall and sphere. Heat conduction through a composite slab, cylinder and sphere, effect of variable thermal conductivity, critical radius of insulation, Economic insulation, and thermal contact resistance. One dimensional steady state heat conduction with heat generation for plane wall, cylinder and sphere.	**(7)**
Unit 3	**Extended Surfaces** Types and Applications of Fins, Heat transfer through extended surfaces, derivation of temperature distribution equations and heat transfer through fins of constant cross-sectional area, Effectiveness and efficiency of a fin, Errors in the measurement of temperature in a thermo-well. **Unsteady state heat conduction** System with negligible internal resistance, Biot and Fourier numbers. Lumped heat capacity method, use of Heisler charts.	**(6)**
Unit 4	**Convection** Local and average convective coefficient, Hydrodynamic and thermal boundary layer, Laminar and turbulent flow over a flat plate and through a duct, Friction factor, Drag and drag co-efficient. **Free and Forced Convection** Dimensional analysis in free and forced convection, physical significance of the dimensionless numbers related to free and forced convection, empirical correlations for free and forced convection for heat transfer in laminar and turbulent flow over a flat plate and through a duct. Introduction to Condensation and Boiling, pool boiling, critical heat flux, burnout point, forced boiling. Film and drop wise condensation, determination of heat transfer coefficient.	**(7)**
Unit 5	**Radiation** Nature of thermal radiation, absorptivity, reflectivity, transmissivity, emissive power and emissivity, spectral and total concept, blackbody, grey body, and white body Kirchhoff's law, Wein's law and Planck's law, and deduction of Stefan Boltzmann law. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces. Shape factor and its characteristics. Energy exchange by radiation between two grey surfaces without absorbing	**(6)**

	medium, concept of radiosity and irradiation. Radiation network method, network for two surfaces which see each other and nothing else, radiation shields.	
Unit 6	**Heat Exchangers, Phase Change and Mass Transfer Phenomenon** Heat exchangers classification, overall heat transfer coefficient, heat exchanger analysis, use of log mean temperature difference (LMTD) for parallel and counter flow heat exchangers, LMTD correction factor, fouling factor, The effectiveness-NTU method for parallel and counter flow heat exchangers. Design considerations of heat exchanger, compact heat exchangers. **Introduction to Design of thermal system:** Electronic component cooling **Boiling and Condensation (Descriptive treatment only)** a. Types of boiling, Pool boiling and Forced convection boiling, Nusselt's theory of condensation for vertical plate, Condensation correlations for practical applications, Film wise and drop wise condensation, promoters. **Introduction to Design of thermal system:** Electronic component cooling **Introduction to mass transfer:** Analogy with Heat transfer (Descriptive treatment only)	**(6)**
Text Books		
1.	"Heat Transfer", J.P. Holman, Tata McGraw Hill Book Company, NewYork, 2nd Edition.	
2.	"Fundamentals of Heat and Mass Transfer",R.C. Sachdeva, Willey Eastern Ltd.,	
3.	"A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman, Hyderabad.	
Reference Books		
1.	"Heat Transfer – A Practical approach",Yunus. A .Cengel, Tata McGraw Hill.	
2.	"Heat Transfer" Chapman A.J., Tata McGraw Hill Book Company, NewYork.	
3.	"Fundamentals of Heat and Mass Transfer", Frank P.Incropera, David P.Dewitt,Wisley India. 5th Edition.	
Useful Links		
1.	http://www.sciencedirect.com/science/bookseries	
2.	http://www.thermalfluidscentral.org/e-books	
3.	http://www.elsevier.com/books/advances-in-heat-transfer	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3								2	1		1			1
CO 2	3		3		3			2							
CO 3			3					2		1					
CO 4			3					2							

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	2	2	0	08
Understand	4	4	1	16
Apply	3	3	3	12
Analyse	2	2	3	08
Evaluate	2	2	2	08
Create	2	2	1	08
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME2504: Machine Design – I

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	Understand concept of design and design procedure of machine elements.
2.	Apply material selection and failure theories of different machine elements
3.	Design machine elements subjected to static loading and fluctuating loading
4.	Analyse selection of transmission elements subjected to static and variable loading

	Course Contents	Hours
Unit 1	**A. Introduction to Machine Design** Concept of machine design, basic procedure of design of machine elements, use of standards in design **B. Engineering Materials** Review and selection of various engineering material properties, factors governing selection of engineering materials, BIS designation of steels, Alloying elements in steels and effects and applications C. **General Three-Dimensional Stress** Cartesian stress components, 2D- stress tensor, 3D-stress tensor Plane stress, plane strain, obtaining principal stresses at a point from stress tensor	**(6)**
Unit 2	**Design for Static and Fluctuating Loading** **A. Design for Static Loading** Types of loads, failure, factor of safety- its selection and significance, theories of elastic failure and their applications Design of knuckle joint, design of cotter joint, design of levers **B . Design for Fluctuating Loading** Introduction to fatigue in metals, mechanism of fatigue failure (crack initiation stage, propagation stage, fracture stage), endurance limit, endurance limit modifying factors. Stress concentration and notch sensitivity, fluctuating stresses, S-N diagram under fatigue load, design for finite and infinite life under reversed stresses, cumulative damage in fatigue failure, Soderberg and Goodman diagrams, Modified Goodman diagram .	**(8)**
Unit 3	**Design of Threaded, Welded and Power screws** **A. Threaded Joints & Welded Joint** Basic types of screw fastening, terminology of screw threads, bolted joint-simple analysis, eccentrically loaded bolted joints in shear, eccentric load perpendicular to axis of bolt, design of turnbuckle, elastic analysis of bolted joint, bolted joint under fluctuating load Welding symbols, butt and fillet welds, strength of butt welds, parallel and transverse fillet welds, eccentric load in the plane of welds, welded joints subjected to bending moment, welded joint subjected to fluctuating forces B. **Design of Power Screw** Forms of threads, terminology of threads, torque requirement (lifting and lowering load) self-locking and overhauling properties, efficiency of square threaded, self-locking screw, trapezoidal and acme thread, collar friction torque, design of power screw and nuts, introduction to re-circulating ball screw	**(6)**
Unit 4	**Design of Springs and Power Screw** A. **Design of Springs** Types of springs and their applications, styles of end, design of helical compression spring subjected to static loading (stresses in helical springs, the curvature effect, deflection of helical springs), leaf springs, design against fluctuating load	**(7)**

Unit 5	**Design of Shaft, Keys, and Couplings** Design of solid and hollow shafts based on strength and rigidity, ASME code for shaft design, types and design of keys, types and applications of couplings, design of muff, rigid coupling, flexible bushed pin type flanged coupling.	**(6)**
Unit 6	**Design calculations for selection of Belts, Ropes and Chains drives** **Belt drives:** Types and construction of belts, selection of flat belt and V belt from manufacturer's catalogue, pulleys for flat and V belts, ribbed V belts **Chain Drives**: Chain drives, roller chains, geometrical relationships, polygonal effect, power rating of roller chains, sprocket wheels, design of chain drive, chain lubrication **Rope Drives** Construction and lay of wire rope, stresses in wire rope, rope sheaves and drums	**(7)**

Tutorials	
Assignments on each Unit - 6 Nos.	
Text Books	
1.	"Design of Machine Elements", V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition
2.	"Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication, 9th Edition
3.	" Machine Design An Integrated Approach", R.L Norton, Pearson Education Publication, 3rd Edition.
4.	" Introduction to Machine design",V.B. Bhandari, Tata McGraw Hill Publication, 2nd Edition
Reference Books	
1.	"Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Publication Schaum's Outline Series.
2.	"Machine Component Design", Robert C. Juvniall, Willey Ltd., 5th Edition
3.	"Design of Machine Elements" M.F.Spotts, Pearson Education Publication, 5th Edition
Useful Links	
1.	https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring2009/lecture-notes/
2.	http://nptel.ac.in/courses/112105124/
3.	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	1	1	1	05
Understand	3	3	2	10
Apply	4	4	2	10
Analyse	3	3	2	15
Evaluate	3	3	2	15
Create	-	-	1	05
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME2515: Elective – I Non-conventional Machining

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	Understand and compare traditional and non-traditional machining process and recognize the need for Non-traditional machining process.
2.	Understand USM, AJM and identify the need of Chemical and electro-chemical machining process
3.	Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM
4	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal.

	Course Contents	**Hours**
Unit 1	**Introduction** Introduction to Non-traditional machining, Need for Non-conventional machining process, Comparison between traditional and non-traditional machining, general classification Non-conventional machining processes, classification based on nature of energy employed in machining, selection of non-conventional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.	**(6)**
Unit 2	**a) Ultrasonic Machining (USM)** Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM. b) **Abrasive Jet Machining (AJM)** Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM. c) **Water Jet Machining (WJM)** Equipment & process, Operation, applications, advantages and limitations of WJM.	**(8)**
Unit 3	**Electrochemical Machining (ECM)** Introduction, Principle of electro chemical machining: ECM equipment, elements of ECM operation, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.	**(6)**
Unit 4	**Electrical Discharge Machining (EDM)** Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish, Heat Affected Zone. Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM	**(7)**

Unit 5	**Plasma Arc Machining (PAM)** Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics. Safety precautions. applications, advantages and limitations.	**(6)**
Unit 6	**a) Laser Beam Machining (LBM)** Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations. b) **Electron Beam Machining (EBM):** Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.	**(7)**

Tutorials

Assignments on each Unit - 6 Nos.

Text Books

1.	Modern Machining Process by P.C Pandey and H S Shah, McGraw Hill Education India Pvt. Ltd. 2000
2.	Non-traditional Machining Processes: Research Advances, Joao Paulo Davim , Springer, New York, 2013.
3.	Non-Conventional Machining, P. K. Mishra, Narosa Publishing House, New Delhi, 2007.
4.	Advanced Machining Processes, Vijaya Kumar Jain, Allied Publishers Pvt. Ltd., New Delhi, 2005

Reference Books

1.	Production technology, HMT, McGraw Hill Education India Pvt. Ltd. 2001
2.	Advanced Machining Processes: Non-traditional and Hybrid Machining Processes, Hassan El-Hofy , McGraw-Hill Professional, New Delhi, 2005

Useful Links

1.	https://nptel.ac.in/courses/112/105/112105212/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	1	1	1	05
Understand	3	3	2	10
Apply	4	4	2	10
Analyse	3	3	2	15
Evaluate	3	3	2	15
Create	-	-	1	05
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical

ME 2525: Elective I -Industrial Automation

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

The students will be able to

1.	Apply knowledge of automation tools and other equipments for manufacturing and assembly components.
2.	Select proper type of automation for particular application such as batch production, mass production and assembly lines, etc.
3.	Program the PLC as per the requirement of the automation problem and interface the PLC with real-time system for automation.
4.	Interface the software tool with real-time system using I/O interface for automation.

	Course Contents	Hours
Unit 1	**Introduction** Automated manufacturing systems, fixed /programmable/ flexible, automation, need of automation, basic elements of automated systems- power, program and control, low-cost automation, advanced automation functions, levels of automation, industrial control systems in process and discrete manufacturing industries, continuous and discrete control; computer process control.	**(7)**
Unit 2	**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.	**(6)**
Unit 3	**Pneumatics and Hydraulics (Overview)** **A. Pneumatic:** Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, applications of pneumatics in automation (explaining the pneumatic circuits) **B. Hydraulics:** Pumps and motors- types, characteristics, cylinders, types, typical construction details, valves for control of direction, flow and pressure, applications of hydraulics in automation (explaining the hydraulic circuits)	**(6)**
Unit 4	**Programmable Logic Controllers (PLC)** Introduction to Programmable Logic Controllers (PLC), PLC system and components of PLC, input output module, PLC advantages and disadvantages over relays, use of PLC in automation, advantages and disadvantages of programmable automation basic components and symbols, PLC programming methods, fundamentals of ladder diagram, internal relays, holding contacts, always ON always OFF contacts, nesting of ladders PLC input instructions, outputs, coils, indicators, operational procedures, contact and coil input output	**(7)**
Unit 5	**Automation using PLC** PLC sequential function and its applications such as water level control, material handling device, stamping device, elevator, etc., PLC timers and industrial applications such as sorting conveyor, bottling plant, etc., PLC counters and its industrial applications such as packaging, automatic vending machine, etc., Use of automation studio software and interface box (input/output interface) in industrial automation	**(6)**
Unit 6	**Fundamentals of Industrial Robots and Robotic End Effectors and Sensors** Specifications and Characteristics, Criteria for selection, Robotic Control Systems: Drives, Robot Motions, Actuators, Power transmission systems, Robot controllers, Dynamic properties of robots-stability, Control resolution, Spatial resolution, Accuracy, Repeatability, Compliance, Work cell control, Interlocks. 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.	**(8)**

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
Reference Books	
1.	"Robot Technology Fundamentals", Keramas, James G, Thomson Learning –Delmar ISBN: 981-240-621-2,(1998).
2.	Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985
3.	"Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition.
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 and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	1	1	1	05
Understand	3	3	2	10
Apply	4	4	2	10
Analyse	3	3	2	15
Evaluate	3	3	2	15
Create	-	-	1	05
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME 2535: Computational Fluid Dynamics (CFD)

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials			CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Student will able to

1.	Understand the basic concepts of Computational Fluid Dynamics
2.	Lean the Governing equations of fluid dynamics
3.	Learn the fundamentals of discretization techniques
4.	Analyze and solve the engineering problems related to heat transfer and fluid flow

	Course Contents	Hours
Unit 1	**Introduction to CFD** Computational approach to fluid dynamics and its comparison with experimental and analytical approach, Applications of CFD Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations	**(07)**
Unit 2	**Governing Equations of Fluid Dynamics** Continuity, Momentum and Energy equations and its simplified for incompressible and compressible fluid, Physical boundary conditions,	**(05)**
Unit 3	**Finite Difference and Finite Volume Methods for Diffusion** Derivation of finite difference equations, General Methods for first and second order accuracy, Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems Parabolic equations, Explicit and Implicit schemes , Use of Finite Difference and Finite Volume methods, Stability, Convergence, Accuracy	**(07)**
Unit 4	**Finite Volume Method for Convection Diffusion** Steady one-dimensional convection and diffusion, Central, upwind differencing schemes properties of discretization schemes, Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes	**(07)**
Unit 5	**Finite Volume Method for Fluid Flow** Finite volume methods-Representation of the pressure gradient term and continuity equation Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms	**(07)**
Unit 6	**Turbulence Models and Mesh Generation** Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, Structured Grid generation, Unstructured Grid generation, Mesh refinement, Adaptive mesh, Mesh quality attributes, Grid Independence test, Introduction to CFD Post and Flow Visualization-Software tools	**(07)**

Tutorials

1.	Tutorial1: Mixing of two stream of fluid at different temp in a mixing Tee
2.	Tutorial2: Flow over an aerodynamic foil external flow
3	Tutorial3: Simulation of Electronic cooling equipments
4.	Tutorial4: Simulation of a rotating body (moving part)
5.	Tutorial5: Simulation of tank flush
6.	Tutorial6: Presentations on applications of CFD based on at least two research paper

Text Books

1.	**John D Anderson:** "Computational Fluid dynamics, The Basic with applications", McGraw-Hill International edition, subject is like having new tool to students Mechanical Engineering series
2.	**Dr. Suhas Patankar: "**Numerical Methods in Fluid flow and Heat Flow", Hemisphere Publishing Corporation
3.	**H. K Versteeg, W. Malalasakera: "**An Introduction to computational fluid flow (Finite Volume Method)", Printice Hall Publications
4.	**Dr. Atul Sharma:** Introduction to CFD: Development, Application and Analysis**,** Ane Books Pvt. Ltd. New Delhi, Wiley UK

Reference Books

1.	**Ferziger and Peric: "**Computational Method for Fluid Dynamics", Springer Publication

2.	**Chuen-Yen Chow: "**An Introduction to Computational Fluid Dynamics", Wiley Publications
3.	**Murlidhar and Sundararajan: "**Computational Fluid Flow and Heat Transfer" Narosa Publication
4.	**Anil W. Date**, "Introduction to Computational Fluid Dynamics", Cambridge University Press,
5.	**Prodip Niyogi, Chakrabarty, S. K., Laha, M.K.** "Introduction to Computational Fluid Dynamics", Pearson Education
Useful Links	
1.	http://www.sciencedirect.com/science/article/pii/S0017931002002235
2.	http://www.ewp.rpi.edu/hardford/~ernesto/F2012/.../Patankar-NHTFF-1980.pdf
3.	www.cfd.com.au/cfd_conf09/PDFs/001EJL.pdf
4	http://www.thermalfluidscentral.org/e-books
5	http://cfdmadeeasy.org/; You-tube Channel: CFDmadeeasy
6	https://www.ansys.com/products/fluids/ansys-fluent

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	2	1	3					1	1	2	1	2	2
CO 2	1	2	1	1	1					1	1	1	1	1	1
CO 3	2	2	2	1	1					1	1	1	1	2	1
CO 4	3	3	3	3	3					2	2	3	3	3	3

Assessment Pattern (with revised Bloom's **Taxonomy)**

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	2	0	05
Understand	4	4	2	05
Apply	3	3	2	15
Analyse	2	3	2	15
Evaluate	3	3	1	10
Create	0	0	3	10
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME2506: Operations Research Lab

Teaching Scheme			Examination Scheme	
Practical	02 Hrs/week		CA	50
Tutorials	-		ESE	-
Total Credits	01			

Lab Outcomes (LO): At the end of course, students will be able to,

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

1.	Understand quantitative techniques in management decision-making and its applications by using mathematical models
2.	Analyse LPP, Assignment and Transportation problem
3.	Evaluate Sequencing and Decision theory problem
4.	Design network by CPM / PERT technique

Lab Content

Term work should consist of any 8 experiments from the following,

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

Text Books

1.	Operations Research – P. Sankara Iyer (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)

Reference Books

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
5.	Operations Research – Natarajan, A.M.; Balasubramani, P. &Tamilrasi, A. (Pearson Education)2005
6.	Operations Research- Applications & Algorithms, 4/e, - Wayne L. Winston (CENGAGE Learning 2003)

Useful Links

1.	**NPTEL Lecture:** http://www.nptelvideos.in/2018/12/mechanical-measurements-and-metrology.html
2.	**Video of Metrology:** https://cosmolearning.org/courses/mechanical-measurements-and-metrology/

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	3	3	2	2									1		
LO 2	3	3	2	3						2	2			3	2
LO 3	3	3	2		1	2									
LO 4	2	3	3	3	1	2	1	2	2	3		2	2	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME_2507: Metrology and Quality Control Lab

Teaching Scheme			Examination Scheme	
Practical	02 Hrs/week		CA	25
Tutorials	-		ESE	25*
Total Credits	01			
		*ESE based on performance in practical oral examination		

Lab Outcomes (LO)

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

1.	Select and use an appropriate linear, angular measuring instrument and comparator for inspection.
2.	Perform an inspection on CMM for dimensional and geometrical features.
3.	Measure surface roughness, screw thread parameter and gear tooth parameter using appropriate instrument.
4.	Plot normal distribution curve and control charts for a given manufacturing process.

	Lab Content
	Term work should consist of any 8 experiments from the following,
Experiment 1	Perform linear measurement using various linear measuring instruments**.**
Experiment 2	Perform angle measurement using various angle measuring instruments**.**
Experiment 3	Use of comparators in industry with the help of pneumatic and electro-pneumatic comparator
Experiment 4	Use of optical profile projector for Screw thread measurement and gear tooth profile inspection**.**
Experiment 5	Flatness measurement of a surface with the help of an optical flat**.**
Experiment 6	Use of CNC-CMM and inspection fixtures to inspect dimensions and geometrical parameters of a given drawing.
Experiment 7	Measurement of surface roughness with surface tester and measurement of gear tooth thickness with gear tooth Vernier Caliper**.**
Experiment 8	Screw thread measurement (major, minor and effective diameter) with the help of floating carriage Micrometer**.**
Experiment 9	Construct a normal distribution curve by actual measurement**.**
Experiment 10	Industrial Visit for studying different comparators, various measuring instruments.
Group Activity	A group of 5 students can select any one group activity given below:• Students should collect drawing of a component from industry and suggest a measuring instrument / method to measure various dimension and geometric parameters in it.

Text Books

1.	"Engineering Metrology", I. C. Gupta, Dhanpat Rai Publications, 7th Edition
2.	"Engineering Metrology", R. K. Jain, Khanna Publications, 17th Edition
3.	"Statistical Methods", S. P. Gupta, Danpat Rai and Sons, New Delhi, 2007

Reference Books

1.	"Engineering Metrology and Measurements", N. V. Raghavendra and L. Krishnamurthy, Oxford publication, 2013 Edition
2.	"Practical Engineering Metrology", Sharp K.W.B., Pitman, London, 1966
3.	"Statistical Quality Control", A. L. Grant, Tata McGraw Hill International, New York. 6th Edition
4.	"Statistical Quality Control", R. C. Gupta, 9th Edition
5.	"Engineering Metrology", Hume K. G., M. C. Donald, Technical and Scientific, London, 2nd Edition.
6.	"Quality Control and Industrial Statistics", Duncon A. J., Publisher- R. D. Irwin, 4th Edition

Useful Links

1.	**NPTEL Lecture:** http://www.nptelvideos.in/2018/12/mechanical-measurements-and-metrology.html
2.	**Video of Metrology:** https://cosmolearning.org/courses/mechanical-measurements-and-metrology/

Mapping of LOs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	3	3	2	3											
LO 2	3	3	2	3						2	3			3	3
LO 3	3	3	2		3	3									
LO 4	2	3	3	3	3	3	3	3	3	3		3	3	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad				
Third Year (Sem –V) B. Tech. Mechanical Engineering				
ME 2508: Heat Transfer Lab				
Teaching Scheme			**Examination Scheme**	
Practical	02 Hrs/week		CA	25
Total Credits	01		ESE	25*
		*ESE based on performance in practical oral examination		

Course Outcomes (CO)

1.	Execute: To understand and execute experiments
2.	Measure: To understand measuring Equipment 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: To perform **any 9** of the following experiments

No	Experiment Name
Experiment 1	Determination of thermal conductivity of Insulating powder.
Experiment 2	Determination of thermal conductivity of a Metal rod
Experiment 3	Determination of thermal resistance and temperature distribution in a Composite wall.
Experiment 4	Determination of thermal conductivity of insulating material in Lagged pipe.
Experiment 5	Determination of local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.
Experiment 6	Determination of Heat Transfer Coefficient under forced convection to air from a hot pipe.
Experiment 7	Determination of emissivity of a Non-black surface.
Experiment 8	Determination of Stefan Boltzmann Constant.
Experiment 9	Determination of Critical Heat Flux
Experiment 10	Determination of heat transfer coefficient in dropwise and film wise condensation
Experiment 11	Determination of overall heat transfer coefficient and effectiveness in a Parallel flow and Counter flow Heat Exchanger.
Experiment 12	Study and Demonstration of Heat Pipe
Experiment 13	Performance analysis of extended surfaces
Experiment 14	To prepare a program in C or C++ for 2 experimental results
Experiment 15	To use virtual lab for 2 experiments in the list
Experiment 16	To simulate 2D heat conduction problem of Laplace using excel
Experiment 17	To simulate 2D heat conduction problem of Laplace using ANSYS

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
LO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
LO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
LO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad				
Third Year (Sem – V) B. Tech. Mechanical Engineering				
ME2519- Elective I- Lab: Non-conventional Machining Lab				
Teaching Scheme			**Examination Scheme**	
Practicals	2 Hrs/week			
Tutorials	-			
Total Credits	01		CA	25

Course Outcomes (CO)	
At the end of this course, student will be able to:	
1.	Understand and compare traditional and non-traditional machining process and recognize the need for Non-traditional machining process.
2.	Understand USM, AJM and identify the need of Chemical and electro-chemical machining process
3.	Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM
4	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal.

	Course Contents
Experiment1	Demonstration of construction and working of plastic molding machine
Experiment 2	Preparation of simple component on plastic molding machine.
Experiment 3	Demonstration of construction and working of EDM machine
Experiment 4	Preparation of simple component on EDM machine
Experiment 5	Demonstration of construction and working of 3D printer
Experiment 6	Demonstration of construction and working of Ultrasonic Label Cutting Machine.

Text Books	
1.	Modern Machining Process by P.C Pandey and H S Shah, McGraw Hill Education India Pvt. Ltd. 2000
2.	Non-traditional Machining Processes: Research Advances, Joao Paulo Davim , Springer, New York, 2013.
3.	Non-Conventional Machining, P. K. Mishra, Narosa Publishing House, New Delhi, 2007.
4.	Advanced Machining Processes, Vijaya Kumar Jain, Allied Publishers Pvt. Ltd., New Delhi, 2005

Reference Books	
1.	Production technology, HMT, McGraw Hill Education India Pvt. Ltd. 2001
2.	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes,Hassan El-Hofy , McGraw-Hill Professional, New Delhi, 2005

Useful Links	
1.	https://nptel.ac.in/courses/112/105/112105212/

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	
Understand	-	-	6	
Apply	-	-	6	
Analyse	-	-	4	
Evaluate	-	-	5	
Create	-	-	0	
TOTAL	-	-	25	

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME 2529 Elective – I Lab: Industrial Automation Lab

Teaching Scheme			Examination Scheme	
Practical	02 Hrs/week		CA	25
Tutorials	-			
Total Credits	01			

Lab Outcomes (LO): At the end of course, students will be able to,

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 analyse and solve refrigeration related problems by applying principles of mathematics, science and engineering

	Lab Content
	Term work should consist of any 10 experiments from the following,
Experiment 1	Exercise on electro pneumatics for sheet bending application
Experiment 2	Exercise on electro pneumatics for press- in and bonding application with time delay
Experiment 3	Exercise on electro hydraulics for press machine with two hand safety control
Experiment 4	Exercise on electro hydraulics for material handling application
Experiment 5	PLC Programming for water level control and its demonstration
Experiment 6	PLC Programming for elevator and its demonstration
Experiment 7	PLC Programming for sorting conveyor and its demonstration
Experiment 8	PLC Programming for bottling plant with counter and its demonstration
Experiment 9	Exercise on Automation Studio software for automation of material handling application.
Experiment 10	Interfacing of Automation Studio software with pneumatics using interface box (Input/output interface)
Experiment 11	Interfacing of Automation Studio software with hydraulics using interface box (Input/output interface)

Tutorials

Text Books

1.	"Automation, Production Systems and Computer Integrated Manufacturing", M. P. Groover, Pearson Education, ISBN: 81-7808-511-9, 2nd Edition, 2004
2.	"Programmable Logical Controller", John R. Hackworth and Frederick D. Hackworth, Pearson Education, 4th Edition, 2008
3.	"Introduction to Hydraulics and Pneumatics", S. Ilango and V. Soundararajan, PHI Learning Pvt. Ltd., 2nd Edition, 2011

Reference Books

1.	"Robotics and Industrial Automation", R. K. Rajput, S Chand 4.
2.	"Automation and Robotics", Khushdeep Goyal, Deepak Bhandari, S. K. Kataria and Sons Publications, 1st Edition, 2012
3.	"Mechatronics", W. Bolton, Pearson Education , 5th Edition, 2011
4.	"Programmable Logic Controllers", W. Bolton, Newnes, 4th Edition, 2006

Useful Links

1.	http://nptel.ac.in/courses/108105062/

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	3	3	2	3											
LO 2	3	3	2	3						2	3			3	3
LO 3	3	3	2		3	3									
LO 4	2	3	3	3	3	3	3	3	3	3		3	3	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	CA	ESE
Remember	-	-	4	-
Understand	-	-	4	-
Apply	-	-	5	-
Analyse	-	-	6	-
Evaluate	-	-	6	-
Create	-	-	0	-
TOTAL	-	-	25	-

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME 2539 Elective – I Lab: Computational Fluid Dynamics Lab

Teaching Scheme			Examination Scheme	
Laboratory	02 Hrs/week		CA	25
Total Credits	01		ESE	-

Lab Outcomes (LO)

Student will able to

1.	Learn latest software useful solving engineering problems
2.	Perform numerical simulations of various engineering and research problems
3.	Analyse research problems of fluid and heat transfer
4.	Solve complex engineering problems numerically

	Course Contents
Tutorial 1	Introduction to ANSYS Workbench
Tutorial 2	Introduction ANSYS Design Modeller
Tutorial 3	Mixing of two streams of fluid at different temp in a mixing Tee
Tutorial 4	Flow over an aerodynamic foil external flow
Tutorial 5	Simulation of electronic cooling equipments
Tutorial 6	Simulation of a rotating body (moving part)
Tutorial 7	Simulation of tank flush
Tutorial 8	Presentations on applications of CFD based on at least two research paper
Tutorial 9	Take any real-life problem by yourself and solve numerically
Tutorial 10	Take any one problem from any reputed research paper and solve it and validate it using data from research paper
Tutorial 11	Performing Grid independence test
Tutorial 12	Study of Accuracy, Stability, Residual and time step , Courant Number
Tutorial 13	Study of various physical model present in ANSYS software

Text Books

1.	**Dr. Suhas Patankar: "**Numerical Methods in Fluid flow and Heat Flow", Hemisphere Publishing Corporation
2.	**H. K Versteeg, W. Malalasakera: "**An Introduction to computational fluid flow (Finite Volume Method)", Printice Hall Publications
3.	**Dr. Atul Sharma:** Introduction to CFD: Development, Application and Analysis**,** Ane Books Pvt. Ltd. New Delhi, Wiley UK

Reference Books

1.	**John D Anderson:** "Computational Fluid dynamics, The Basic with applications", McGraw-Hill International edition, subject is like having new tool to students Mechanical Engineering series
2.	**Ferziger and Peric: "**Computational Method for Fluid Dynamics", Springer Publication
3.	**Chuen-Yen Chow: "**An Introduction to Computational Fluid Dynamics", Wiley Publications
4.	**Murlidhar and Sundararajan: "**Computational Fluid Flow and Heat Transfer" Narosa Publication
5.	**Anil W. Date**, "Introduction to Computational Fluid Dynamics", Cambridge University Press,
6.	**Prodip Niyogi, Chakrabarty, S. K., Laha, M.K.** "Introduction to Computational Fluid Dynamics", Pearson Education

Useful Links

1.	http://www.sciencedirect.com/science/article/pii/S0017931002002235
2.	http://www.ewp.rpi.edu/hardford/~ernesto/F2012/.../Patankar-NHTFF-1980.pdf
3.	www.cfd.com.au/cfd_conf09/PDFs/001EJL.pdf
4.	http://www.thermalfluidscentral.org/e-books
5.	http://cfdmadeeasy.org/; You-tube Channel: CFDmadeeasy
6.	https://www.ansys.com/products/fluids/ansys-fluent

Mapping of COs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	1	2	1	3	3					1	1	2	3	3	2
LO 2	1	2	2	2	3					1	1	2	3	3	3
LO 3	1	2	2	1	3					1	1	2	2	2	1
LO 4	1	2	3	3	3					1	2	2	3	3	3

Assessment Pattern **(with revised Bloom's Taxonomy)**

Knowledge Level	TA/CA	ESE
Remember	3	5
Understand	3	5
Apply	7	5
Analyse	7	3
Evaluate	5	2
Create		5
TOTAL	25	25

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME2510: Machine Design-1 Lab

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	25

Lab Outcomes (LO)

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

1.	Understand concept of design and design procedure of machine elements.
2.	Apply material selection and failure theories of different machine elements
3.	Design machine elements subjected to static loading and fluctuating loading
4.	Analyse selection of transmission elements subjected to static and variable loading

Course Contents

Term work should consist of following experiments.

Design Projects	Design and prepare two Assemblies (Manual/ CAD drawing) covering entire syllabus. The design project shall consist of two full imperial (A1) size sheet involving assembly - drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.
Assignments	
1:	Selection of materials and manufacturing methods for machine elements designed in any one of the above design projects.
2:	2D, 3D Stress Tensors, Strain Tensors
3:	Theories of failures and their applications.
4:	Use of dimensional tolerances, geometrical tolerances and surface finish symbols in machine component drawing.
5:	Components subjected to fluctuating loads
6:	Live Examples based on fasteners and welded joints
	The assignment shall be internally presented in the form of power point presentation, by a group of two/ three students. A report of assignment (Max 8 to10 pages) along with print out of ppt is to be submitted. Each student shall complete any four of the above assignments.

Text Books

1.	"Design of Machine Elements", V. B. Bhandari., Tata McGraw Hill Publication, 3rd Edition
2.	"Design of Machine Element", J. F. Shigley, Tata McGraw Hill Publication, 9th Edition
3.	"Machine Design an Integrated Approach", R. L Norton, Pearson Education Publication, 3rd Edition.
4.	"Introduction to Machine design", V. B. Bhandari, Tata McGraw Hill Publication, 2nd Edition

Reference Books

1.	"Machine Design", Hall, Holowenko Laughlin, Tata McGraw Hill Publication Schaum's Outline Series.
2.	"Machine Component Design", Robert C. Juvniall, Willey Ltd., 5th Edition
3.	"Design of Machine Elements" M. F. Spotts, Pearson Education Publication, 5th Edition

Useful Links

1.	https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring2009/lecture-notes/
2.	http://nptel.ac.in/courses/112105124/

Mapping of COs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	
Understand	-	-	6	
Apply	-	-	6	
Analyse	-	-	4	
Evaluate	-	-	5	
Create	-	-	0	
TOTAL	-	-	25	

Government College of Engineering, Karad

Third Year (Sem – V) B. Tech. Mechanical Engineering

ME2511: Mini Project

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		TA	25
			ESE	25

Course Outcomes (CO)

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

1.	To understand team work to realize an engineering task.
2.	To analyse the steps involved for the selection, execution and reporting of the project.
3.	To apply engineering knowledge to real life problem solving.
4	To evaluate community needs and covert idea in to product

Course Contents

The main aim of this course is to demonstrate the important attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The aim is also to make students aware with the process involved in making product from idea. Not more than five students may carry out the minor project together. One supervisor from the department shall be assigned three project batches of the mini project.

The steps involved for completion of mini project includes, but not limited to:

1	Conceptualization of innovative idea through literature and market survey; sight visits; interaction with community or industry, socio-economic survey, etc.
2	Design of product, processes, methods and systems using multidisciplinary knowledge.
3	Fabrication of product, development of software, measurement methods, etc..
4	Deployment, implementation and demonstration of project.
5	Presentation of project.

Guidelines for Project Selection:

Project work shall be based on any of the following:

- Design of any equipment /test setup/product
- Design and manufacturing of drilling jig for a component
- Design and manufacturing of milling fixture for component
- Design and manufacturing of press tool for component and trials for the same. (1.5 mm M.S. sheet)
- Prototype modelling for 3-4 parts assembly. (Design CAD model for a component / assembly and make it with the help of 3-D printer)
- Design a model and preparing the cam programming and making of the part with the help of VMC.
- Making the model of any heat power engineering system
- Any electromechanical /hydraulic/pneumatic circuit design with PLC for particular application
- Design and manufacturing pneumatic pick and place unit
- Design a pattern and make it with 3D printer and pour a casting with the help of AUTO CAST
- Auto pouring ladle for aluminium foundry
- Semi-automatic gravity die casting machine
- Analysis for auto component with the help of ANSYS software
- Energy audit for an industry/hospital/institute (up to 10 kW) 2. Hardware/numerical or theoretical analysis/review of survey

2**. Hardware/numerical or theoretical analysis/review of survey study/research and development wor**k

- The subject content of the minor project shall be from emerging/thrust areas, topic of current relevance
- The completion of work, the submission of the report and assessment should be done at the end of semester.

Project Report Format:
Project report should be of 15 to 20 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:

a. Title Sheet
b. Certificate
c. Acknowledgement
d. Table of Contents
e. List of Figures
f. List of Tables

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

List of Submission

1. Working model of the project
2. Project Report
3. Presentation and demonstration of project in exhibition

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	-	-	-	-	-	-	-	-	2	2	2
CO 2	3	2	2	1	2	-	-	-	-	-	1	2	2	2	2
CO 3	2	3	2	1	2	-	-	-	1	-	1	2	2	2	2
CO 4	1	2	2	1	2	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	1	1
Understand	-	-	5	5
Apply	-	-	5	5
Analyse	-	-	5	5
Evaluate	-	-	5	5
Create	-	-	4	3
TOTAL	-	-	25	25

Government College of Engineering, Karad

Third Year (Sem –V) B. Tech. Mechanical Engineering

ME2512: Industrial Training

Teaching Scheme			Examination Scheme	
Lectures	-		CA	50
Tutorials	01 Hr/week			
Total Credits	01			

Course Outcomes (CO)

1.	To make the students aware or familiar with the industrial work
2.	Comprehend the knowledge gained in the course work
3.	Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.

	Course Contents	Hours
	Execution scheme Industrial training of minimum two (2) weeks should be done after S. Y. B. Tech. **(semester IV)** in summer vacation and its assessment will be done in T.Y. (semester V) 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 fourth semester and complete within 15 calendar days before the start of fifth 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.	
	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, chemical or any process engineering industry? 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 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?	

Industrial Training Report Format:

Maximum five students in one batch, shall work under one Faculty. However, each student should have different industrial training and its presentation.

The report should be of 20 to 40 pages.

For standardization of the report the following format should be strictly followed.

1. Page Size: 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 Font 12
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12, Times New Roman
9. Headings: Times New Roman, Font14, Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded 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 Objectives: To make the students aware or familiar with the industrial work

Reference Books

1. Design Data Handbook for Mechanical Engineers in SI and Metric Units by K. Reddy, K. Balaveera, Mahadevan, CBS Publishers

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	-	-	-	-	-	-	-	-	2	2	2
CO 2	3	2	2	1	2	-	-	-	-	-	1	2	2	2	2
CO 3	2	3	2	1	2	-	-	-	1	-	1	2	2	2	2
CO 4	1	2	2	1	2	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's **Taxonomy)**

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	1	-
Understand	-	-	5	-
Apply	-	-	5	-
Analyse	-	-	5	-
Evaluate	-	-	5	-
Create	-	-	4	-
TOTAL	-	-	25	-

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2601: Control Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

1.	Identify application-wise components of feedback control systems.
2.	Apply mathematical models of physical systems and state-space approach in the analysis and design of control systems.
3.	Develop block diagram representation for Mechanical, Electrical, Thermal, Liquid Level, Hydraulic, Pneumatic, Gear Train systems, etc.
4.	Analyse the time and frequency-domain responses of first and second-order systems to step, ramp, parabolic, sinusoidal and impulse inputs.

	Course Contents	Hours
Unit 1	**Basics of Control Systems:** Background, Definitions, Classification of Control Systems- Natural, Manmade, Combinational, Time Varying and Time-Invariant, Linear and Nonlinear, Lumped Parameter and Distributed Parameter, SISO and MIMO systems, Open Loop and Closed Loop Systems, Real time applications of Open loop and closed loop systems, Comparisons, Position Control System- Servomechanisms, Regulating Systems- Regulators , Generalized Control System, Requirements of an Ideal Control Systems, Linearization of Non Linear Functions, Linearization of Operating Curves.	**(6)**
Unit 2	**Mathematical Model of Control System:** Concept of transfer function, Mechanical Translational/ Rotational Systems, Electrical Systems, Equivalent Mechanical System –Node Basis, Grounded Chair Representation, Analogous Systems- FV and FI analogy, Thermal System, Hydraulic/Pneumatic System, Mechanical levers, Gear Train, Belt/rope drives.	**(8)**
Unit 3	**Block Diagram Representation of Control System Components:** Block diagrams, Block Diagram Algebra, Rules for Reduction of Block Diagrams, Block diagram development from system equations, Block diagram development of system components- Thermometer, Water heating system, Liquid Level Systems, Hydraulic actuator, pneumatic actuator, Hydraulic servomotor, Jet-pipe amplifier, Pneumatic amplifier, potentiometers, DC and AC Servomotors.	**(8)**
Unit 4	**Time Domain Analysis:** Standard Test signals- Step, Ramp, Parabolic, Impulse, Exponential, Sinusoidal, Concept of Poles and Zeros, Distinct, Repeated and Complex Poles. Response of First and Second Order Systems to Inputs -Step, Ramp and Impulse, Damping Ratio and Natural Frequency, Transient Response Specifications.	**(7)**
Unit 5	**State Space Analysis:** System Representation in Time and Laplace Domain, Modelling of Electrical and Mechanical Systems, Construction of Simulation diagrams, Transfer function from state space model.	**(6)**
Unit 6	**Frequency Response Analysis:** Frequency Domain approach, Magnitude Plots and Phase angle Plots, Bode plots, Gain Margin, Phase Margin, Polar Plots and Stability Determination.	**(5)**

Tutorials- -- Assignments on each Unit- 6 Nos.

Text Books

1.	"Control System Engineering", R Anand Natarajan, P. Ramesh Babu, SciTech Publication, 2nd Edition.
2.	"Control Systems", A. Anand Kumar, Prentice Hall Publication.
3.	"Modern Control Systems", K Ogata, Prentice Hall Publication, 3rd Edition.

4.	"Automatic Control Engineering", D. Roy and Choudhari, Orient Longman Publication Calcutta.
Reference Books	
1.	"Automatic Control Engineering", F.H. Raven Tata McGraw Hill Publication, 5th Edition.
2.	"Automatic Control Systems", B.C. Kuo, Willey India Ltd. / Prentice Hall Publication, 7th Edition.
3.	"Control System Analysis and Design", A. K. Tripathi, Dinesh Chandra, New Age International Publishers, 1st Edition.
4.	"Modern Control Systems", Richard C. Dorf, Robert H. Bishop, Prentice Hall, 2008
Useful Links	
1.	www.ieeecss.org
2.	www.controlengineering.com
3.	www.journals.elsevier.com/control-engineering-practice
4.	www.learnerstv.com/Free-engineering-Video-lectures-ltv

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	3	3	1	2	1	-	-	1	-	1	2	2	2	3
CO 3	3	2	3	-	2	-	-	-	1	-	-	2	2	2	3
CO 4	3	3	1	-	3	-	-	-	-	-	-	2	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	2	05
Understand	5	4	2	15
Apply	5	3	2	10
Analyse	-	3	2	10
Evaluate	-	1	2	15
Create	-	-	0	05
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME2602: Internal Combustion Engines

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
			CT – 2	15
Total Credits	02		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Study constructional details and various types of internal combustion engine
2.	Understand and analyse basic thermodynamic cycles of I. C. engines
3.	Understand combustion phenomenon in S. I. engine and C. I. engines
4.	Impart knowledge about various engine systems and performance characteristics

	Course Contents	Hours
Unit 1	**Introduction** to I. C. engine, classification and applications, valve timing diagrams, port timing diagrams, power transmitting components, I. C. engine cycles: Air standard cycles- Auto, diesel and dual cycle, fuel-air cycles, assumptions, actual cycles- Time loss, heat loss and exhaust blow down losses	**(6)**
Unit 2	**Fuel Systems for S.I. Engines:** Engine fuel requirements, carburettor, derivation for calculation of A/F ratio, calculation of main dimensions of carburettors, effect of altitude. electronic petrol injection systems types of MPFI systems and their applications, sensors, ECU merits and demerits **Fundamentals of Combustion in S. I. Engines:** Stages of combustion in S. I. engine – Ignition lag, propagation of flame and afterburning, factors affecting flame speed, abnormal combustion, influence of engine design and operating variables on detonation, fuel rating, Octane number, fuel additives, HUCR, combustion chambers of S.I. engines and its types	**(8)**
Unit 3	**Fuel Systems for C.I. Engines:** Requirements of injection system, types of injection systems – Individual pump, common rail and distributor systems, unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux, formation of spray, atomization and penetration. Electronic diesel injection system **Fundamentals of Combustion in C.I. Engines**: Stages of combustion in C. I. engine, delay period, factors affecting delay period, abnormal combustion- diesel knock, influence of engine design and operating variables on diesel knock, comparison of abnormal combustion in S.I. and C.I. engines, Cetane number, additives, requirements of combustion chambers for C.I. engines, types of combustion chambers, Visualisation of combustion by optical instrumentation.	**(8)**
Unit 4	**Performance Testing of Engines:** Determination of fuel consumption, air consumption, air-fuel ratio, torque, brake power, indicated power, friction power, brake thermal efficiency, mechanical efficiency, volumetric efficiency and mean effective pressure. numerical on Heat balance sheet, engine performance and performance curves	**(6)**
Unit 5	**Engine Emission and Control:** S. I. engine emission (HC, CO, NOx) control methods- Evaporative Loss Control Device (ELCD), catalytic converters, C. I. engines emission (HC, CO, NOx, smog, particulate), control methods- chemical, EGR, standard pollution norms like EURO, Bharat stage-IV, alternative fuels, dual-fuel engines, introduction to lubricating and cooling systems. Superchargers, Turbochargers,	**(6)**
Unit 6	**Modern Trends in I. C. Engines:** Advances in valve and valve mechanism e.g. camless engine, variable valve Timing (VVT), advances in S. I. engines: gasoline direct injection system (GDI) components such as sensors, ECU etc., merits and demerits, fuel supply system for LPG/CNG fuels and engines. recent trends in ignition system e.g. Digital Twin Spark Ignition (DTSI), advances in C. I. engines: Common Rail Direct Injection System (CRDI) components such as sensors, ECU etc., merits and demerits	**(6)**

Text Books

1.	"Internal Combustion Engines", V. Ganesan, Tata McGraw-Hill Publishing Company Ltd, Fourth Edition, 2013
2.	"A Course in Internal Combustion Engines", M. L. Mathur and R. P. Sharma, Dhanpat Rai Publications Pvt. Ltd, First Edition, Re-print 2003
3.	"Internal Combustion Engines", Rajput R. K., Laxmi Publications Pvt. Ltd, First Edition, Re-print 2014
Reference Books	
1.	"Internal Combustion Engines and Air Pollution", R. Yadav, Central Publishing House, Allahabad, Second Edition, 2004
2.	"Internal Combustion Engine Fundamentals", John B. Heywood, Tata McGraw-Hill. Publishing Company Ltd, First Edition, 2011
3.	"Automotive Engines",Srinivasan, Tata McGraw-Hill Publishing Company Ltd., First Edition, 2001
4.	"Internal Combustion Engines", Domkundwar and Domkundwar,Dhanpat Rai Publications Pvt. Ltd. First Edition, 2002
Useful Links	
1.	http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/internal_combusn_engines.htm
2.	http://vwts.ru/injector/k-jetronic/gasoline_fuel_injection_system_k-jetronic_eng.pdf 3.
3.	www.yildiz.edu.tr/~sandalci/dersnotu/AKTraining.pdf

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2						1								1
CO 2	2	2	2				1					1		2	2
CO 3	2	2	2				1					1	1	2	2
CO 4	2	2	2		1							1	1		

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	1	1	0	10
Understand	4	4	1	14
Apply	4	4	3	14
Analyse	3	3	3	12
Evaluate	2	2	2	08
Create	1	1	1	02
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2613 Elective – II: Additive Manufacturing

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials			CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

1.	Understand the concept of additive manufacturing and evaluation of its process sequence
2.	Understand the materials required for AM and its molecular structures
3.	Apply the knowledge of software tools for additive manufacturing
4.	Develop the 3D component using additive manufacturing process

	Course Contents	Hours
Unit 1	**Introduction to Additive Manufacturing (AM)** General overview Introduction to reverse engineering Traditional manufacturing vis AM Computer aided design (CAD) and manufacturing (CAM) and AM Different AM processes and relevant process physics AM process chain Application level: Direct processes – Rapid Prototyping, Rapid Tooling. Rapid Manufacturing; Indirect Processes - Indirect Prototyping. Indirect Tooling, Indirect Manufacturing	**(6)**
Unit 2	**Software Technologies and Tools** Design/Fabrication Processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing	**(6)**
Unit 3	**Materials science for AM** Discussion on different materials used Use of multiple materials, multifunctional and graded materials in AM Role of solidification rate Evolution of non-equilibrium structure property relationship Grain structure and microstructure	**(6)**
Unit 4	**AM technologies** Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting. involvement). Printing processes (droplet-based 3D Solid-based AM processes - extrusion based fused deposition modelling object Stereolithography Micro- and nano-additive	**(8)**
Unit 5	**Process Selection planning, control for AM** Selection of AM technologies using decision methods Additive manufacturing process plan: strategies and post processing. Monitoring and control of defects, transformation	**(8)**
Unit 6	**Applications of AM** Applications of AM: Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing.	**(6)**

Text Books

1.	Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009
2.	Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.

Reference Books

1.	Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.
2.	Gibson, Advanced Manufacturing Technologies for Medical Applications. Wiley, 2005.
3.	C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: principles and applications, 3rd Edition, World Scientific, 2010.
4.	Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech, 2012
5	J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, e-ISBN: 978-3-642- 28359-8.

Useful Links

1.	https://additivemanufacturing.com/basics/
2.	https://www.ge.com/additive/additive-manufacturing
3.	https://www.additive.sandvik/en/

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	3	3	3		2	1						2		3
CO 2	3	2	3		2	1		1						2	
CO 3	2	3	2	3	3	3		2	1				3		
CO 4	1			3		2	1		1						3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	2	2	10
Understand	3	3	2	15
Apply	2	3	2	10
Analyse	3	2	2	10
Evaluate	2	3	1	10
Create	2	1	1	5
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem –VI) B. Tech. Mechanical Engineering

ME2623 Elective – II Welding Technology

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT - 1	15
Tutorials	--		CT - 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	**02 Hrs 30 Min**

Course Outcomes (CO)

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

1.	Perform different metal profile by selection of different cutting methods
2.	Get required component by different fabrication techniques
3.	Analyze welding defects which would happen during welding
4.	Perform latest welding methods.
5.	Detect defective components manufactured by fabrication methods

	Course Contents	Hours
Unit 1	**Fundamentals and Classification of Welding Processes:** Introduction, classification of Welding processes. Comparison with other joining processes, Advantages, disadvantages, practical applications. Welding Symbols. Basic & supplementary weld symbols, types of weld Joints, Selection of Weld Joint, and edge preparation. **Preparatory Operations:** Different metal cutting methods used in fabrication, Advantages and limitations, straightening methods, bending on roll bending machine, press, press brake. Different edge preparation and cleaning methods, Precautions in preparatory operations for stainless steel and aluminum, fabrication characteristics of metals and composites.	**(7)**
Unit 2	**Fabrication Machinery:** Welding machines, three roll bending presses, press brakes, shearing machine, plasma arc cutting machine, Different types of hand grinders, loading, unloading equipment's, material handling equipment's	**(7)**
Unit 3	**Arc Welding Processes and Equipment's:** Definition, types of processes, Carbon Arc Welding, Flux Shielded Metal Arc Welding, Submerged Arc Welding, Tungsten Inert Gas Welding, Metal Inert Gas Welding, Electro slag Welding, Electro Gas Welding, Plasma Arc Welding, Arc Welding equipment's, Electrodes Types, classification and coding of electrodes. **Gas Welding**-Principle of operation, types of flames, Gas welding Techniques, filler material and fluxes, Gas welding equipment's, advantages and applications **Resistance welding:** Definition, Fundamentals, variables advantages and application, Spot Welding, Heat Shrinkage, Heat Balance Methods, Equipment, Electrodes, Seam, Projection Butt (up sets and flash), Percussion Welding – Definition, Principle of Operation, equipment, Metal Welded, advantages and application.	**(8)**
Unit 4	**Weld Quality and Defects,** failure of welds, inspection and testing of welds, I.S. code for welding and weld metals, destructive tests for welds, microstructure for weld joints, welding defects and remedies	**(5)**
Unit 5	**Inspection and Testing of Welds:** Destructive testing of weld – Tensile, Bend, Impact, Nick Break, Hardness, Etch Tests, Non-Destructive Testing of Welds – Visual, Leak, X- ray and Gamma ray Radiography, Magnetic Particle Inspection, Dye, Fluorescent Penetrant Tests, Ultrasonic Inspection & Eddy Current Testing.	**(6)**
Unit 6	**Modern welding processes**: EBW, LBW, diffusion bonding, ultrasonic welding, pulsed current welding processes, and friction welding. Welding of ceramics, plastics and composites **Welding Automation and Robotics:** Introduction, Automation options, Robotic welding, Modular Automation, Programmable control, Remote Control Slave and Automated Systems **Welding Fixtures:** Introduction, welding fixtures, their characteristics, classification and selection considerations, various types of welding fixtures.	**(7)**

Text Books				
1.	Richard Little, "Welding and Welding Technology." TM			
2.	U. S. Steel Corporation, "Fabrication of Stainless Steel."			
3.	ASTME, "Fundamentals of Tool Engineering Design", PHI Publication			
4.	Schwartz M.M., "Metal Joining Manual", McGraw Hill, NY 1979.			
5.	O.P.Khanna, “Welding Technology” Dhanpat Rai Publications			
Reference Books				
1.	Begman, "Manufacturing Processes			
2.	Schwartz M.M., "Metal Joining Manual", McGraw Hill, NY 1979			
3.	Cnnur L.P., "Welding Handbook Vol I & II", American Welding Society, 1989			
4.	Hauldcraft P.T, "Welding Process Technology", Cambridge University Press, 1985			
5.	V. Rybakav “Arc and Gas welding” (Mir Publication)			
Useful Links				
1.	www.sciencedirect.com/science/book/9780750666916			
2.	unesdoc.unesco.org/images/0016/001613/161340e			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3								2	2	3	2	
CO 2	3	3	3	2	1				2		2	2	2	2	
CO 3	3	3	3	2	1				2		2	2	3	2	
CO 4	3	3	3	2	2				3		3	2	3	3	
CO5	3	3	3	2	2				3		3	2	2	3	

Assessment Pattern (with revised Bloom’s Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyse	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2633 Elective – II: Energy and Power Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	--		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

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

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 1	**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	**(6)**
Unit 2	**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	**(9)**
Unit 3	**Energy from Wind and Biomass** **Energy from Wind** - Nature of wind energy, Data collection and site selection, Vertical axis wind turbine, Horizontal axis 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	**(6)**
Unit 4	**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	**(6)**
Unit 5	**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	**(9)**
Unit 6	**Energy Audit and Management** Concept and purpose of energy audit, Energy conservation acts, Auditing procedure, Basic components of energy audit, Energy management certification, Energy performance assessment.	**(4)**

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
Reference Books	
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 and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO 2	2	2	2	1	1		-	-	-	-	1	2	2	2	2
CO 3	3	3	3	1	1	1	-	1	1	1	1	2	2	2	2
CO 4	3	3	3	1	1	1	-	-	-	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	3	2	10
Understand	3	3	1	16
Apply	4	4	3	10
Analyse	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 (Sem – VI) B. Tech. Mechanical Engineering

ME 2604: Dynamics of Machines

Teaching Scheme		Examination Scheme	
Lectures	03 Hrs/week	CT – 1	15
Tutorials	--	CT – 2	15
Total Credits	03	TA	10
		ESE	60
		Duration of ESE	02 Hrs 30 Min

Course Outcome (CO):

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

1.	Demonstrate the fundamental principles of dynamics to machinery
2.	Apply balancing methods to balance rotating and reciprocating components
3.	Analyze vibrations of single degree of freedom systems
4.	Evaluate the fluctuation of energy stored in flywheel and effect of gyroscopic couple on naval ship, aero plane, etc.

	Course Contents	Hours
Unit 1	**Toothed Gearing** Geometry of motion, gear geometry, types of gear profile- involute and cycloidal, theory of spur, helical and spiral gears, interference in involute tooth gears and methods for its prevention.	**(7)**
Unit 2	**Gear Trains** Types of gear trains - simple, compound, reverted, epicyclic gear train, tabular method for finding the speeds of elements in epicyclic gear train, torques in epicyclic gear train, differential gear box, equivalent mass and moment of inertia applied to gear trains, recent trends in automatic transmission.	**(7)**
Unit 3	**Balancing** Static and dynamic balancing of rotary and reciprocating masses, primary and secondary forces and couples. direct and reverse cranks, balancing of single cylinder, multi cylinder, in-line and radial engines for four wheeler	**(8)**
Unit 4	**Gyroscope** Gyroscopic couple, spinning and precession motion, gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Four-wheeler	**(5)**
Unit 5	**Mechanical Vibrations** Basic concepts and definitions, types of vibrations, equivalent springs, equation of motion, types of damping, SDOF free vibrations with and without damping, logarithmic decrement. SDOF forced vibrations with and without damping, magnification factor, frequency response curves, vibration isolation and transmissibility	**(8)**
Unit 6	**Flywheel** Turning moment diagrams, fluctuation of energy, coefficient of fluctuation of speed, rimmed flywheel	**(5)**

Text Books

1.	"Theory of Machines", Rattan S. S., Tata McGraw Hill, 3rd Edition
2.	"Theory of Machines", Sadhu Singh, Pearson Education, 3rd Edition
3.	"Theory of Machines", Jagdishlal, Metropolitan Publication, 2nd Edition
4.	"Theory of Machines", Ballaney, Khanna Publication, 4th Edition
5.	"Theory of Machines", V. P. Singh, Dhanpat Rai Publications, 3rd Edition

Reference Books

1.	"Theory of Machines and Mechanisms", Shigley, Tata McGraw Hill, 4th Edition
2.	"Theory of machines", Thomas Beven, Pearson Education, 3rd Edition
3.	"Mechanism and Machine Theory", Rao, Dukkipati, New Age International, 2nd Edition
4.	"Mechanisms and Dynamics of Machines", J. Srinivas, SciTech Publication, 2nd Edition
5.	"Kinematics, Dynamics and Design of Machinery", Walidron, Wiley India Publication, 2nd Edition

Useful Links			
1.	http://nptel.ac.in/courses/112104114/		
2.	http://nptel.ac.in/courses/112104121/1		
3.			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1		1								2	2	1	2
CO 2	2	2	2	2								1	1	1	1
CO 3	2	2	2	2								3	2		1
CO 4	2	2	2	2								2	1	1	1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	2	2	0	10
Understand	4	4	1	16
Apply	4	4	3	16
Analyse	3	3	3	10
Evaluate	2	2	2	08
Create	0	0	1	00
TOTAL	15	15	10	60

Government College of Engineering, Karad

Third Year (Sem –VI) B. Tech. Mechanical Engineering

ME 2605: Manufacturing Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorial	1Hrs /Week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	03 Hrs

Course Outcomes (CO)

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

1.	Understand & identify the metal cutting action with different cutting tool
2.	Design jigs and fixtures for simple components
3.	Select and design dies press tool die for different components.
4.	Select the tooling for advanced manufacturing like CNC, Rapid prototyping etc.

	Course Contents	Hours
Unit 1	**Design of Jigs and Fixtures (Special Tooling)** Definition, Applications, basic elements, Principles and Types of Locating, Clamping and Indexing elements, Auxiliary elements like Tenon, Setting block etc. Type of Drilling jigs and Milling fixtures- design consideration of jigs and fixtures with respect to different operations, introduction to modular fixtures and Computer Aided Fixture Designing (CAFD)	**(7)**
Unit 2	**Mechanics of Metal Cutting** Introduction to metal cutting, wedge action, concept of speed, feed and depth of cut, orthogonal and oblique cutting. Parts, angles and types of single point cutting tools, tool geometry of single point cutting tool, Mechanics of metal cutting-Chip formation, Types of chips, cutting ratio, Theory of shear angle, shear plane shear stress & strain, velocity relationships, Types of tool dynamometers, estimation of cutting forces, Merchants circle of forces, cutting tool materials and their properties, machinability of metals- factors affecting, improvement and machinability index	**(8)**
Unit 3	**Theory of Metal Cutting** • Tool life - Types of wear, relationship with cutting parameters, Taylor's equation and improvement measures. Surface finish- Factors affecting, effect of cutting parameters, improvements. Heat generation in machining, its effect on cutting force, tool life and surface finish, types and selection criteria of cutting fluids. • Tool geometry- tool geometry of multipoint cutting tools- drills, milling cutters, reamers.	**(7)**
Unit 4	**Press Tools** Press working terminology, Elements of Dies and Punch set. Types of dies – Simple, Compound, Combination and Progressive dies and punches of various press working operations such as punching, blanking, drawing, bending, forming, coining etc. Design of Blanking die, Progressive die, Calculations of centre of pressure, different forces, press capacity in tonnage, strip layout, methods of reducing forces. Design considerations for die elements (theoretical treatment only)	**(7)**
Unit 5	**Cost Estimation** Definition, Purpose of Cost Estimation and Cost Accounting, Difference between Cost Accounting and Cost Estimation, Types of costs, direct cost, indirect cost, fixed cost, variable cost, elements of cost, material, labour, expenses, factory, selling and distribution, overheads, cost structure, machine hour rate, steps in cost estimate, breakeven point analysis.	**(6)**
Unit 6	**Introduction Advanced Manufacturing** • **CNC Technology & CNC Tooling:** Introduction, Construction and working of CNC and machining centre, Automatic Tool Changer (ATC) and Automatic Tool Setter, Automatic pallet changer (APC). • **Reverse Engineering Using Rapid Prototyping:** Rapid prototyping concept, advantages, applications, Rapid Tooling- Direct Rapid Prototyping Tooling, Silicone Rubber Tooling, Investment-cast Tooling, Powder Metallurgy Tooling**,** Spray Metal Tooling**,** Desktop Machining, Study of 3D printing, file formats.	**(5)**

Text Books	
1.	Workshop technology Vol.- I, II and III by Chapman, Edward Arnold Publication Ltd. London
2.	Workshop Technology Vol.- I and II by Hajara Chaudhari, Media Prom and Publication, Mumbai.
3.	Production Engineering by P.C. Sharma, S. Chand Publication, 11th Edition.
4.	Machine Tool Engineering by G. R. Nagpal, Khanna Publication.
	CAD/CAM Principles & Applications by P. N. Rao Mc Graw Hill Publication.
5.	Principles of Modern Manufacturing by Mikell P. Groover , Wiley Publication., 5th Edition.
6.	Production technology by R. K. Jain, Khanna Publications.
7.	Jigs and Fixtures by P.H. Joshi Tata McGraw Hill.
8.	Users Guide to Rapid Prototyping, T. A. Grimm and Associates, Society of Manufacturing Engineers (SME) ISBN 0872636976
Reference Books	
1.	HMT Hand Book- Production Technology
2.	Manufacturing Processes by S. E. Rusinoff Times India Press.
3.	Manufacturing Processes and Materials for Engineers, by Doyle, Prentice Hall of India.
4.	Fundamentals of Tool Design, by S. K. Basu, Oxford IBH
5.	Metal Cutting Theory and Tool design by Mr. Arshinnov, MIR Publication
6.	Fundamentals of Tool Design" ASTME, Prentice-Hall of India Private Ltd., New Delhi, Publication,
7.	Tool Design by Donaldson, THM Publication, 3rd Edition.
8.	Theory of Metal Cutting by Sen and Bhattacharya, New Central Book Agency.
9	Introduction to Jigs and Fixtures by Kempster, ELBS.
10.	Rapid Prototyping Theory and Practice, Manufacturing System Engineering Series, Ali K.
11.	Rapid Prototyping- case book, J. A. McDonalds, C. J. Ryall, Wiley Eastern
12.	Rapid-Prototyping Technology by Kenneth Cooper, MARCEL DEKKER, INC. Publication.
13.	Introduction to Jigs and Fixtures by Hoffman, Galgotia Publishers.
Useful Links	
	NPTEL Lecture: http://nptel.ac.in/courses/112105126/ https://youtu.be/KJj8CfnC0Ek https://www.youtube.com/watch?v=S6P7fOwV04Q

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2									2	3	2	
CO 2	3		2	2					2			2	3	3	
CO 3	3	3	2	2	2				2			2	3	3	
CO 4	3	3	2	2	2				3			2	3	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	2	2	0	08
Understand	4	4	1	16
Apply	4	4	3	12
Analyse	2	2	3	08
Evaluate	2	2	2	08

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2606: Control Engineering Lab

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	25
			ESE	25

Course Outcomes (CO)

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

1.	Compare the properties/ characteristics of controllers with modes like P, I, D, PI, PD and PID.
2.	Select controllers in design and analysis of Control Engineering applications.
3.	Describe the input-output differential equation for control components used in Feedback Control Systems.
4.	Use MATLAB/SIMULINK/SciLab software to formulate the simple Control Engineering Problems.

Course Contents

Term work should consist of any 08 experiments from the following.

Experiment 1	Study of response characteristics of On-Off Controller for Fluid flow/ Thermal system.
Experiment 2	Study of various Control Modes like P, I, D, PD, PI, PID for Pressure / Thermal / Flow level system.
Experiment 3	Study of PID control of single DOF of spring-mass-damper system.
Experiment 4	MATLAB Programming for Generation of transfer function and block diagram reduction.
Experiment 5	Using MATLAB, Transient response and system performance of linear system to different inputs.
Experiment 6	MATLAB Programming for Pole-zero pattern and system stability.
Experiment 7	MATLAB Programming for State space method and Frequency Response method.
Experiment 8	Modeling of any physical system using Simulation software MATLAB/SIMULINK.
Experiment 9	Industrial visit and report writing to study Automatic control system applications.
Experiment 10	**Group Activity**

Maximum 3 to 4 students in one group.

Detailed survey of collection literature/case studies related to any one of the control system application based on Mechanical system, Electrical/Electronic system, Vibration system, Fluid flow system, Thermal system etc. Survey/case studies includes following points-

1. Introduction/Relevance
2. Objectives
3. Physical layout
4. Block diagram representation
5. Selection of Controller and feedback element
6. Theory/Description and specifications of System Components
7. Principle of working operation
8. Design calculations/theoretical analysis
9. Concluding remarks/comments

Text Books

1.	"Control Systems Engineering using MATLAB", S. N. Sivanandam, S. N. Deepa, Vikas Publishing House Pvt. Ltd., 2nd Edition.
2.	"MATLAB and Simulink-Introduction to Applications", Parth S. Mallick, Scitech Publications (I) Pvt. Ltd, 2nd Edition.
3.	"Analysis and Design of Control Systems using MATLAB", Rao V. Dukkipati, New Age International Publishers, 1st Edition
4.	"Control Systems Engineering using MATLAB", S. N. Sivanandam, S. N. Deepa, Vikas Publishing House Pvt. Ltd., 2nd Edition.

Reference Books

1.	"Getting Started with MATLAB", Rudrapratap, Version 6, Oxford University Press, 2nd Edition.
2.	"Introduction to MATLAB 6", D. M. Ether, D. C. Kuncicky, D. Hull. Pearson Education, 1st Edition.
3.	"Getting Started with Control System Toolbox", Version 5, The Math Works.

Useful Links	
1.	http://www.controlandinstrumentation.com/
2.	https://instrumentationandcontrol.net/
3.	https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_control.php

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1	2	-	-	-	1	-	1	2	3	2	3
CO 2	3	2	2	1	2	1	-	-	1	-	1	2	2	2	3
CO 3	3	2	1	-	2	-	-	-	-	-	-	2	2	2	3
CO 4	2	2	2	1	3	-	-	-	1	-	-	2	2	2	3

Assessment Pattern (with revised Bloom's **Taxonomy)**

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad				
Third Year (Sem – VI) B. Tech. Mechanical Engineering				
ME2607 Internal Combustion Engines Laboratory				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week			
Total Credits	01		CA	25

Lab Outcomes (LO)	
1.	Study constructional details and various types of internal combustion engines
2.	Understand various engine systems
3.	Understand fuel injection in S. I. engine and C. I. engines
4.	Impart knowledge about various engine performance characteristics and its testing

List of Experiments	**Hours**
Term work should consist of any 10 experiments from the following	
Experiment 1	Demonstration of constructional detail of I. C. engines by dismantling and assembly
Experiment 2	Demonstration of engine systems: Air intake, exhaust, cooling, lubrication systems
Experiment 3	Demonstration of ignition systems, starting systems
Experiment 4	Demonstration of carburettor and petrol injection system
Experiment 5	Demonstration of GDI.
Experiment 6	Demonstration of fuel injection system of diesel engine
Experiment 7	Demonstration of CRDI
Experiment 8	Experiment on diesel engine to determine variable load performance and heat balance sheet
Experiment 9	Experiment on petrol engine to determine variable load performance and heat balance sheet
Experiment 10	Variable speed test on two stroke petrol engine.
Experiment 11	Morse test on multi cylinder petrol engine to determine Indicated Power of each cylinder
Experiment 12	Test on computer controlled I. C. Engine to plot pressure versus crank angle (P-θ) diagram
Experiment 13	Measurement of exhaust emissions of S. I. engine/ C. I. engine
Experiment 14	Test on variable compression ratio engine to plot performance curves of engine
Experiment 15	Survey of commercial engines, their specifications, details and troubleshooting
Experiment 16	Visit to an engine manufacturing company / service station.

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	2								2				1		
LO 2	2	2	2						1	1		1		1	
LO 3	2	2	2						1	1		1		1	
LO 4	2	2		1					2	1		1		1	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2608: Dynamics of Machines Laboratory

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	25

Lab Outcomes (LO)

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

1.	To demonstrate the vibrational behavior of system
2.	To analyze the balancing of rotating and reciprocating machine elements
3.	To evaluate the moment of inertia of various mechanical systems
4.	To apply the principles of gyroscope

List of Experiments

Term work should consist of any 10 experiments from the following.

Experiment 1	Determination of M. I. using bifilar suspension system
Experiment 2	Determination of M.I. using trifilar suspension system
Experiment 3	Demonstration and study of the gear box of any four wheelers with respect to types of gear, velocity ratio, type of train, arrangement of gears
Experiment 4	Experiment on torque measurement in epicyclic gear train
Experiment 5	Experiment on balancing of rotary masses (static and dynamic)
Experiment 6	Study of balancing of reciprocating masses (draw solution on half imperial size drawing sheets)
Experiment 7	Design of flywheel for IC engine and punch press
Experiment 8	Verification of gyroscopic principle and determination of gyroscopic couple
Experiment 9	Study of vibration measuring instruments
Experiment 10	Determination of critical speeds of shaft
Experiment 11	To determine stiffness of the given helical spring, period and frequency of undamped free vibration of spring mass system
Experiment 12	Industrial visit to correlate practical applications of the gearbox, balancing of machine and vibration

Lab Outcomes:

At the end of course students will be able to

1.	Analyse the gears and gear train for typical power transmission application
2.	Comprehend gyroscopic principle and effect of gyroscopic couple
3.	Solve the problems on balancing of rotary and reciprocating masses
4.	Determine the vibration parameters of different systems

Text Books

1.	"Theory of Machines", Rattan S. S., Tata McGraw Hill, 3rd Edition
2.	"Theory of Machines", Sadhu Singh, Pearson Education, 3rd Edition
3.	"Theory of Machines", Jagdishlal, Metropolitan Publication, 2nd Edition
4.	"Theory of Machines", Ballaney, Khanna Publication, 4th Edition
5.	"Theory of Machines", V. P. Singh, Dhanpat Rai Publications, 3rd Edition

Reference Books

1.	"Theory of Machines and Mechanisms", Shigley, Tata McGraw Hill, 4th Edition
2.	"Theory of machines", Thomas Beven, Pearson Education, 3rd Edition
3.	"Mechanism and Machine Theory", Rao, Dukkipati, New Age International, 2nd Edition
4.	"Mechanisms and Dynamics of Machines", J. Srinivas, SciTech Publication, 2nd Edition
5.	"Kinematics, Dynamics and Design of Machinery", Walidron, Wiley India Publication, 2nd Edition

Mapping of COs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	2	1			2				1	1		2	2		1
LO 2	2	2	1	1					2	1		2	1	1	1
LO 3	2	2							1	1		1	2	1	1
LO 4	2	2	1						1	1		2	1		1

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	6
Understand	-	-	4	8
Apply	-	-	5	6
Analyse	-	-	6	3
Evaluate	-	-	6	2
Create	-	-	0	0
TOTAL	-	-	25	25

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2609 Computer Integrated Manufacturing Lab and Workshop Practice - IV

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	50
	At the end, the job assessment will be done for 25 marks by the workshop superintendent and will be submitted to CIM course coordinator.			

Lab Outcomes (LO)

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

1.	To introduce students to the concept of manufacturing automation and factory automation
2.	To write and simulate CNC and robot program for simple component.
3.	To understand and perform the various machining operations
4.	To implement principles of metrology to various components

List of Experiments

Term work should consist of any 10 experiments from the following.

Experiment 1	Robot pick and place programming.
Experiment 2	Understanding construction of CNC lathe machine and learning G and M codes.
Experiment 3	Programming for simple components on CNC Lathe machine.
Experiment 4	Graphic simulation of CNC lathe operations for simple components.
Experiment 5	Understanding construction of CNC milling machine and learning G and M codes.
Experiment 6	Programming for simple components on CNC milling machine.
Experiment 7	Graphic simulation of CNC milling operations for simple components.
Experiment 8	Programming of ASRS.
Experiment 9	Demonstration of CNC-CMM.
Experiment 10	**Workshop Practice** To manufacture the components as per the drawing requiring at least four of the following operations i. Milling ii. Shaping iii. Grinding iv. Tapping v. Die threading vi. Slotting

1.	"Automation, Production systems and Computer Integrated Manufacturing" by M. P. Groover (PHI), 3rd Edition
2.	"Computer Aided Manufacturing", by P. N. Rao, N.K. Tewari and T. K. Kundra, Tata McGraw Hill, ISBN 9780074631034, 3rd Edition
3.	"CAD/CAM Computer Aided Design and Manufacturing", M. Groover, E. Zimmers, Pearson Publications, ISBN 9788177584165, 5th Edition
4.	"Workshop Technology Vol. II" – by Raghuvanshi, Dhanpath Rai and co. (P) Ltd., 9th Edition
5.	"Workshop Technology Vol. II "– by Hajara Choudhary, Media Promoters and Publishers, Mumbai, 10th Edition

Reference Books

1.	"Principles of Computer Integrated Manufacturing", by S. Kant Vajpayee (PHI), 2nd Edition
2.	"Introduction to Robotics in CIM system" James A. Rehg, Pearson Education, 3rd Edition.
3.	"Workshop practice manual" by V. Venkata Reddy, BS Publications, 6th edition
4.	"Automation, Production systems and Computer Integrated Manufacturing" by M. P. Groover (PHI), 3rd Edition

Useful Links

http://nptel.ac.in/courses/112102103/17

http://nptel.ac.in/courses/112107077/module5/lecture2/lecture2.pdf

Mapping of LOs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	3	2	2	1	2	-	-	-	1	-	1	2	3	2	3
LO 2	3	2	2	1	2	1	-	-	1	-	1	2	2	2	3
LO 3	3	2	1	-	2	-	-	-	-	-	-	2	2	2	3
LO 4	2	2	2	1	3	-	-	-	1	-	-	2	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	-
Understand	-	-	4	-
Apply	-	-	5	-
Analyse	-	-	6	-
Evaluate	-	-	6	-
Create	-	-	0	-
TOTAL	-	-	25	-

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME 2610 CAD Lab-I

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	25

Lab Outcomes (LO)

1.	Apply geometric transformations on the created lines, curves, wireframe, surface and solid models.
2.	Create surface primitives using parametric modelling.
3.	Create the different wireframe primitives using parametric representations.
4.	Create the different solid primitives using the different representation schemes.

List of Experiments

1.	C++/MATLAB Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D;
2.	Parametric representation of lines, circle, Ellipse, parabola and hyperbola.
3.	Graphics programming in C++/MATLAB for geometric modeling of different curves
4.	Parametric representation of Surfaces
5.	programming in C++/MATLAB for Solid primitives
6.	The generated geometric models will have the capability to be modified as per the user's requirements.
7.	Minor projects based on geometric modelling in Rapid Prototyping.

Text Books

1.	D. F. Rogers and J. A. Adams, Mathematical Elements in Computer Graphics, McGraw-Hill,1990
2.	Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with open GL, Pearson Education,2001
3.	Grigore Burdea, Philippe Coiffet, Virtual Reality Technology, John Wiley and sons,2003
4.	Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill,2007

Reference Books

1.	Geometric Modeling, Michael E. Mortenson
2.	Introduction to Solid Modeling, Martii Mantyla

Useful Links

1.	http://catiatutor.com
2.	http://nptel.ac.in/courses/106106090/

Mapping of LOs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2								2				1		
CO 2	2	2	2						1	1		1		1	
CO 3	2	2	2						1	1		1		1	
CO 4	2	2		1					2	1		1		1	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	-
Understand	-	-	4	-
Apply	-	-	5	-
Analyse	-	-	6	-
Evaluate	-	-	6	-
Create	-	-	0	-
TOTAL	-	-	25	-

Government College of Engineering, Karad

Third Year (Sem –VI) B. Tech. Mechanical Engineering

ME2611: Technical Training and Technical Presentation

Teaching Scheme			Examination Scheme	
Lectures	-		CA	50
Tutorials	01 Hr/week			
Total Credits	01			

Course Outcomes (CO)

1.	To make the students aware or familiar with the industrial work
2.	Comprehend the knowledge gained in the course work
3.	Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.

	Course Contents	Hours
	Execution scheme Industrial training of minimum two (2) weeks should be done after T. Y. **(First semester)** in winter vacation and it's assessment will be done in T.Y. (Second semester) 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 fourth semester and complete within 15 calendar days before the start of fifth 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.	
	GUIDELINES FOR INDUSTRIAL TRAINING All T.E. Mechanical students are informed that they should follow the guidelines for industrial training period. a) Minor Activity : General study about industry (Day 1to5) i) Type of industry. ii) Organisation structure, departments etc. iii) Detailed information about products/processes. iv) Machinery/ Equipment List. v) Plant Layout. vi) Study financial reports of the company (Turnover). During industrial training the students should identify a case study at the end of first 5 days and communicate the topic of the case study to the concerned guide. b) Major Activity: Topics for case study should be based on one of the following (Day 6 to15) i. Product Design and Analysis ii. Process Improvement iii. Rejection Analysis iv. Productivity Improvement v. Value Engineering vi. Material Handling vii. Industrial Engineering viii. Computer Application ix. Material Selection x. Management Principles and Techniques The student should undergo the training in small, medium or large-scale industries like manufacturing, processing, service sector etc. c) Training Report:	

The training report should be typed in Times New Roman, font size 12 for regular text, font size 14 for subheadings and font size 16 for main headings (e.g., chapter no), 1.5 spacing. There should be only two chapters namely,

1. Introduction
2. Case Study

The report should include front page, certificate by the industry, certificate by the guide, acknowledgement, contents, two chapters, conclusion and references.

d) Instructions:

- Training period should be minimum 15 days.
- During their training period the students should keep in touch with their guide.
- Each student should work on different case study.
- As far as possible the students should undergo training in different industries.
- Fill the daily report regularly by keeping "Project diary" and submit it after completion of training to the guide.

GUIDELINES FOR PRESENTATION

Follow these rules for presentation

1. Remember that you are the presenter, not PowerPoint. Use your slides to emphasize a point, keep yourself on track, and illustrate a point with a graphic or photo. Don't read the slides.
2. Don't make your audience read the slides either. Keep text to a minimum (6-8 lines per slide, no more than 30 words per slide). The bullet points should be headlines, not news articles. Write in sentence fragments using key words, and keep your font size 24 or bigger.
3. Make sure your presentation is easy on the eyes. Stay away from weird colors and busy backgrounds. Use easy-to-read fonts such as Arial and Times New Roman for the bulk of your text, and, if you have to use a funky font, use it sparingly.
4. Never include anything that makes you announce, "I don't know if everyone can read this, but…." Make sure they can read it before you begin. Print out all your slides on standard paper, and drop them to the floor. The slides are probably readable if you can read them while you're standing.
5. Leave out the sound effects and background music, unless it's related to the content being presented. If you haven't made arrangements with the conference coordinator before your presentation, your audience members might not be able to hear your sound effects anyway. The same goes for animated graphics and imbedded movie files. Your sounds and animated graphics will not be functional on the synchronized version of your webcast.
6. Sure you can make the words boomerang onto the slide, but you don't have to. Stick with simple animations if you use them at all. Remember that some of your audience may have learning disabilities such as dyslexia, and swirling words can be a tough challenge. These animations will not be functional in the webcast version.
7. Proofread, proofread, and proofread. You'd hate to discover that you misspelled your company's name during your presentation in front of 40 colleagues, with your boss in the front row.
8. Practice, practice, practice. The more times you go through the presentation, the less you'll have to rely on the slides for cues and the smoother your presentation will be. PowerPoint software allows you to make notes on each slide, and you can print out the notes versions if you need help with pronunciations or remembering what comes next.

Follow following rules to prepare power point presentation

1. Keep the Text to a Minimum
2. Use Large Font Sizes
3. Make Sure Fonts Are Readable
4. Use Colour Sparingly
5. Enhance the Data with Charts and Graphs
6. Design for Wide Screen Formats
7. Be Consistent With Style Settings
8. Use Animations Sparingly
9. Proofread Everything
10. Consider Using a Template

Tutorials:- (Any Six Tutorials in the form of presentation by each student)
1. Prepare presentation on SWOT analysis of your self
2. Prepare presentation on Simulation done / Excel sheet calculations
3. Prepare presentation on College / Club / Competition Event organising plan
4. Prepare presentation on Prepare presentation on experiment carried on Lab Setup
5. Prepare presentation on New Product Design process
6. Prepare presentation on New Product Launching process
7. Prepare presentation on your Future Career Planning
8. Prepare presentation on Industrial Visit
9. Prepare presentation on Any one research paper
10. Prepare presentation on Industrial Training

Course Objectives: - 1. To make the students aware or familiar with the industrial work and technical presentation

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, chemical or any process engineering industry?
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 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?

Reference Books

1.	Design Data Handbook for Mechanical Engineers in SI and Metric Units by K. Reddy, K. Balaveera, Mahadevan, CBS Publishers

Useful Links Videos

1.	https://www.youtube.com/watch?v=V8eLdbKXGzk
2.	https://www.youtube.com/watch?v=d4y1OO9rppA
	https://www.youtube.com/watch?v=AXYxManvI8E

Mapping of COs and POs

PO → LO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
LO 1	2	3	3	3	3	2	2	3	3	3	3	2	3	3	3
LO 2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
LO 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	4	-
Understand	-	-	4	-
Apply	-	-	5	-
Analyse	-	-	6	-
Evaluate	-	-	6	-
Create	-	-	0	-
TOTAL	-	-	25	-

Government College of Engineering, Karad

Third Year (Sem – VI) B. Tech. Mechanical Engineering

ME2612: Industrial Psychology

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

The students will be able to

1.	Analyze how perceptions of difference contribute to disparate educational opportunities and work environments.
2.	Conduct a conflict analysis
3.	Apply leadership lessons to class teams and team assignments.
4.	Communicate effectively on business topics and concepts.

	Course Contents	Hours
Unit 1	**People in Organisation** Course Overview, Nature and Meaning of Industrial Psychology, Issues and Challenges Organizations Face, Role of Industrial, Psychology, Organizational Attitude, Perception, Habit Corner: Overcome Restrictive Mental Models	**(4)**
Unit 2	**Diversity, Equity and Inclusion (DEI)** Fundamentals of Diversity, Why Bias Matters, How Bias Manifests in Structural Inequalities, Different Types of Structural Inequalities, Actions to take to become Anti-Bias, Skills for Difficult Conversations about Diversity and Bias, Challenge of Diversity, Diversity Management	**(7)**
Unit 3	**Motivating People** Motivation- Goal Setting- Elements, Theories of Motivation – Herzberg's-Motivator Hygiene (Two Factors) Theory, Alderfer's- E-R-G Model. Reward System- Financial and Non-Financial Incentives. Economic Incentive Systems: Purposes & Types- Incentives Linking Pay with Performance, Wage Incentives, Profit Sharing, Gain Sharing, and Skill-Based Pay, Designing a Motivating Job, Designing & Leading Inclusive Teams, Leading DEI Change in Your Organization.	**(8)**
Unit 4	**Conflict and Emotion: Good or Bad?** Defining Conflict • Conditions for Conflict to Arise • Positive Side of Conflict • Power vs Influence Conflict Management Approaches/Dealing with Difficult People; Conflict Management Process Steps 1 – 4: Diagnosing Conflicts, Inclusiveness, Ground Rules, Creating Safety Conflict Management Process, Steps 5 – 6: Role of Emotions in Conflict Situations, Listening and Communications Skills, Conflict Management Process Steps 7 – 10: Identifying Options, Choosing the Best Options, Reaching Agreement and Getting Closure, Establishing Accountability	**(7)**
Unit 5	**Teams and Teamwork** Defining Teams and Teamwork, Understanding the Types of Teams, Team-Based Problem Solving, Team Composition, Personality & Behavior, Models of Teamwork: Team Assessment Methods, Team Intervention Methods & Techniques. Team Leadership Styles and Techniques, Team Membership & Selection, the Role of Team Values, Identity, Affinity, and Interdependence in Team Performance.	**(7)**
Unit 6	**Cross Cultural and Global Leadership** Communication and Culture, The Deep Structure of Culture, Shaping Interpretations of Reality: Cultural Values, Culture and The Individual: Cultural Identity, Language and Culture: The Essential Partnership, Nonverbal Communication: The Messages of Action, Space, Time and Silence, Cultural Influences on Context: The Business Setting, Venturing into a New Culture: Becoming Competent	**(7)**

Text Books

1.	Nelson, Quick and Khandelwal, ORGB: An innovative approach to learning and teaching Organizational Behaviour. A South Asian Perspective, Cengage Learning, 2012
2.	The Blackwell Handbook of Principles of Organizational Behavior (Blackwell Handbooks in Management) by Edwin A. Locke, Wiley; 2nd edition, 2009
3.	**Organization Theory, Modern, Symbolic, and Postmodern Perspectives, by Mary Jo Hatch,** ***Oxford University Press,*** Fourth Edition, 2018

Reference Books

1.	Luthans, Fred, Organizational Behavior, McGraw Hill 2008
2.	Udai Pareek, Understanding Organizational Behavior, Oxford University Press
3.	Robbins, Stephen, Organizational Behavior, Prentice Hall, India

Useful Links			
1.	Organisational behaviour: Know your people | Coursera		
2.	Leading Diverse Teams & Organizations | Coursera		
3.			

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 6	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1			1					2	2	2	3	1	2	-	3
CO 2								2	3	2		2	1	-	-
CO 3								2	3	2	2		-	2	1
CO 4								2	2	3	2	1	2	1	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	2	05
Understand	5	4	2	15
Apply	5	3	2	10
Analyse	-	3	2	15
Evaluate	-	1	2	15
Create	-	-	0	00
TOTAL	15	15	10	60