Government College of Engineering, Karad

Final Year B. Tech. Mechanical

ME 2701: Mechatronics

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

Course Outcomes (CO)

At the end of course students are able to

1.	Understand key elements of Mechatronics system, Understand principles of sensors and actuators and its characteristics
2.	Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
3.	Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application. Development of PLC ladder programming and implementation of real-life system.
4.	Developing / Creating Simple Mechatronics and IoT based System using Knowledge received during course.

	Course Contents	Hours
Unit 1	**Introduction** Introduction to mechatronics, Mechatronics systems, Measurement systems, Multi discipline scenario. **Transducers / Sensors**: - Position sensors: limit switch, photoelectric switches, proximity sensors, Pneumatic limit valves and backpressure sensors, Pressure switches, resolvers, Incremental and absolute encoders, decoders and relays. Displacement sensors: Potentiometer sensors, LVDT, capacitive displacement sensors, Velocity sensors: Tacho-generator. **Actuators:** AC Motors, DC Motors**,** BLDC Motors, Stepper Motors, Voice Coil Actuators, Solenoid Actuators.	**(07)**
Unit 2	**Signal conditioning** Signal conditioning process, Bit Width, Resolution of Measurements in DAQ (Data Acquisition System), Sampling Theorem, Nyquist Criteria. ADC (Analog to Digital Convertor), DAC (Digital to Analog Convertor). Interfacing of Sensors, Actuators with Microcontrollers such as Atmel, Cortex, Arm Processors, ARDUINO, Raspberry PI. Digital and Analog Signal Processing, Time Domain and Frequency domain representation of discrete time signals and systems.	**(07)**
Unit 3	**Operational Amplifiers and Driver Circuits** Characteristics of an operational amplifier and describe how they can be used as the basis for different types of useful amplifiers such as voltage follower, inverting amplifier, noninverting amplifier, summing amplifier, differential amplifier, and comparator. Types of circuits: integrators and differentiators, active filters, current-loop signal transmission, analog switches and multiplexers, and sample and hold. Concepts of the earth ground and ground loops, magnetic and electrostatic shielding, and the importance of a single-point ground. Stepper Motor, DC Motor, AC Motor Driver Circuits and Shields, Its Interfacing with microcontrollers such as ARDUNIO, Raspberry PI.	**(06)**
Unit 4	**Programmable Logic Controllers (PLC)** Introduction, Definition, PLC system and components of PLC,input output module, PLC advantages and disadvantages. **Ladder Diagram and PLC Programming Fundamentals:** Basic components and other symbols, Fundamentals of ladderdiagram, Machine control terminology, Update – Solve ladder– Update, Physical components Vs program components, Lightcontrol example, Internal relays, Disagreement circuit,Majority circuit, Oscillator, Holding (sealed or latches) contacts, Always ON always OFF contacts, Nesting of ladders. **PLC Functions:** PLC timer functions – Introduction, Timer functions, Industrial applications, Industrial process,Timing applications, PLC control functions – PLC counters and its industrial applications, Introduction to SCADA.	**(08)**
Unit 5	**Mechatronics Systems and Its Control Implementation** Traditional Vs Mechatronic Design, Case studies of Mechatronic systems designs, like piece counting system, Pick and place manipulator, Simple assembly task involving a few parts, Part loading / unloading system, Automatic tool and pallet changers etc. Fault finding and troubleshooting, Control Design and Implementation Feedforward and Feedback Control System, Control Elements, Proportional, Integral, and Derivative and PD and PID Control. Control Implementation on DC Motor Speed, Position Control, Stepper	**(04)**

	Motor Control.	
Unit 6	**Internet of Things and Industry Internet of Things** IoT fundamentals, Arduino Simulation Environment, Sensor & Actuators with Arduino, Basic Networking with ESP8266 Wi-Fi module, IoT Protocols, Cloud Platforms for IOT, Future trends, Home automation, Industry applications, Surveillance applications, Other IoT applications. Design challenges, Development challenges, Security challenges, other challenges	**(08)**

Text Books

1.	Ramesh S. Gaonkar, "Microprocessor Architecture Applications", New Age International Publishers Ltd., 1995
2.	W. Bolton, "Mechatronics", Pearson Education, 4th Edition, 2008
3.	Mahalik, ""Mechatronics"", TATA McGraw Hill, 2006
4.	Hackworth, "Programmable Logical Controller", Pearson Education, 2008.
5.	Cuno Pfister, "Getting Started with Internet of Thigs", O Relly 2011

References

1.	K. P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)", Wiley, 2008
2.	K. K. Appukuttan, "Introduction to Mechatronics", Oxford University Press,2007
3.	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier; First edition 2006

Useful Links

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

Mapping of COs 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	3	1	2	2	2	1	0	1	0	0	1	2	1	2
CO 2	2	2	1	1	2	0	2	1	1	0	0	1	1	2	2
CO 3	2	3	2	1	2	3	2	1	1	1	1	1	2	2	2
CO 4	3	3	2	1	3	2	1	1	2	2	1	1	1	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	2	0	10
Understand	3	5	2	20
Apply	3	3	2	15
Analyze	3	2	1	10
Evaluate	2	1	2	5
Create	1	2	3	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2714: Refrigeration and Air Conditioning

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 fundamentals of refrigeration systems
2.	apply knowledge for various applications of refrigeration, air conditioning and cryogenics
3.	design refrigeration system and compute cooling load
4.	analyse various refrigeration systems for thermal performance

	Course Contents	Hours
Unit 1	**Recapitulation of Fundamentals** Various fundamental methods of refrigeration, Commercial unit, Energy Efficiency Ratios (EER), BEE star rating Reversed Carnot cycle, Limitations of Carnot cycle **Simple Vapour Compression System** Classical development of vapour compression refrigeration system, Use of phase change (evaporator and condenser), Dry versus wet compression, Throttling versus isentropic expansion, Standard VCRS, Representation on P-h, T-S diagram, Actual VCR cycle, Refrigerator and heat pump, their relationship, Reversed Brayton or Reversed Joule or Bell Coleman cycle (numerical treatment), Various Air standard refrigeration cycles used for cooling of aircraft cabins (descriptive treatment)	**(06)**
Unit 2	**Multi Pressure System** Effect of operating conditions: effect of evaporator pressure, effect of condenser pressure, effect of suction vapour superheat, effect of liquid sub cooling (numerical treatment), Multi-evaporator, Multi-compressor, Individual and multiple expansion valves, Flash gas inter-cooling, Removal of flash gas, Need for multi pressure system and cascade system, Dry- ice refrigeration system	**(06)**
Unit 3	**Non-Conventional Refrigeration System** ***Vapour Absorption Systems*** Need and comparison VCRS, Properties of refrigerant- absorbent pair, Ammonia-Water system, Water-Lithium Bromide absorption system. ***Steam Jet Refrigeration System*** Schematic component diagram, Sample calculations, Use and Limitation ***Magnetic and CO2 Refrigeration System*** Introduction, working, scope and limitations **Refrigerants** Classification & ASHRAE nomenclature of refrigerants, Desirable properties of refrigerants. Comparison among commonly used refrigerants, Effect on Ozone depletion and global warming, Alternative refrigerants. Environmental protection protocol and India's commitment	**(08)**
Unit 4	**Psychometry** Definition of air conditioning, Psychometric properties of moist air, Use of psychometric tables and charts, Processes, ADP, Sensible heat factor, Bypass factor, Air washer and its applications **Human Comfort** Thermal exchange between human body and environment, Factors affecting comfort, Effective temperature comfort chart, Ventilation requirements.	**(07)**
Unit 5	**Load Calculation and Applied Psychometrics** Design of air conditioning systems, Different heat sources, Adiabatic mixing of two air streams, Sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point, Ventilation and infiltration, Inside and outside design conditions Introduction to unitary products viz. Room/Split and packaged air conditioners, Central air conditioning systems	**(08)**
Unit 6	**Applications of Refrigeration & Air Conditioning System** Cold storage plant, Energy conservations and green buildings, Freeze drying, Pharmaceutical and hospital air conditioning, Textile and car air conditioning (plant layout, system components and design considerations)	**(06)**

	Cryogenics Definition, Methods of producing cryogenic temperature, Liquefaction of gases- N2, H2, He, Linde Cycle, Application of Cryogenics: Medical applications, Space applications, production engineering applications, Superconductivity, Magnetic levitation	

Tutorials- --Nil

Text Books

1.	C. P. Arora, "Refrigeration & Air-Conditioning", Tata McGraw Hill, 3rd edition, 2010
2.	Jordan & Pester, "Refrigeration & Air Conditioning", Prentice-Hall India, 2nd edition, 1973
3.	Manohar Prasad, "Refrigeration & Air-Conditioning", New Age Intl. Publications, 2010

Reference Books

1.	ASHRAE Handbook, Fundamentals, 2021
2.	Carrier Handbook of Air Conditioning System Design, 2021
3.	Roy J. Dossat, "Principles of Refrigeration", Wiley Eastern Limited, New Delhi,2006
4.	W. P. Jones, "Air Conditioning Engineering", Elsevier,5th Edition, 2010
5	P. N. Ananthanarayan "Basic Refrigeration and Air Conditioning", Tata McGraw Hill publishing Company Ltd., New Delhi, 3rd Edition, (2016)
6	W. P. Jones, "Air Conditioning Applications and Design", Elsevier, 2nd Edition, 1994

Useful Links

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

Mapping of COs 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	1	1	-	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	2	2	-	1	1	-	-	1	-	1	2	3	2	3
CO 3	3	2	2	-	2	-	-	-	-	-	-	2	3	2	3
CO 4	3	2	1	1	2	-	-	-	-	-	-	2	3	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	-	10
Understand	5	5	3	20
Apply	5	3	2	15
Analyse	0	2	5	10
Evaluate	0	1	-	5
Create	0	0	0	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2724: Maintenance Engineering & Condition Monitoring

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.	explain maintenance planning and condition monitoring techniques.
2.	illustrate maintenance policies.
3.	analyse faults of basic machine element like bearings, gears etc.
4.	apply condition monitoring technique for machinery.

	Course Contents	Hours
Unit 1	**Principles and Practices of Maintenance Planning** Introduction: Maintenance, Need of Maintenance Management, Types of maintenance; Preventive and corrective Maintenance; Condition Based Maintenance and Condition Monitoring; Cost effectiveness. Basic Principles of maintenance planning, Objectives and principles of planned maintenance activity, Importance and benefits of sound Maintenance systems, Reliability and machine availability.	**(07)**
Unit 2	**Maintenance Policies** Maintenance categories –Comparative merits of each category, maintenance schedules, repair cycle, Maintenance Organisations: factors determining effectiveness of a Maintenance organization, objectives of organization design, types of organization; Maintenance Planning and Control: Establishing a Maintenance Plan-Preliminary considerations, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs.	**(07)**
Unit 3	**Repair Methods For Basic Machine Elements** Repair methods for general machine tool parts: spindles, gears, lead screws and bearings –Failure analysis, Failures and their development, Logical fault location methods, Sequential fault location.	**(07)**
Unit 4	**Different condition monitoring Techniques** Introduction to various condition monitoring Techniques: vibration monitoring, Temperature monitoring, Motor Current Signature Analysis, NDT, Ultrasonics, Eddy Current, Wear Fluid condition and particle monitoring: Debris and Oil Analysis,	**(06)**
Unit 5	**Wear debris analysis** SOAP, Ferrography and other spectrometric analysis techniques for wear rate evaluation and interpretation. Case study on wear debris analysis.	**(06)**
Unit 6	**Vibration monitoring methods** Vibration data collection; Techniques; Instruments; Transducers; Commonly witnessed machinery faults diagnosed by vibration analysis. Noise Monitoring	**(07)**

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

Text Books

1.	Venkataraman K., "Maintenance Engineering and Management", PHI Learning, Pvt. Ltd.,2007.
2.	R. Collacott , "Mechanical Fault Diagnosis and condition monitoring", John Wiley & Sons, 1977
3.	S.K Srivastava, "Industrial Maintenance Management", - S. Chand and Co., 2010

Reference Books

1.	Doc Palmer,"Maintenance Planning and Scheduling Handbook", TATA McGraw Hill, 4th edition, 2019
2.	Amiya Ranjan Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press, 2020
3.	Davis, Neil, "Handbook of Condition Monitoring", Springer, 1998
4.	Trevor M. Hunt, Brian J. Roylance, "The Wear Debris Analysis Handbook",Coxmoor Publishing Co., 1999

5.	A. Kelly, Maintenance Planning and Control, Butterworth-Heinemann Ltd, 1983

Useful Links	
1.	https://nptel.ac.in/courses/112/105/112105048/
2.	https://www.udemy.com/course/reliability-and-maintenance-engineering-fmea/
3.	https://www.digimat.in/nptel/courses/video/112107241/L11.html

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	3	1	-	-	-	1	1	-	-	-	-	3	2	2	3
CO 2	3	1	-	-	-	1	-	-	-	-	-	3	3	2	3
CO 3	3	2	2	2	1	-	-	-	-	-	-	2	3	2	3
CO 4	3	2	1	2	1	-	-	-	-	-	-	2	3	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	2	10
Understand	5	5	3	20
Apply	5	4	4	15
Analyse	0	2	1	10
Evaluate	0	0	0	5
Create	0	0	0	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

Second Year (Sem – IV) B. Tech. Mechanical Engineering

ME2734: Industrial Fluid Power

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 the basic laws, principle, operation and applications of fluid power systems
2.	Select the proper hydraulic or pneumatic component for a specific fluid power application.
3.	Interpret any hydraulic and pneumatic application circuits with practice of symbols and ISO/JIC standards.
4.	Develop and design basic fluid power and control circuit related to industrial applications.

	Course Contents	Hours
Unit 1	**Introduction to Fluid Power:** Classification, general features applications in various fields of engineering, ISO/JIC Symbols, Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, Energy and Power in Hydraulic Systems, Basic requirement of pneumatic system, comparison between hydraulic and pneumatic system	**(05)**
Unit 2	**Hydraulic System Elements:** a) Pumps-types-Gear, lobe, screw, vane, piston, selection of pumps, theoretical flow rate, pump performance – efficiencies b) Hydraulic Cylinders- Types, single acting, double acting, telescopic and tandem, cylinder force, velocity and power, acceleration and deceleration of cylinder loads, load calculations for vertical, horizontal and inclined cylinders, first, second and third –class lever systems c) Hydraulic Motors-Types, gear, vane and piston, semi-rotary actuators, analysis of a semi-rotary single-vane motor, performance of hydraulic motors- efficiencies	**(08)**
Unit 3	**Fluid Power Control Valves :** **Hydraulic Systems** Direction control valves – Types, check valves, two way, three way, four way, shuttle valves, methods of actuation Pressure control valves – Types, pressure relief, pressure reducing, unloading, counterbalance, pressure - sequence flow control valves – types, needle, non-pressure compensated, pressure compensated b) Principle of pressure control valves, directly operated and pilot operated pressure **Pneumatic Systems** Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve, Solenoid operated, pilot operated valves	**(07)**
Unit 4	**Fluid Power Systems Accessories:** **Hydraulic Systems** Seals- Classification, reservoirs-types and sizing, Accumulators- types, selection,	**(06)**

	sizing accumulators, applications, fluid conditioners, filters and strainers, heat exchangers, hydraulic lines-sizing, burst and working pressure. **Pneumatic Systems** Compressors- Types, piston, screw and vane, air capacity rating of compressors, power required to drive compressors, sizing of air receivers, Fluid conditioners- air filters, air pressure regulators, air lubricators, FRL unit, air dryers	
Unit 5	**Basic Fluid Power Circuits :** **Hydraulic Systems** 1. Control of a single acting hydraulic cylinder 2.Control of a double acting hydraulic cylinder 3.Regenerative cylinder circuit 4. Pump-unloading circuit 5.Double-pump hydraulic system 6.Counterbalance application 7.Hydraulic cylinder sequencing circuits 8.Speed control of hydraulic cylinder/motor **Pneumatic Systems:** 1.Manual control of single acting and double acting cylinder 2.Unidirectional and bi-directional speed control single acting cylinder 3.OR control of single acting cylinder 4.AND control of single acting cylinder 5.NOT control of single acting cylinder 6.Bidirectional speed control of a double-acting cylinder	**(07)**
Unit 6	**Hydraulic Circuit Design and Analysis :** Design of hydraulic system for industrial applications includes following 1.Load, Pressure and flow calculations 2.Sizing and selection of components 3.Design constraints considerations 4.Circuit preparation 5. Energy losses in systems	**(07)**

Text Books

1.	"Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005
2.	"Pneumatic Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005
3.	"Fluid Power with Applications", Anthony Esposito, Prentice-Hall India Publication, 6th Edition,2008
4.	"Pneumatic Controls", Joji P., Wiley India , 1st Edition, 2009
5.	"Fluid Power", Jagadeesha T., Wiley Publications, 1st Edition, 2013

Reference Books

1.	"Hydraulic and Pneumatic", H. L. Stewart, Industrial Press
2.	"Industrial Hydraulic", J. J. Pipenger, Tata McGraw Hill
3.	"Introduction to Hydraulic and Pneumatics", S. Ilango and V.Soundararajan, Prentice Hall of India, 2nd Edition
4.	"Hydraulics and Pneumatics Workshops User's Guide", Automation Studio 5.7, Latest Edition, 2013

Useful Links	
1.	https://www.fluidpowerworld.com/
2.	http://www.nfpa.com/
3.	http://www.ifps.org/docs/certification/.../fluid_power
4.	http://www.ifps.org/
5.	https://www.jstage.jst.go.jp/browse/jfpsij

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

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	1			2				3	2			1
CO 2	2	2	2	1			2	1	2	2	3	3	1	1	
CO 3	3	3	3	3			2	2	2	2	3	2	2	3	
CO 4	3	3	3	3	2		2	2	3	2	3	3	3	3	

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	3	5	1	14
Understand	3	5	2	16
Apply	4	2	3	08
Analyse	3	2	2	10
Evaluate	2	2	1	12
Create	0	0	1	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

B Tech (Sem – VII) B. Tech. Mechanical Engineering

ME2713: Total Quality Management

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.	Acquainting learners with the evolution, scope and basics of TQM
2.	To integration of applications of TQM principles and ISO 9000 systems
3.	Demonstrate concepts of implementation of Quality programs with confidence and knowledge.
4.	Apply TQM tools and techniques

	Course Contents	**Hours**
Unit 1	**Introduction to Quality:** Definition of Quality, need for quality, evolution of quality, product quality and service quality; Quality statements, House of Quality, Costs to quality, Quality control tools, review of measuring instruments and testing equipments	06
Unit 2	**TQM principles :** Leadership, Employee involvement, motivation, Empowerment, Team and Teamwork, Factual approach of decision making, recognition and reward, performance appraisal, Continuous process improvement, PDCE cycle, 5S, Kaizen, Supplier partnership, Partnering, Supplier rating & selection, System approach of management	06
Unit 3	**Essentials of TQM:** **Customer Focus-** Customer perception of quality, Quality policy deployment, Quality function deployment, Voice of customer, Customer satisfaction, Kano's model of satisfaction, Customer retention. **Leadership And Strategic Planning** – Leadership theory and practices, Creating the leadership system, Strategic Planning, leadership strategy and organization structure, leadership for Quality, The Seven Management and Planning tools	07
Unit 4	**TQM tools and techniques:** 5-S campaign, quality circles, poka-yoke, KAIZEN Control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.	06
Unit 5	**TQM in service sector:** **Definition** and meaning and service, problems in defining service quality, attributes of service quality, SERVQUAL model, Implementing TQM in service industries, Measurement system for service quality. **Benchmarking** -Define, benchmarking, Reasons to benchmark Process, Deciding what to Benchmark, Pitfalls and criticism of Benchmarking	07
Unit 6	**Quality Management Systems:** Main objective, Member body, Parties of ISO certificate, ISO series, **ISO 9001:2008 Series Standards** – Clauses, contents, interpretation and implementation, audit Sector Specific Standards – AS 9100, ISO/ TS 16949, TL9000. **ISO 14000:2015 Series Standard** – Environment Management system, **OHSAS 18000 Series Standard (Occupational Health and safety assessment series)**	07

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

Text Books	
1.	Patrick D. T. O'connor and Andre Kleyner , Practical Reliability Engineering-, Wiley India, A John Wiley & Sons, Ltd., Publication, 5th Edition 2012
2.	B. Janakiraman, R. K. Gopal, Total Quality Management: Text And Cases- Prentice Hall India Publication, 3th Edition 2008
3.	Dr. Gunmala Suri, Dr. Puja Chhabra Sharma, Total Quality Management- Wiley Publication, (ISBN 978-93-5004-317-2) 1st Edition 2013
5.	M. Sivakumar and S. Rajaram , Total Quality Management –Wiley Publication, (ISBN 978-81-7722-63-2) 1st Edition 2008
Reference Books	
1.	Dale H. Besterfield, Total Quality Management-, Published by Pearson Education, Inc. (ISBN 9788131764961), 3th Edition 2012
2.	Dr. Poornima Charantimath, Total Quality Management –Pearson Education, Asia (ISBN 978-81-317-3262-5), 2nd Edition 2011
3.	Amitava Mitra, Fundamentals of Quality Control and Improvement –Pearson Education, Asia 3rd Edition 2016
4.	Dr. R. P. Mohanti, R. R. Lakhe, Handbook of Total Quality Management- Jaico Publishing House, (ISBN 81-7224-833-44), 3nd Edition 2015
Useful Links	
1.	www.ncqm.com
2.	https://asq.org.in
3.	https://www.juran.com/
4.	https://deming.org/

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	3	1	1	-	-	-	-	-	-	-	-	2	2	2	2
CO 2	3	2	2	1	1	1	-	-	1	-	-	2	3	2	3
CO 3	3	2	2	-	1	-	-	-	-	-	-	2	2	2	3
CO 4	3	2	1	1	3	-	-	-	1	-	-	2	3	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	2	10
Understand	5	5	3	20
Apply	5	3	4	15
Analyse	0	2	1	10
Evaluate	0	1	0	5
Create	0	0	0	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

B Tech (Sem – VII) B. Tech. Mechanical Engineering

ME2723: Industrial 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.	Demonstrate the concept of industrial engineering like Forecasting, Break Even Analysis and Inventory control
2.	Acquainting learners with tools and techniques of industrial engineering.
3.	Understand motion study and work measurement techniques
4.	To integration of applications of industrial engineering in Job Evaluation and Merit Rating

	Course Contents	Hours
Unit 1	**Introduction to Industrial Engineering** Definition, Scope, Responsibilities, Important contributors to I.E., Tools and techniques of Industrial engineering, Plants Layout.	04
Unit 2	**Production Planning** **A) Forecasting:** Qualitative and quantitative forecasting, Forecasting error analysis, MRP, Aggregate production planning. **B) Break Even Analysis:** BEP, make or buy decision	07
Unit 3	**Inventory control and control charts** Deterministic and probabilistic model, safety stock inventory control systems, Inventory with Classification like ABC,VED, etc. and control charts	07
Unit 4	**Work Study: Motion study** Principles of motion economy, Micro motion study, SIMO chart, MEMO motion study, Cycle graph **Ergonomics:** Introduction, Definition, Man machine system, Physiological work measurement, Design of controls	07
Unit 5	**Work Measurement (Time Study)** Definition, Objectives, Procedure, Time study equipment, Performance rating, Allowances, Concept of normal time and standard time, Calculation of standard time, Work sampling, Predetermined motion time analysis	07
Unit 6	**Value Analysis and Job Evaluation and Merit Rating** **Value Analysis:** Definition, Concept of approaches of value analysis and engineering, steps, Evaluation, and applications of value analysis. **Job Evaluation and Merit Rating:** Definition, Objectives, Procedure of job evaluation, Different schemes and their advantages and disadvantages .	08

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

Text Books

1.	O.P. Khanna, Industrial Engineering and Management- Dhanpat Rai Publisher, 17th Edition 2017
2.	Martand Telsang, Industrial Engineering and Production Management, S. Chand Publisher, 3rd Edition 2018
3.	S. B. Patil, Industrial Engineering and Management, Technical Publications, (ISBN 10: 8184314973) 1st Edition 2008

4.	M. I. Khan, Industrial Engineering, New Age International Publisher ,1st Edition 2004
Reference Books	
1.	Geneva Indian Adaptation International Labour Office, 'Work study' *Publisher* : *Oxford* & *IBH Publishing* Co Pvt.Ltd; 3rd E*dition 2015*
2.	Gavriel Salvendy, Handbook of Industrial Engineering: Technology & Operations Management, John Wiley & Sons; 3rd Edition 2007
3.	Isabel L. Nunes, Ergonomics- a System Approach, Publisher :Intechopen, 1st Edition 2012
4.	Kjell B. Zandin, Harold B. Maynard, Industrial Engineering Handbook, Publisher :McGraw Hill, 5th Edition 2012
Useful Links	
1.	https://www.isixsigma.com/topic/most-maynard-operation-sequence-technique/
2.	https://www.nitie.edu/
3.	iiie-india.com/

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	3	1	1	-	-	-	-	-	-	-	-	2	2	2	2
CO 2	3	2	2	-	1	1	-	-	1	-	-	2	2	2	3
CO 3	3	2	2	-	2	-	-	-	-	-	-	1	3	2	3
CO 4	3	2	1	1	2	-	-	-	1	-	-	2	2	2	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	5	4	2	10
Understand	5	5	3	20
Apply	5	3	4	15
Analyse	0	2	1	10
Evaluate	0	1	0	5
Create	0	0	0	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VIII) B. Tech. Mechanical Engineering

Elective – IV - ME 2733 : Advanced Casting 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 students will be able to

1.	design pattern and dies & select material for patterns, special sands for casting
2.	control quality of casting
3.	work on casting simulation software
4.	apply management information systems

	Course Contents	Hours
Unit 1	Introduction: Comparison of casting technology with other metal processing technologies, merits and limitations, Comparison of casting manufacturing in India with that in other countries, specifications of composition.	(5)
Unit 2	Casting Design & Pattern / Die Making: Review of conventional method of casting and pattern design, pattern and die design considerations, Computer aided casting component design, advanced materials for pattern sand dies - selection and applications, Use of simulation software for casting methoding and metal flow simulation, rapid pattern making Resin Coated Sands & Processing: Properties of shell sand, no-bake sand systems, CO_2 sand, cold box sand, their comparison, equipment for sand processing, developments in sand mullers and sand plants, sand reclamation - cost and environmental issues.	(8)
Unit 3	Sand Molding & Core Making Practices: High pressure molding technology, flaskless molding technology, magnetic molding, Core shooters used in shell core making and cold box process, Mold and core washes / coats – types, applications, selection and significance Permanent Mold & Special Casting Techniques: Process parameters for Die casting-gravity, pressure and low pressure, Centrifugal casting, Vacuum casting, Investment casting, Squeeze casting; Advantages, limitations and applications.	(8)
Unit 4	Melting Practices: Developments in melting practices with reference to energy saving, scale of production, homogeneity of melt, handling and dispensing of molten metal, automated pouring equipment, use of robots for metal pouring, Melting technology: Melting technologies for steels, grey C.I., S.G. iron and compacted graphite iron, Al-Si alloys, Magnesium and Titanium based alloys; Inoculation, modification	(6)
Unit 5	Post processing of Castings: Fettling and shot basting techniques, salvaging of defective castings, heat treatment for ferrous and non-ferrous cast alloys, protective coating for castings Quality & Productivity: Casting defects, rejection analysis, remedial measures; instrumentation, mechanization and automation, Safety aspects in foundries, Environmental issues and regulations	(6)
Unit 6	Management Information systems for Foundries: Techniques for improvement in productivity, Total Preventive Maintenance, Costing of castings, QS standards for foundries.	(6)
Tutorials		

Text Books

1.	Principles of Metal Castings - Heine, Loper and Rosenthal (TMH), 2013
2.	Principles of Foundry Technology - P.L. Jain (TMH), 5th edition, 2012
3.	IIF - Foundry Journal, Volume 63 , 2017
4.	Advanced Pattern Making – Cox I.L. (The Technical Press, London.)
5.	ASM Handbook – Vol. 15 Castings
6.	Metal Castings – Principles & Practice - T.V. Ramanna Rao. (New Age International Pvt. Ltd. Publishers.)

Reference Books

1.	AFS and Control hand book – AFS.

2.	Mechanization of Foundry Shops – Machine Construction - P.N. Aeksenov (MIR)
3.	Fundamentals of Metal Casting Technology - P.C. Mukherjee (Oxford, IBH)
4.	Foundry Engineering – Taylor, Fleming & Wulff (John Wiley)
5.	The Foseco Foundryman's Handbook, -Foseco, CBS Publishers & Distributors
6.	The New Metallurgy of Cast Metals Castings – Campbell, CBS Publishers & Distributors
7.	Fundamentals of Metal Casting – Flinn, Addison Wesley
Useful Links	
1.	www.ifam.fraunhofer.de/.../casting *_technology/casting _technology*
2.	www.simtech.a-star.edu.sg/.../pe *_metal _initiative advanced _casting*
3.	*www.castingstechnology.com/public/documents*
4.	*me.emu.edu.tr/me364/2*

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	-	-
CO 2	2	1	1	-	1	1	-	-	1	-	1	2	-	1	2
CO 3	2	2	2	-	2	-	-	-	-	-	-	1	2	2	2
CO 4	2	1	1	1	2	-	-	-	-	-	-	1	-	2	1
CO 5	2	1	1	2	-	-	-	2	2	1	-	2	2		2

Assessment Pattern (with revised Bloom's Taxonomy)

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

Government College of Engineering, Karad

Second Year (Sem – VII) B. Tech. Mechanical Engineering

ME2704 :Noise and vibration

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

	Course Contents	Hours
Unit 1	**Introduction** Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, damper models, Motion – periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, Static equilibrium position, Vibration classification, Steps involved in vibration analysis, Simple harmonic motion, Vector and Complex, method of representing vibration, Fourier series and harmonic analysis	**(06)**
Unit 2	**Two Degree of Freedom Systems** Generalized and Principal coordinates, Derivation of equations of motion, Eigen values and Eigen vectors, Mode shapes, Lagrange's equation, Coordinate coupling, Forced harmonic vibration	**(06)**
Unit 3	**Multi Degree of Freedom Systems** Derivation of equations of motion, Influence coefficient method, Properties of vibrating systems: flexibility and stiffness matrices, normal modes and their properties, reciprocity theorem, Modal analysis: undamped and damped	**(08)**
Unit 4	**Measurement of Vibration** Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- construction, principles of operation and uses, Vibration Analyzer, Signal analysis - Analysis of Vibration Spectrum, Standards related to measurement of vibration, Machine Conditioning and Monitoring, fault diagnosis	**(07)**
Unit 5	**Control of Vibration** Introduction to control of vibration, Vibration control methods, Passive and active vibration control, Reduction of excitation at the source, Control of natural frequency, Vibration isolators, Tunned Dynamic Vibration Absorbers	**(07)**
Unit 6	**Noise** Fundamentals of noise Sound concepts, Decibel Level, White noise, Weighted sound pressure level, Logarithmic addition, Subtraction and averaging, Sound intensity, Noise measurement, Sound fields, Octave band, Sound reflection, Absorption and transmission, Pass-by-noise, Reverberation chamber, Anechoic Chamber, Noise standards	**(06)**

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

Text Books

1.	S. S. Rao, "Mechanical Vibrations", Pearson Education, 6th edition, 2011
2.	G. K. Grover, "Mechanical Vibrations", Published by Nemchand and Brothers, Roorkee, 8th edition, 2009
3.	T. Gowda, T. Jagadessha, "Mechanical Vibration" Published by Tata McGraw Hill Publication, Copyright 2012.
4.	Dr. Debabrata Nag, "Mechanical Vibration", Wiley India Pvt. Ltd, 5th edition, 2011.

Reference Books

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

Useful Links

1.	nptel.ac.in/courses/112104194/

2.	nptel.ac.in/courses/112107087/
3.	nptel.ac.in/courses/112104026/
4.	http://nptel.ac.in/courses/112103112/

Mapping of COs 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	3	3	3	3	-	-	-	1	-	2	-	-	-	1	2
CO 2	3	2	2	2	-	-	-	-	1	3	1	-	-	2	1
CO 3	3	2	2	3	1	-	-	-	1	3	2	-	-	2	1
CO 4	3	2	2	1	-	-	-	1	-	2	-	-	-	1	2

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	08
Evaluate	2	2	2	10
Create	0	0	1	00
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2705: Machine Design II

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	01		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.	explain functions and design procedure of various transmission elements
2.	apply basic design principles to choose an appropriate transmission element for given application
3.	analyse the mechanical system to ensure safety of the component.
4.	design the mechanical component.

	Course Contents	Hours
Unit 1	**Design of Clutches and Brakes.** **A. Clutches** Types, single plate and multi disk clutch , torque transmitting capacity, cone clutches, centrifugal clutches, friction materials, energy equation, thermal considerations **B. Brakes** Energy equation, types, block brake with short and long shoe, pivoted block brake with long shoe, band brakes, internal expanding brakes.	**(06)**
Unit 2	**Design calculation for selection of Bearings** **Rolling Contact Bearing** Tribological consideration, types of rolling contact bearings, static and dynamic load carrying capacities, Stribeck's equation, bearing life, selection of bearing from manufactures catalogue, design for cyclic load and speed, bearings with probability of survival other than 90%,needle bearings, bearing failure, mounting and enclosure	**(06)**
Unit 3	**Design calculation for selection of Bearings** **Sliding Contact Bearing** Basic modes of lubrication, Petroff's equation, Mckee's investigation, hydrostatic step bearing, Reynolds's equation, Raimondi and Boyd method relating bearing variables, temperature rise bearing design-selection of parameters, bearing construction and material, selection of lubricants and additives, bearing failure-causes and remedies Comparison of sliding and rolling contact bearing	**(06)**
Unit 4	**Design of Spur and Helical gears** **A. Spur Gear** Gear tooth failures, selection of materials, gear blank design, beam and wear strength of gear tooth, effective load on gear tooth, estimation of module based on beam and wear strength **B. Helical Gears** Terminology, tooth proportions, virtual number of teeth, force analysis, beam and wear strength of helical gears	**(08)**
Unit 5	**Design of Bevel and Worm gear** **A. Bevel Gear** Terminology, force analysis, beam and wear strength of bevel gears, effective load on gear tooth **B. Worm Gears** Terminology, proportions, force analysis, friction in worm gears, selection of materials, strength and wear rating of worm gears, thermal considerations, failure modes and its relation to material selection and occurrence in manufacturing	**(07)**
Unit 6	**Pressure Vessel Design** Thin and thick cylinders; Failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels- Horizontal and vertical; Classification of pressure vessel as per IS 2825, Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening and nozzles in shell and covers. Types of pressure vessel support.	**(07)**

Tutorial:

Total 10 tutorials based on the above syllabus

Text Books	
1.	V.B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publication, 4th Edition 2016
2.	J.F. Shigley, "Design of Machine Element", Tata McGraw Hill Publication,9th Edition 2011
3.	R.L. Norton, "Machine Design An Integrated Approach", Pearson Education Publication, 3rd Edition 2011
Reference Books	
1.	Robert C. Juvniall , "Machine Component Design", Willey Ltd, 5th Edition 2015
2.	M.F.Spotts, "Design of Machine Elements" , Pearson Education Publication, 8th Edition, 2006
3.	PSG Design Data Book and Bearing Catalogue
Useful Links	
1.	https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring2009/lecture-note/
2.	http://nptel.ac.in/courses/112106137/

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	-	-	-	-	-	-	-	-	-	-	2	2	-	-
CO 2	2	2	3	2	-	-	-	-	-	1	-	2	1	2	-
CO 3	3	2	3	2	-	-	-	-	-	-	-	2	1	1	-
CO 4	2	3	3	3	-	-	-	-	-	2	-	2	1	1	-

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
Create	1	1	1	08
TOTAL	15	15	10	60

Government College of Engineering, Karad				
Final Year B. Tech. Mechanical				
ME 2706: Mechatronics Lab				
Teaching Scheme			**Examination Scheme**	
Laboratory	02 Hrs/week		TA/CA	50
Total Credits	01		ESE	-

Course Outcomes (CO)

Students are able to

1.	Interface sensors, actuators to microcontrollers such as ARDUNIO, Raspberry PI, dSPACE DS1104 etc.
2.	Simulate and Experiments on Control of environment using suitable control systems
3.	Develop and create a PLC programming and implement on practical system
4.	Develop and create IoT based Data Acquisition and Control System

	Course Contents	Hours
Experiment 1	Sensor Interfacing with Microcontroller ARDUNIO: Sensors, ADXL, Ultrasonic Distance	**(2)**
Experiment 2	Sensor Interfacing with Microcontroller ARDUNIO: Sensors, Strain Gauge, Thermocouple	**(2)**
Experiment 3	Actuator Interfacing with Microcontroller ARDUNIO: DC Motor, Stepper Motor	**(2)**
Experiment 4	Actuator Interfacing with Microcontroller ARDUNIO: Solenoid Actuator, VCM, Heater	**(2)**
Experiment 5	Modeling and Simulation of Typical Mechatronics System using MATLAB Environment	**(2)**
Experiment 6	Control Implementation (P, PD and PID) on Mechatronics System using MATLAB Environment	**(2)**
Experiment 7	Interfacing of Sensors and Data Acquisition using dSPACE DS1104 Microcontroller, Interfacing of Actuators (stepper motor, DC motor) and Control Implementation using dSPACE DS1104 Microcontroller	**(2)**
Experiment 8	PLC Programming for Bottle Filling Plant and its Practical Implementation	**(2)**
Experiment 9	ARDUNIO and Raspberry PI for IoT Fundamentals and its awareness	**(2)**
Experiment 10	Development of Lab Automation using ARDUINO/Raspberry PI Environment	**(2)**
Experiment 11	Industrial visit to study Mechatronic system application and submission of visit report.	**(4)**

Group Activity: Maximum 3 to 4 students in one group

1. Development / Simulation / Control of Mechatronics System using ARDUINO/Raspberry PI/ dSPACE DS1104 Microcontroller/ MATLAB/Python Environment

Text Books	
1.	Ramesh S. Gaonkar, "Microprocessor Architecture Programming andApplications", New Age International Publishers Ltd.
2.	W. Bolton, "Mechatronics",Pearson Education , 4th Edition, 2008
3.	Mahalik, ""Mechatronics"", TATA McGraw Hill, 2006
4	"dSPACE DS1104 Microcontroller Manuals", dSPACE GmbH, Germany, 2020
References	
1.	K.P. Ramachandran, "Mechatronics: Integrated Mechanical Electronic Systems (WIND)", Wiley, 2008
2.	K. K. Appukuttan, "Introduction to Mechatronics", Oxford University Press, 2007
3.	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier; First edition 2006

Mapping of 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	3	1	2	2	2	1	0	1	1	0	2	2	2	2
CO 2	2	2	1	2	3	0	1	1	1	1	0	2	1	2	2
CO 3	2	3	2	1	2	0	2	1	1	1	1	3	2	2	2
CO 4	3	3	2	2	3	2	1	1	2	2	1	1	1	2	2

Assessment Pattern

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

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2717: Refrigeration and Air Conditioning Lab

Teaching Scheme			Examination Scheme	
Practical	02 Hrs/week		CT – 1	-
Tutorials	-		CT – 2	-
Total Credits	01		CA	50
			ESE	25
				-

Course Outcomes (CO)

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

1.	understand basics of refrigeration system
2.	apply the knowledge of refrigeration for selection of various system components and accessories
3.	evaluate performance of Refrigeration and Air Conditioning Systems
4.	analyse and solve refrigeration related problems by applying principles of mathematics, science and engineering

Course Contents

Term work shall consist of any 09 experiments from the following:

Experiment 1	Study and demonstration of hermetically sealed compressor with electrical circuit diagram.
Experiment 2	Study and demonstration of dehydration, leak testing and charging of refrigeration system.
Experiment 3	Study of refrigeration tools.
Experiment 4	Study and demonstration of controls and safety devices in refrigeration and air conditioning.
Experiment 5	Trial on pilot ice plant test rig.
Experiment 6	Study and trial on cascade refrigeration system.
Experiment 7	Trial on air conditioning test rig
Experiment 8	Industrial visit to cold storage /dairy plant to study refrigeration system.
Experiment 9	Industrial visit to air conditioning system of public house.
Experiment 10	Study and demonstration on air conditioning systems. (Unitary and central air conditioning / system)
Experiment 11	Study of heat operated/ Electrolux/ thermo- electric refrigeration.
Experiment 12	Study of throttling devices used in vapour compression refrigeration system.

Group Activity-

Minimum 3, Maximum 5 students in one group.

1. Group will undertake cooling load calculation of particular application e.g. residential space, cinema hall, cold storage, operation theatre, auditorium, Industrial installation, Airport, ATM, etc.
2. Group shall submit detailed report along with process equipment selection.

Text Books

1.	Rex Miler, Edwin P Anderson, "Audel Refrigeration Home and Commercial", Audel Technical Trades Series, John Wiley & sons, 2004
2.	James E Brumbaugh," Audel HVAC Fundamentals ", Audel Technical Trades Series, John Wiley & sons, 2004
3.	Rex miller, Mark R Miller," HVAC Licensing Study Guide", Mc-Graw Hill education, 2018
4.	Manohar Prasad, "Refrigeration & Air-Conditioning", New Age Intl. Publications, Third edition, 2010

Reference Books

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

Useful Links

1.	http://nptel.ac.in/courses/112107208/
2.	https://www.beestarlabel.com/
3.	http://www.emersonclimate.com/europe/ProductDocuments/CopelandLiterature/SGE127-Emerson-General-Product-Catalogue-2017-EN_1.pdf

4.	http://nptel.ac.in/courses/112105128/

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	3	1		-	-	-	2	-	1	3	3	2	3
CO 2	1	2	1	1		1	-	-	2	-	1	2	2	2	3
CO 3	2	2	1	1		-	-	-	1	-	-	2	2	2	3
CO 4	3	3	1	1		-	-	-	1	-	-	3	2	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	CA	ESE
Remember	-	-	3	-
Understand	-	-	5	10
Apply	-	-	10	10
Analyse	-	-	12	-
Evaluate	-	-	10	5
Create	-	-	10	-
TOTAL	-	-	50	25

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2737: Maintenance Engineering & Condition Monitoring Lab

Teaching Scheme			**Examination Scheme**	
Practicals	02 Hrs/week		CT – 1	-
Tutorials	-		CT – 2	-
Total Credits	01		CA	50
			ESE	25

Lab Outcomes (CO)

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

1.	understand maintenance policy for machinery.
2.	apply knowledge to conduct failure analysis.
3.	evaluate fault diagnosis of machine component using FFT and Noise signal analysis.
4.	apply the knowledge of condition monitoring to analyze the faults.

Course Contents

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

Experiment 1	Case study on preventive maintenance.
Experiment 2	Case study on failure analysis and prevention of lathe machinery.
Experiment 3	Case study on maintenance policy and maintenance planning.
Experiment 4	Failure analysis and repair suggestion for general machine tool parts.
Experiment 5	Study on detection of surface and sub-surface defects, their location and extend using Ultrasonic and Eddy current testing.
Experiment 6	Study of engine oil for lubricant condition, contaminants and machine wear.
Experiment 7	Condition Monitoring and Fault Diagnostics of gear box using FFT Analyzer.
Experiment 8	Condition Monitoring and Fault Diagnostics of bearing using FFT Analyzer.
Experiment 9	Conduct experiments to measure noise around utilities like generator, pumps, blowers etc., with emphasis on frequency analysis.
Experiment 10	Industrial visit- plant maintenance.
Experiment 11	Case Study- on thermal condition monitoring technique.

Text Books

1.	Venkataraman K., "Maintenance Engineering and Management", PHI Learning, Pvt. Ltd.,2007.
2.	R. Collacott , "Mechanical Fault Diagnosis and condition monitoring", John Wiley & Sons, 1977
3.	S.K Srivastava, "Industrial Maintenance Management", - S. Chand and Co., 2010

Reference Books

1.	Doc Palmer,"Maintenance Planning and Scheduling Handbook", TATA McGraw Hill, 4th edition, 2019
2.	Amiya Ranjan Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press, 2020
3.	Davis, Neil, "Handbook of Condition Monitoring", Springer, 1998
4.	Trevor M. Hunt, Brian J. Roylance, "The Wear Debris Analysis Handbook",Coxmoor Publishing Co., 1999
5.	A. Kelly, Maintenance Planning and Control, Butterworth-Heinemann Ltd, 1983

Useful Links

1.	https://nptel.ac.in/courses/112/105/112105048/
2.	https://www.udemy.com/course/reliability-and-maintenance-engineering-fmea/
3.	https://www.digimat.in/nptel/courses/video/112107241/L11.html

PO → LO ↓	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
LO 1	3	1	1	1	1	-	-	-	2	-	-	2	3	2	3
CO 2	3	2	1	2	1	-	-	-	2	-	-	2	2	2	3
CO 3	3	2	1	3	3	-	-	-	2	-	-	2	2	2	3
CO 4	3	2	1	3	1	-	-	-	1	-	-	2	2	2	3

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	8	3
Understand	-	-	10	6
Apply	-	-	12	6
Analyse	-	-	12	6
Evaluate	-	-	8	4
Create	-	-	0	0
TOTAL	-	-	50	25

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Final Year (Sem –VII) B. Tech. Mechanical Engineering

ME 2737: Industrial Fluid Power Lab

Teaching Scheme			**Examination Scheme**	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA	50
			ESE	25

Course Outcomes (CO)

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

1.	**Interpret any hydraulic and pneumatic application circuits with practice of symbols and ISO/JIC standards**
2.	Select the suitable hydraulic or pneumatic components for a specific fluid power application
3.	Develop and design a simple hydraulic/ pneumatic circuit with known input data and specific conditions
4.	Use of Fluid Simulation software to develop the ability to build real circuits and demonstrate the understanding of the theories behind the circuitry

Course Contents

Term work should consist following 08 experiments.

Experiment 1	Demonstration of basic hydraulic and pneumatic system
Experiment 2	Demonstration of different types of control valves used in hydraulic and pneumatic system
Experiment 3	Demonstration of actuators, accumulators, intensifiers and ancillary components used in hydraulic and pneumatic systems
Experiment 4	Preparation of circuits on Hydraulic trainer kit (Minimum 2)
Experiment 5	Preparation of circuits on Pneumatic trainer kit (Minimum 2)
Experiment 6	Preparation of circuits using Fluid Simulation Software (Minimum 2).
Experiment 7	Design of hydraulic / pneumatic system with related components for any one of the industrial applications
Experiment 8	Industrial visits are recommended to study basics, working operation and circuit diagram of pneumatic and hydraulic system applications and their reports .
Experiment 9	Preparation of circuits on Electro Hydraulic trainer kit
Experiment 10	Preparation of circuits on Electro Pnumatic trainer kit

Text Books

1.	"Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005
2.	"Pneumatic Systems", S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2005
3.	"Fluid Power with Applications", Anthony Esposito, Prentice-Hall India Publication, 6th Edition,2008
4.	"Fluid Power", Jagadeesha T., Wiley Publications, 1st Edition, 2013

Reference Books

1.	"Hydraulic and Pneumatic", H. L. Stewart, Industrial Press
2.	"Introduction to Hydraulic and Pneumatics", S. Ilango and V.Soundararajan, Prentice Hall of India, 2nd Edition
3.	"Industrial Hydraulic", J. J. Pipenger, Tata McGraw Hill

Useful Links

1.	https://pc-coep.vlabs.ac.in/List%20of%20experiments.html

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	3	2	2	1					2		2		2	1	
CO 2	3	2	3	2	2				2		2		2	1	
CO 3	3	3	3	3	2				3	2	2	3	3	3	2
CO 4	3	3	3	3	3				3	3	3	2	3	3	2

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	8	2
Understand	-	-	10	5
Apply	-	-	10	5
Analyse	-	-	12	8
Evaluate	-	-	10	5
Create	-	-	0	-
TOTAL	-	-	50	25

Government College of Engineering, Karad

Second Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2709 : Noise & Vibration Lab

Teaching Scheme			Examination Scheme	
Practicals	02 Hrs/week		TA	25
Total Credits	01		ESA	25

Course Outcomes (CO)

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

1.	carryout measurement of various vibration control parameters
2.	analyze the vibration response of the mechanical system
3.	measure the sound intensity level
4.	find out resonance frequency of torsional, transverse and damped vibration

Course Contents

Term work should consist of any 09 experiments from the following.

Experiment 1	Experiment on equivalent spring mass system.
Experiment 2	Vibration control of SDOF system by dynamic vibration absorber
Experiment 3	Determination of logarithmic decrement for single DOF damped system.
Experiment 4	Experiment on torsional vibration of two rotor without damping
Experiment 5	To determine resonance frequency of transverse vibration of beam.
Experiment 6	Experiment on free vibration of a coupled pensdulum and/or double pendulum
Experiment 7	Use of different types of exciters for vibration analysis
Experiment 8	Measurement of vibration parameters using vibration measuring instruments
Experiment 9	Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.
Experiment 10	Case study in detail based on Conditioning Monitoring and Fault Diagnosis
Experiment 11	Measurement of Noise by using noise measuring instruments
Experiment 12	Vibration analysis of mechanical system using MATLAB

Group Activity-

Maximum 3 to 4 students in one group

Carry out experimental analysis on a steeped bar and compare its results with FEAanalysis.

Text Books

1.	Singiresu S.Rao, "Mechanical Vibrations", Pearson Education, 6th Edition in SI units, 2018.
2.	G. K. Grover, "Mechanical Vibrations", Published by Nemchand and Brothers, Roorkee, 2nd Edition, 2017.
3.	Willam T Thomson, "Mechanical Vibration", Published by Pearson Education, 5th Edition, 2008
4.	T. Gowda, T. Jagadessha, "Mechanical Vibration" Tata McGraw Hill Publication, Copyright 2012.

Reference Books

1.	Austin Church, "Mechanical Vibration", Wiely Eastern, 2nd edition,2011.
2.	J.P. Den Hartog, "Mechanical Vibrations", Tata Mc-Graw Hill Book Company Inc., 3rd edition, 2008.
3.	Leonard Meirovitch, "Elements of Vibration Analysis" Tata Mc-Graw-Hill, New York, 2nd edition1986
4.	Kewal Pujara, "Vibrations and Noise for Engineers", Dhanpat Rai and Sons, 4th edition, 2007

Useful Links

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

Mapping of COs 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	1	1	-	-	-	2	-	1	1	3	2	3
CO 2	3	3	1	1	-	1	-	-	2	-	1	2	2	2	3
CO 3	3	2	1	1	-	-	-	-	1	-	-	2	2	2	3
CO 4	2	2	1	1	-	-	-	-	1	-	-	1	2	2	3

Assessment Pattern(with revised Bloom's Taxonomy)

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

Government College of Engineering, Karad

Final Year (Sem – VII) B. Tech. Mechanical Engineering

ME 2711: Seminar

Teaching Scheme			**Examination Scheme**	
Practical	02 Hrs/week		TA	50
			ESE	25
Total Credits	01			

Course Outcomes (CO)

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

1.	Comprehend new topic related to engineering and management ; get an overview of the current trends.
2.	Develop communication skills, intellectual and professional competence.
3.	Improve the presentation and report writing skills
4.	Demonstrate and present the techniques for conducting a minor research based on the literature review

	Course Contents	**Hours**
	Any topic of mechanical engineering application may be a seminar topic. The seminar may be based on latest technology, innovations in engineering and management field etc. Students can create, select, learn & apply appropriate techniques, resources, and modern engineering tools.	
	Seminar Report Content & Format: Seminar report should be of 20 to 35 pages. Which may contains, • Abstract • Literature review • Research gap • Methodology • Design & development • Results and discussions • Expected outcome • References **For standardization of the report the following format should be strictly followed.** 1. Page Size: Trimmed A4 2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.32 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Point. Font 7. Line Spacing: 1.5 Lines 8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman 9. Headings: Times New Roman, 14 Point, Bold Face Expected Content for Report , 1. Introduction 2. Literature Survey/ Theory 3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation. 4. Observation Results 5. Discussion on Result and Conclusion 6. References: References should have the following format For Books: "Title of Book", Authors, Publisher, Edition For Papers: " Authors, Title of Paper, Journal/Conference Details, Year of publication, volume, page, number, etc.	
	Assessment Pattern:- The continuous assessment shall be done by the supervisor based on attributes like critical thinking, creativity, collaborative efforts and communication skills. All students have to present their seminars individually before the committee constituted by the department. The end semester assessment shall be done by external examiner.	

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	2	1	1	1	3	2	2	2	2	3
CO 2	3	2	2	1	2	2	-	-	2	3	2	2	2	-	1
CO 3	1	1	2	-	2	-	-	1	-	1	2	2	-	1	1
CO 4	3	3	2	1	2	2	1	2	3	3	2	3	2	3	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	2	2
Understand	-	-	13	8
Apply	-	-	13	5
Analyse	-	-	10	5
Evaluate	-	-	12	5
Create	-	-	-	-
TOTAL	-	-	50	25

Government College of Engineering, Karad

Final Year (Sem –VII) B. Tech. Mechanical Engineering

ME2712: Industrial Training and Technical Presentation

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

Course Outcomes (CO)

After completion of this course students should able to:

1.	Familiar with the industrial work environment.
2.	Comprehend the knowledge gained in the course work
3.	Create, select, learn and apply appropriate techniques, resources, and modern engineering tools.
4.	Pursue higher studies and succeed in academic and research career

	Course Contents	**Hours**
	Execution scheme Industrial training of minimum (4-8) weeks should be done after final year (First semester) in winter vacation and it's assessment will be done in final year (Second semester) based on report submitted.	
	Industrial Training. The students have to undergo an industrial training of minimum 4-8 weeks in an industry preferably dealing with Mechanical Engineering during the semester break after fifth semester and complete within 4-8 weeks before the start of sixth 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 *etc*.	
	# 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 (Other days) i. Product Design and Analysis ii. Process Improvement iii. Rejection Analysis iv. Productivity Improvement v. Value Engineering vi. Case study related to service industry 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

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 2017**

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 → 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	3	1	1	-	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	2	2	-	1	1	-	-	1	-	1	2	3	2	3
CO 3	3	2	2	-	2	-	-	-	-	-	-	2	3	2	3
CO 4	3	2	1	1	2	-	1	1	1	1	1	2	3	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	TA	ESE
Remember	10	10
Understand	10	10
Apply	05	05
Analyse	15	15
Evaluate	10	10
Create	0	0
TOTAL	50	50

Government College of Engineering, Karad

Second Year (Sem – VIII) B. Tech. Mechanical Engineering

ME2801: Finite Element Analysis

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 FEA and its procedure and able to solve 1D and 2D problems
2.	Formulate 1D and 2D elemental stiffness matrix and solve it using suitable solvers
3.	Model and simulate 1D and 2D Structural, Heat Transfer and Dynamic Problems
4.	Simulate and analyze 1D, 2D and 3D practical Problems using commercially available tools

	Course Contents	**Hours**
Unit 1	**Introduction to Finite Element Analysis** Introduction Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis, Stress tensor, Stress and equilibrium, Strain – displacement relations, Stress – strain relations, Plane stress, Plane strain and axisymmetric conditions, Element stiffness matrix by direct stiffness method, Assembly of the global stiffness matrix (K) and load vector, Properties of K, Band width, Imposing boundary conditions; Calculations for displacements, strains and stresses. **Analysis of Bar, Composite Bar, Trusses** Stepped Bar, Composite Stepped Bar, Plane trusses, Local and Global coordinate systems, Formulas for calculating *l* and *m*, element stiffness matrix, Stress Calculations, Assembly of global stiffness matrix	**(07)**
Unit 2	**Finite Element Formulation: 1D Element** Virtual Work and Variational Principle, Functional, extremization of functional, Obtaining the variation from a differential equation, Principle of minimum potential energy, Rayleigh-Ritz method **Weighted residual methods** Galerkin Method, least square method, Collocation method and sub domain method Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions, Numerical Integration: One Dimensional	**(07)**
Unit 3	**2D and 3D FEA Analysis** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements Worked out Examples	**(07)**
Unit 4	**Isoparametric Formulation:** Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – **Heat Transfer:** Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid, 1D finite element formulation using vibrational method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.	**(07)**
Unit 5	**Dynamic Analysis** Formulation for point mass and distributed masses, Consistent element mass matrix of one-dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.	**(07)**
Unit 6	**Computer Implementation of the Finite Element Method: Pre-processing** Introduction to commercial software (most preferred in Industry), Preprocessing (Modeling, Application of Boundary Conditions, Assigning Material Properties, Materials Library, Meshing and its methods, Convergence requirements), Solution (Solvers: Direct, Iterative, RK based, Explicit, and Implicit) and Post Processing Modules (field variable, processing of required data). Commercial Software Awareness through Static Structural, Modal, Harmonic, Transient Dynamic, Thermal, Fatigue Analysis.	**(05)**

	Advances in FEA tools: multi-body dynamic simulation, crash analysis, optimization etc.	
Text Books		
1.	S. S. Rao, "Finite Element Method in Engineering", Elsevier Publication, 4th Edition, 2004	
2.	P. Seshu, "Textbook of Finite Element Analysis", 1st Edition, 2001	
3.	Chandr Apatala, Belgundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India, 3rd Edition, 1992	
4.	M. J Fagan, "Finite Element Analysis- Theory and Practice"; Longman Scientific & Technical, 1st Edition, 1992	
Reference Books		
1.	J. N. Reddy, "An Introduction to Finite Element Method", Tata McGraw Hill publication co. 2nd Edition, 1993	
2.	Logan D. L. "A first course in Finite Element Method", Cengage learning, 4th Edition, 2008	
3.	S. S. Deshpande, S. V. Bedekar, A. N. Thite, "Practical Finite Element Analysis", N. S. Gokhale, Finite to Infinite Publication	
Useful Links		
1.	http://nptel.ac.in/courses/112104193/	
2.	http://feaforall.com/	
3.	http://www.open.edu/openlearn/science-maths-technology/introduction-finite-element-analysis/content-section-1.5	
4.	http://www.ansys.com/	

Mapping of COs and POs

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CO 1	3	3	2	1	3	2	0	0	1	2	0	2	2	3	2
CO 2	2	2	2	1	3	0	0	0	1	2	0	2	2	2	2
CO 3	2	3	2	1	3	3	0	0	1	2	1	2	2	2	2
CO 4	3	3	2	1	3	2	1	0	2	2	1	2	2	3	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	14
Apply	3	3	2	10
Analyse	4	4	3	14
Evaluate	2	2	2	12
Create	0	0	0	00
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem –VIII) B. Tech. Mechanical Engineering

ME2814: MEMS and NEMS

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

Course Outcomes (CO)

Students will be able to

1.	Understand concept of micro-nano systems.
2.	Understand different processes of micro-nano systems manufacturing.
3.	Understand the working principles of various microsensors and micro actuators.
4.	Design a micro system and develop a process sequence for its manufacturing.

	Course Contents	Hours
Unit 1	**Overview and Introduction** New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.	**(06)**
Unit 2	**MEMS Fabrication: Bulk Lithography** Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching.	**(06)**
Unit 3	**MEMS Fabrication: Surface Micromachining** Surface micromachining: Working Principle of Surface Micromachining, Surface micromachining materials, Surface micromachining layers, Fabrication process of surface micromachining, advantages and disadvantages, applications. Case study: Surface Micromachined accelerometer, Nano electro mechanical relays.	**(08)**
Unit 4	**MEMS Fabrication: LIGA and Micro-Nano Stereolithography** High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems's packaging, Essential packaging technologies, Selection of packaging materials. Micro-Nano Stereolithography: need of micro stereolithography and limitations of conventional processes, System components of micro stereolithography, Methods of Micro stereolithography, Need of nano stereolithography, Recent trends in nano stereolithography.	**(08)**
Unit 5	**Micro Sensors & Micro Actuators** MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators	**(08)**
Unit 6	**Design Aspects of Micro-Nano Systems** Applications of MEMS in Cantilever sensors, Emulsion equipment, Humidity sensor, Liquid lenses, Micro spectrometer.	**(04)**

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

Text Books

1.	"MEMS", Nitaigour Premchand Mahalik, TMH Publishing corporation,1st Edition,2014
2.	"Springer Handbook of Nanotechnology", Bharat Bhushan, Springer, Berlin, Heidelberg, 2nd Edition,2006.

Reference Books

1.	"Fundamentals of Micro fabrication", Marc Madou, CRC press 1997.
2.	"Micro system Design", Stephen D. Senturia, Kluwer Academic Publishers,2001.
3.	"MEMS and Microsystems Design and Manufacture", Tai Ran Hsu, Tata McGraw Hill, 2002.

4.	"Foundations of MEMS", Chang Liu, Pearson education India limited, 2006.
5.	"MEMS and NEMS: Systems, Devices, and Structures", Sergey Edward Lyshevski , CRC Press, 2002.
Useful Links	
1.	https://www.me.iitb.ac.in/~gandhi/me645/05L13_muSL.pdf
2.	http://www.nanolab.t.u-tokyo.ac.jp/pdffiles/060815ASPE-kajiwara.pdf
3.	https://www.slideshare.net/navinec1/micro-electromechanical-system-mems

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	3	1	2	3	2	1	0	0	0	0	2	2	1	3
CO 2	3	2	1	1	3	0	2	0	0	0	0	2	1	2	3
CO 3	3	3	2	1	3	3	2	0	0	0	1	1	2	2	3
CO 4	3	3	2	1	3	2	1	0	0	0	1	1	1	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	2	2		8
Understand	3	3	2	12
Apply	3	3	2	12
Analyze	3	3	2	12
Evaluate	2	2	2	8
Create	2	2	2	8
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VIII) B. Tech. Mechanical Engineering

(Elective V) ---- ME2824: Tribology

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 importance, scope, lubricant properties, modes of lubrication in Tribology
2.	Understand different theories and types of friction and wear, and wear mechanisms in tribo-pairs
3.	Apply knowledge of friction, wear, and lubrication for selection of proper tribo-pair material in machine design
4.	Analyse & evaluate causes of friction & wear in tribological systems.

	Course Contents	**Hours**
Unit 1	**Introduction:** Definition, history, Objective, and importance of Tribology. Tribological contacts: conformal & non-conformal contacts, genesis of friction, coefficient of friction, Lubrication regimes or modes of Lubrications, Stribeck curve. Surface contamination. Recent trends in Tribology	**(05)**
Unit 2	**Lubrication of Tribological systems:** Difference between lubricant & lubrication, purposes of lubricants / lubrication, requirement of good lubricant, function, classification / types of lubricants, physical properties of lubricants *viz*: oil viscocity (dynamic & kinematic), Newton's law, units, viscosity temperature relationship, viscosity index, viscosity pressure relationship, measurement *etc*. Some Thermal properties of lubricant *viz:* specific heat; Pour point, Cloud point and Flock point; Flash point and Fire point; Volatility and Evaporation; oxidation stability, thermal stability, Demulsibility. Flow of viscous liquid through a rectangular slots Semi-solid lubricants, solid lubricants & dry lubricants.	**(07)**
Unit 3	**Friction:** Introduction, types of friction, Laws dry of friction, friction sources, theories of friction *viz* Coulombs Friction theory of interlocking, Tomlinson's theory, Bowden – Tabors theory of simple Adhesion, Abrasive theory of friction (Deformation theory) for conical & spherical shape asperities, Modified Adhesion (Junction Growth) theory, Stick-slip friction / motion, Friction measurement methods. Friction properties of metallic & non-metallic materials. Friction in extreme condition.	**(07)**
Unit 4	**Wear:** Definition, types of wear mechanisms, Adhesive (Scuffing, Scoring, and Galling Wear, seizure) Abrasive (Polishing, Scoring, Scratching, Cutting, Grinding, Gouging Wear), Corrosive / Chemical, Erosion, Surface fatigue, fretting, *etc*. Simple theory of sliding wear: Archard's equation for Adhesive wear, Theory of Abrasive wear (Rabinowicz law), two body Abrasion, three body abrasion, wear rate, factors affecting wear rate, wear prevention. Measurement of wear.	**(08)**
Unit 5	**Hydrodynamic Lubrication:** Petrof's equation, Towers experiment, Reynolds's equation and its limitations, infinitely long and infinitely short (narrow) journal bearings, comparison of long & short journal bearing, pressure distribution, load carrying capacity. Finite length hydrodynamic journal bearing. Design consideration, Somerfield number, Raimondi & Boyd method, numericals.	**(09)**
Unit 6	**Bearing materials:**	**(04)**

	Tribological properties of bearing materials, classification. Metal bearing materials, *viz* White Metal: Tin- and Lead-Based Alloys (Babbitts), Copper - Lead Alloys, Bronze, Aluminum Alloys, Silver, Cast Iron, Porous Metal Bearings. Nonmetallic materials *viz* Plastics, Ceramics, Carbon Graphite, Rubber, Other diverse materials, such as wood and glass.	

Text Books

1.	Gwidon Stachowiak, A W Batchelor, "Engineering Tribology", Butterworth-Heinemann Publication, 4th ed, 2014
2.	Marika Torbacke, "Lubricants: Introduction to Properties & Performances", John Wiley & sons, 1st ed, 2014
3.	John Williams, "Engineering Tribology", Cambridge University Press, 4th ed, 2008
4.	Harish Hirani, "Fundamentals of Engineering Tribology with Applications", Cambridge University Press, 2017
5.	Kenneth C Ludema, "Friction Wear Lubrication: A Textbook in Tribology", CRC-Press, 1996
6.	D.D. Fuller, "Theory and Practice of Lubrication for Engineers", John Wiley and Sons, 1984

Reference Books

1.	Bharat Bhushan, "Principles and Applications of Tribology", John Wiley, 2nd ed, 2013
2.	Ian Hutchings and Philip Shipway, "Tribology: Friction and Wear of Engineering Materials", Butterworth-Heinemann, 2017
3.	Kenneth G. Budinski, "Friction, Wear, and Erosion Atlas", CRC Press (2013)
4.	Bernard J. Hamrock, Steven R. Schmid, "Fundamentals of Fluid Film Lubrication", Marcel Dekker Inc, USA, 2nd ed (2004)

Useful Links

1.	https://nptel.ac.in/courses/112/102/112102014/
2.	https://www.youtube.com/watch?v=aoWBUhlN3-0&list=PLbMVogVj5nJRCfyN1QEiBsNFek8d00kWw
3.	https://www.youtube.com/watch?v=7XBeRGmpLrE&t=17s
4.	https://ocw.mit.edu/courses/mechanical-engineering/2-800-tribology-fall-2004/index.htm#

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	3	1	1	-	-	-	-	-	-	-	-	2	2	-	2
CO 2	3	2	2	-	1	-	-	-	-	-	-	2	2	-	2
CO 3	3	1	2	1	1	-	-	-	-	-	-	2	2	-	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	2	2	-	2

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	7	2	2	12
Understand	8	6	3	18
Apply	-	7	3	12
Analyse	-	-	2	12
Evaluate	-	-	-	6
Create	-	-	-	-
TOTAL	15	15	10	60

Government College of Engineering, Karad

Final Year (Sem – VIII) B. Tech. Mechanical Engineering

ME 2834: Automobile 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.	understand the components and layout of automobile.
2.	implement the knowledge obtained in theory towards design and analysis of various automobile systems
3.	analyse the effect of various factors on subsystems of automobile.
4.	evaluate the performance of automobile.

	Course Contents	**Hours**
Unit 1	**Introduction to Automobile System:** Automobile history and development, Current scenario in automobile industries, Classification of automobiles, Automobile subsystems, Role of the automobile industry in national growth Vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, function and materials. Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).	**(06)**
Unit 2	**Automobile transmission system** Classification of clutches, single plate, multi plate, cone, diaphragm spring, centrifugal, Clutch materials, Clutch plate, Electromagnetic clutch, Vacuum operated clutch, Necessity of gear box, Manual gear box-constant mesh, sliding mesh, synchromesh, epicyclic, fluid flywheel, torque convertor, Continuous variable transmission, Electronic transmission control, Overdrive, Propeller shaft, Universal joint, Differential and final drive, Rear axle drives - Hotchkiss drive, torque tube drive, Bearing loads due to lateral forces on the rear axle, Axle housing.	**(06)**
Unit 3	**Front axle and steering mechanism, wheels and tyres :** Front Axle, Bearing loads on the front axle, Fundamental condition for true rolling, Function of steering system, Steering geometry, Cornering force, Slip angle, Scrub radius, Steering characteristics, Steering linkages & gearbox, Ackerman steering gear, Davis steering gear, Power steering- hydraulic and electric, Collapsible steering. **Wheel and tyres:** Wheel construction, Alloy wheel, Wheel alignment and balancing, Type of tyres, Tyre construction, Tyre materials, Factors affecting tyre life	**(08)**
Unit 4	**Suspension & Brake System** **Suspension: F**unctions, Types of suspension linkages, Types of spring - leaf, coil, air springs, telescopic shock absorber, Hydro gas suspension, Rubber suspension, Interconnected suspension, Self-levelling suspension advances in suspension system, Air suspension. **Brakes**: Function, Principle, Types, mechanical, hydraulic and pneumatic brakes, Disc and drum types, Air brakes, Servo and power braking, ABS, Brake adjustments, Defects and causes.	**(07)**
Unit 5	**Electrical and Electronics System** **Batteries**	**(07)**

	Principles and construction of lead-acid battery, Characteristics of battery, Rating capacity and efficiency of batteries, Various tests on battery condition, Charging methods. **Modern trends:** Sensors and actuators, Electronic control unit (ECU), Electronic stability program, Traction control devices, Electrical car layout, Hybrid drives, Hill hold, Cruise control. Electric and Hybrid vehicles, application of Fuel Cells	
Unit 6	**Performance of automobile** Power for propulsion, Traction and traction effort, Relation between engine revolutions N and vehicle Speed V, **Road performance curves:** Acceleration, gradeability and drawbar pull, Calculation of equivalent weight (We), gear ratio for maximum acceleration, distribution of weight, stability of a vehicle on a slope, calculation of maximum accelerations, maximum tractive effort and reactions for different drives, dynamics of a vehicle running on a banked track, stability of a vehicle taking a turn (role over mitigation) **Vehicle safety:** Active & passive safety, Air bags, Seat belt, Types of collisions- front, rear, side, Vehicle interior and ergonomics, Comfort, NVH in automobiles. **Latest trends in automotive electronics (Self-study):** i)The glass cockpit, ii) Driver assistance, iii) Gesture and voice recognition, iv)Engine control, v) Black boxes vi) Electronic ignition and injection for SI and CI engines	**(06)**

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

Text Books

1.	G.B.S. Narang, "Automobile Engineering" , Khanna Publication,3rd Edition, 1995
2.	Dr. Kirpal Singh (Vol. I and II) , "Automobile Engineering", Standard Publishers, New Delhi 13th edition, 2014 .
3.	N. K. Giri, "Automobile Mechanics", Khanna Publishers, 2014.
4.	R. B. Gupta, "Automobile Engineering", Satya Prakashan, 2014.
5.	P. S. Gill, "Automobile Engineering," S. K. Kataria & sons, 2010.
6.	P. S. Kohali, "Automobile Electrical Equipment", Tata McGraw Hill Publishing House, 1999.

Reference Books

1.	K. Newton and W. Seeds, T.K. Garrett, "Motor Vehicle", 13th Edition, Elsevier publications, 1996
2.	W. H. Crouse, "Automobile Mechanics", Tata McGraw Hill Publishing Co. 1998
3.	Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999

Useful Links

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

Mapping of COs 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	-	-	-	-	-	1	2	1	2			-
CO 2	1	-	2	2	-	-	-	-	2	1	-	1	1	2	-
CO 3	1	3	3	-	1	-	-	-	3	2	2	-	1	1	2
CO 4	2	2	2	1	-	-	-	3	2	3	-	3	2	3	-

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	8	4	2	7
Understand	3	5	3	20
Apply	4	3	3	15
Analyse	0	2	1	10
Evaluate	0	1	1	8
Create	0	0	0	0
TOTAL	15	15	10	60

Government College of Engineering, Karad

Second Year (Sem – VIII) B. Tech. Mechanical Engineering

ME 2805 : Finite Element Analysis Lab

Teaching Scheme			**Examination Scheme**	
Practicals	02 Hrs/week		CT – 1	-
Tutorials	-		CT – 2	-
Total Credits	01		CA	50
			ESE	-
			Duration of ESE	-

Course Outcomes (CO)

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

1.	Code 1D FEA problems and simulate using coding tools.
2.	Model and Simulate 1D/2D/3D using commercial Software to solve structural problems: Static, Dynamic
3.	Model and Simulate 1D/2D/3D using commercial Software to solve Thermal and Thermo-Mechanical problems: Heat Transfer and Thermal Stress Analysis
4.	Model and Simulate 1D/2D/3D using commercial Software to solve Multi-disciplinary problems and Multi-body dynamic problems

Course Contents

Term work should consist of any 09 experiments from the following.

Experiment 1	Finite Element Formulation for 1D problem and solve it by using suitable coding platform (C++, MATLAB, Python etc.) to solve stepped bar/composite bar and verify with hand calculations
Experiment 2	Finite Element Formulation for 1D problem and solve it by using suitable coding platform (C++, MATLAB, Python etc.) to solve Truss examples and verify with hand calculations
Experiment 3	FEA Modeling and Simulation of 1D problems using commercial software (ANSYS) and compare results with experiment 1 and 2 and hand calculations
Experiment 4	FEA Modeling and Simulation of 2D practical problems (plane stress, plane strain and axisymmetric) using commercial software (ANSYS etc.).
Experiment 5	FEA Modeling and Simulations of 1D/2D/3D practical problem: Static Structural Analysis
Experiment 6	FEA Modeling and Simulations of 1D/2D/3D practical problem: Fatigue Life Analysis
Experiment 7	FEA Modeling and Simulations of 1D/2D/3D practical problem: Modal Analysis
Experiment 8	FEA Modeling and Simulations of 1D/2D/3D practical problem: Harmonic Analysis
Experiment 9	FEA Modeling and Simulations of 1D/2D/3D practical problem: Thermal Analysis
Experiment 10	FEA Modeling and Simulations of 1D/2D/3D practical problem: Thermo-mechanical Analysis: Thermal Stress Analysis
Experiment 11	FEA Modeling and Simulations of 1D/2D/3D practical problem: Multi-Body Dynamic Analysis, Crash Analysis etc.

Group Activity-

Maximum 3 to 4 students in one group

Carry out experimental analysis on a steeped bar and compare its results with FEAanalysis.

Text Books

1.	MATLAB Guide to Finite Elements - Peter I. Kattan – Springer, Third Edition, 2003
2.	**Xiaolin Chen, Yijun Liu, Finite Element Modeling and Simulation with ANSYS Workbench, CRC Press, 2014**
3.	Saeed Moaveni, Finite Element Analysis, Theory and Application with ANSYS, Pearson Publication, 2011

Reference Books

1.	J. N. Reddy, "An Introduction to Finite Element Method", Tata McGraw Hill publication co. 2nd Edition, 1993
2.	Logan D. L. "A first course in Finite Element Method", Cengage learning, 4thEdition, 2008.
3.	N. S. Gokhale, S.S. Deshpande, S.V. Bedekar, A. N. Thite, "Practical Finite Element Analysis", Finite to Infinite Publication

Useful Links

1.	http://nptel.ac.in/courses/112104193/
2.	http://feaforall.com/

3.	http://www.open.edu/openlearn/science-maths-technology/introduction-finite-element-analysis/content-section-1.5
4.	http://www.ansys.com/

Mapping of COs 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	1	3	2	0	0	1	1	0	2	2	3	1
CO 2	2	2	1	1	3	0	0	0	1	1	0	2	2	2	2
CO 3	2	3	1	0	3	3	0	0	1	1	1	2	2	2	3
CO 4	3	3	1	0	3	2	1	0	2	2	1	2	2	3	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	3	-
Understand	-	-	5	-
Apply	-	-	10	-
Analyse	-	-	12	-
Evaluate	-	-	10	-
Create	-	-	10	-
TOTAL	-	-	50	-

Government College of Engineering, Karad

Final Year (Sem –) B. Tech. Mechanical Engineering

ME2814: MEMS and NEMS Laboratory

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		CT – 1	-
Tutorials	00 Hrs/week		CT – 2	-
Total Credits	01		CA	50
			ESE	25

Lab Outcomes (LO)

Students will be able to

1.	Understand MEMS systems and its manufacturing processes.
2.	Study various design aspects of MEMS systems and its simulation using software
3.	Study Micro-Nano Characterization and Testing tools and techniques
4.	Analysis and Design MEMS system using basic principles of micro nano domains

	Course Contents	**Hours**
	Term work should consist of any 08 experiments from the following:	
Experiment 1	Introduction to MEMS simulation tools like COMSOL and its different modules.	**(02)**
Experiment 2	Assignment on microsystem fabrication system.	**(02)**
Experiment 3	Study of various micro sensors.	**(02)**
Experiment 4	Study of Design and simulation of capacitive MEMS devices.	**(02)**
Experiment 5	Design of MEMS accelerometer, Pressure sensor and Gyroscopes	**(02)**
Experiment 6	Design of magnetic, thermal and piezoelectric MEMS devices	**(02)**
Experiment 7	To evaluate the operational characteristics of electromechanical actuators (solenoids, motors, etc.)	**(02)**
Experiment 8	Study of Schrodinger equation and wave function theory.	**(02)**
Experiment 9	Assignment on case study on micro actuators.	**(02)**
Experiment 10	Assignment on case study on application of NEMS.	**(02)**
List of Submission:	1. Total number of Experiments:	

Text Books

1.	"Foundation of MEMS", Cheng Liu, Pearson Publication,2011.
2.	"Fundamentals of Microfabrication", M. Madou ,CRC Press,2nd edition,2002.
3.	"Micro Electro Mechanical System Design", J. Allen, CRC Press,2005.

Reference Books

1.	"An Introduction to Microelectromechanical Systems Engineering", N. Maluf, Artech House,2nd Edition,1999.
2.	"Microsystem design", S.Senturia", Springer US,2001.
3.	"VLSI Fabrication Principles", S.K. Ghandhi, Wiley,2nd Edition,2008.
4.	"Practical MEMS", Ville Kajaakari, Small Gear Publishing,2009.

Useful Links

1.	https://www.slideshare.net/navinec1/micro-electromechanical-system-mems

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															
CO 2															
CO 3															
CO 4															

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				
TOTAL				

Government College of Engineering, Karad

Final Year (Sem – VIII) B. Tech. Mechanical Engineering

(Elective –V lab) ME2826: Tribology Laboratory

Teaching Scheme			**Examination Scheme**	
Practicals	02 Hrs/week			
Tutorials	-			
Total Credits	01		CA/TA	50
			ESE	50
			Duration of ESE	-

Course Outcomes (CO)

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

1.	Remember & Understand significance and purpose of Tribological experiments
2.	Apply experimental method to measure Viscosity, friction & wear in various multi-disciplinary fields in practice
3.	Analyse failure of tribo pair materials
4.	Evaluate factors affecting friction & wear.

Course Contents

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

Experiment 1	Study of various apparatus to measure Viscosity of Oil & Grease
Experiment 2	Study of measurement of surface roughness by stylus Profilometry
Experiment 3	Study of commonly used parameter in the Characterization of real tribological contacts
Experiment 4	Study of Tribometers for dry or partially Lubricated sliding contacts
Experiment 5	Study and demonstration of Pin-on-disc tester
Experiment 6	Study of Four Ball tester
Experiment 7	Study of Abrasive & erosive wear test with specific problems in test
Experiment 8	Study of Apparatus for wear & friction measurements in Hydrodynamic bearing
Experiment 9	Study application and demonstration of Microhardness measurement
Experiment 10	Assignments, problems on Theory course

Text Books

1.	Gwidon Stachowiak, A W Batchelor, "Engineering Tribology", Butterworth-Heinemann Publication, 4th ed, 2014
2.	D.D. Fuller, "Theory and Practice of Lubrication for Engineers", John Wiley and Sons, 1984
3.	Marika Torbacke, "Lubricants: Introduction to Properties & Performances", John Wiley & sons, 1st ed, 2014

Reference Books

1.	Gwidon W. Stachowiak & Andrew W. Batchelor, "Experimental Methods in Tribology", Tribology series 44, Elsevier, 2004
2.	Kenneth G. Budinski, "Friction, Wear, and Erosion Atlas", CRC Press (2013)
3.	Shizhu Wen & Ping Huang, "Principles of Tribology", Wiley, 2nd ed, 2018

Mapping of COs & POs

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CO 1	3	2	1	-	2	-	-	-	2	-	-	2	1	-	3
CO 2	3	2	2	2	2	-	-	-	2	-	-	2	2	-	3
CO 3	3	3	2	1	2	-	-	-	1	-	-	2	2	-	3
CO 4	2	3	1	1	2	-	-	-	1	-	-	2	2	-	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	CA/TA	ESE
Remember	-	-	10	10
Understand	-	-	14	12
Apply	-	-	14	12
Analyse	-	-	6	8
Evaluate	-	-	6	8
Create	-	-	0	-
TOTAL	-	-	50	50

Government College of Engineering, Karad

Final Year (Sem – VIII) B. Tech. Mechanical Engineering

ME 2836 : Automobile Engineering Lab

Teaching Scheme			**Examination Scheme**	
Practicals	02 Hrs/week		CT – 1	-
Tutorials	-		CT – 2	-
Total Credits	01		TA	50
			ESE	50

Course Outcomes (CO)

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

1.	understand four wheeler chassis and vehicle layout
2.	make student conversant with different transmission system like clutch, gear box, final drive and differential.
3.	understand steering system, suspension system and braking system
4.	get knowledge of electronic ignition system, fuel supply system and automobile air condition system and to make student conversant about wheel balancing.

Course Contents

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

Group A

Experiment 1	Study and demonstration of four-wheeler chassis layout and vehicle components.
Experiment 2	Study and Demonstration of working of single plate and multiplate automobile clutch.
Experiment 3	Study and demonstration of automatic transmission.
Experiment 4	Study and demonstration of final drive and differential.
Experiment 5	Study and demonstration of front wheel steering geometry and steering mechanism.
Experiment 6	Study and demonstration of suspension system of a four-wheeler.
Experiment 7	Study and demonstration of working air braking system.
Experiment 8	Study and demonstration of Electronic Ignition system of automobile and MPFI system.
Experiment 9	Study and demonstration of fuel supply system of petrol engine.
Experiment 10	Study and demonstration of automobile air conditioning system.
Experiment 11	Study of electric vehicle.

Group B

Experiment 1	Experiment on wheel balancing machine.
Experiment 2	Visit to servicing station for study of vehicle maintenance, repair and report

Group Activity-

Group Activity: Maximum 3 to 4 students in one group

All vehicle details of any one four wheeler or two wheeler with complete specifications.

Text Books

1.	G. B. S. Narang, Automobile Engineering Khanna Publication, 5th Edition 1995
2.	Dr. Kirpal Singh (Vol. I and II) "Automobile Engineering" Standard Publishers, New Delhi 13th edition,

	2014
3.	R. B. Gupta ,"Automobile Engineering", , Satya Prakashan, 2014 .
Reference Books	
1.	Laboratory manual for Automobile laboratory.
2.	K. Newton and W. Seeds, T.K. Garrett, "Motor Vehicle", 13th Edition, Elsevier publications 1996
3.	Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999

Mapping of COs and POs

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CO 1	1	1	1	2	1	1	-	1	2	2	1	1	-	-	-
CO 2	2	2	2	2	2	2	-	3	2	2	2	2	1	2	-
CO 3	2	2	2	2	2	2	1	2	2	2	2	2	1	1	2
CO 4	3	3	3	2	2	2	-	3	2	3	3	3	2	3	-

Assessment Pattern(with revised Bloom's Taxonomy)

Knowledge Level	CT 1	CT 2	TA	ESE
Remember	-	-	10	12
Understand	-	-	10	10
Apply	-	-	8	8
Analyse	-	-	12	10
Evaluate	-	-	10	10
Create	-	-	0	0
TOTAL	-	-	50	50

Government College of Engineering, Karad

Final Year (Sem –VIII) B. Tech. Mechanical Engineering

ME2807 Project (Academic Mode)

Teaching Scheme			Examination Scheme	
Lectures	-		CA	200
Tutorials	05Hr/week		ESE	200
Total Credits	10			

Course Outcomes (CO)

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

	Course Contents	Hours
	Project load: A group of minimum two and maximum five students per group will be permitted to select project as approved by guide.	
	Project Project Definition: Project is a task approved by Guide to be done in particular time line. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.	
	Project II Report Format Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed. 1. Page Size: Trimmed A4 2. Top Margin: 1.00 Inch 3. Bottom Margin: 1.32 Inches 4. Left Margin: 1.5 Inches 5. Right Margin: 1.0 Inch 6. Para Text: Times New Roman 12 Point. Font 7. Line Spacing: 1.5 Lines 8. Page Numbers: Right Aligned at Footer. Font 12 Point Times New Roman 9. Headings: Times New Roman, 14 Point Bold face 10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal /Director 11. Index of Report: i) Title Sheet ii) Certificate iii) Acknowledgement iv) Table of Contents. v) List of Figures vi) List of Tables 1. Introduction 2. Literature Survey/ Theory 3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation. 4. Observation Results 5. Discussion on Result and Conclusion 12. References: References should have the following format For Books: Authors, “Title of Book”, Publisher, Edition For Papers: Authors, “Title of Paper, Journal/Conference Details, Year 13. The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department 14. Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.	
	# GUIDELINES FOR PRESENTATION Follow these rules for presentation 9. 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. 10. 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.	

11. Make sure your presentation is easy on the eyes. Stay away from weird colours 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.
12. 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.
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19. **Proofread everything**
20. **Consider using a template**

Upon successful completion of this project, the student should be able to answer following questions

1. Which subjects you found useful for this project?
2. Have you referred any chart, tables, and graphs for this project? What was its meaning for you?
3. Can you design any system or part of it from this project at your own? If not what knowledge you feel inadequate?
4. Was this project involved knowledge of electrical, electronics, civil, chemical or any process engineering industry?
5. Have you come across any technical difficulty in project? If yes write in short, How you solved?
6. What was timing scheduled for project? Have you followed it?
7. Which language used for communication in workshop (when required)? Have you talked there?
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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	3	1	1	-	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	2	2	-	1	1	-	-	1	-	1	2	3	2	3
CO 3	3	2	2	-	2	-	-	-	-	-	-	2	3	2	3
CO 4	3	2	1	1	2	-	1	1	1	1	1	2	3	2	3

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	TA	ESE
Remember	20	20
Understand	10	10
Apply	20	20
Analyse	10	10
Evaluate	10	10
Create	30	30
TOTAL	100	100

Government College of Engineering, Karad

Final Year (Sem –VIII) B. Tech. Mechanical Engineering

ME2807 – A Project (Industry Mode)

Teaching Scheme			Examination Scheme	
Lectures	-		CA	200
Tutorials	05Hr/week		ESE	200
Total Credits	10			

Course Outcomes (CO)

After completion of this course students should able to:

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

Course Contents — **Hours**

One student doing internship in Industry is expected to work on some small projects / case studies which are part of his internship.

Project

Project Definition: Project is a task approved by Guide and Industry Supervisor to be done in particular time line. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Report Format

Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictly followed.

1. Page Size: Trimmed A4
2. Top Margin: 1.00 Inch
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inch
6. Para Text: Times New Roman 12 Point. Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point Times New Roman
9. Headings: Times New Roman, 14 Point Bold face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal /Director
11. Index of Report: i) Title Sheet ii) Certificate iii) Acknowledgement iv) Table of Contents. v) List of Figures vi) List of Tables 1. Introduction 2. Literature Survey/ Theory 3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation. 4. Observation Results 5. Discussion on Result and Conclusion 12. References: References should have the following format For Books: Authors, “Title of Book”, Publisher, Edition For Papers: Authors, “Title of Paper”, Authors, Journal/Conference Details, Year
13. The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department
14. Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

GUIDELINES FOR PRESENTATION

Follow these rules for presentation

17. 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.
18. 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.

19. Make sure your presentation is easy on the eyes. Stay away from weird colours 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.
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