GOVERNMENT COLLEGE OF ENGINEERING, KARAD

(*An Autonomous Institute of Government of Maharashtra*)

DEPARTMENT OF MECHANICAL ENGINEERING

Curricula for

FINAL YEAR B.TECH MECHANICAL ENGINEERING

as per NEP-2020

w.e.f

AY 2026-27

FINAL YEAR

B.TECH MECHANICAL ENGINEERING

COURSE SYLLABI

FOR

SEMESTER VIII

(Mode-2-Academic)

Government College of Engineering, Karad

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

ME3801: Machine Design – II

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	03 Hrs

Prerequisite : Strength of Material, Machine Design I

Course Outcomes (CO): Students will be able to

CO1	Design friction clutches and brakes by applying principles of torque transmission and standard design equations
CO2	Analyze and design rolling contact bearings and hydrodynamic journal bearings by applying load analysis, lubrication theories and bearing selection criteria
CO3	Design spur, helical, and bevel gears by applying force analysis, strength criteria, wear considerations, and standard gear design procedures
CO4	Design thick cylinders and pressure vessels by applying Lame's equations, failure theories, and relevant design standards for safe operation

	Course Contents	**CO**	**Hours**
Unit 1	**Design of Clutches and Brakes.** **A. Clutches** Types of clutches, friction materials, consideration in design of friction clutches and its types, single plate clutch, torque transmitting capacity (Uniform pressure theory & uniform wear theory), Design of centrifugal clutch. Energy equation, Thermal considerations. **B. Brakes** Function, Energy absorbed by brakes (Energy equations), Heat to be dissipated during braking (Thermal consideration), types of brakes: Block brake with short shoe, Block brake with long shoe, pivoted block brake with long shoe; Internal expanding brake, disc brakes	**CO1**	**(06)**
Unit 2	**Rolling Contact Bearing** Bearings: Radial bearing & Thrust bearing; Types of rolling contact bearing, selection of bearing type, static and dynamic load carrying capacities, Stribeck's equation, equivalent bearing load, bearing life, selection of bearing from manufactures catalogue, Standard dimensions and Designation of ball bearings, design for cyclic load and speed, bearings with probability of survival other than 90%, bearing failure, Lubrication of Rolling contact bearing, Materials and manufacture of ball bearings.	**CO2**	**(07)**
Unit 3	**Hydrodynamic Lubrication & Design of Hydrodynamic Bearings** Types of lubrication: Thick film - Hydrodynamic, Hydrostatic, Thin flim - Elastohydrodynamic, Boundary, zero film - Solid film lubrication. Stable film lubrication (stribeck's curve), McKee's experiment, Petroff's equations (no derivation), Reynold's equation (no derivation) and its results, Design consideration in Finite length Hydrodynamic Journal bearings, Design of full & partial Journal bearing using Ramondi & Boyd method. Advantages and Disadvantages of Rolling Contact Bearings Over Sliding ContactBearing,	**CO2**	**(07)**
Unit 4	**Design of Spur Gears** Standard systems of Gear tooth, Force analysis, Gear tooth failure. Beam strength of gear tooth, permissible bending stress, effective load on tooth, estimation of module based on beam strength. Wear strength of gear tooth, estimation of module based on wear strength. **Helical gears**: Comparison, application, beam strength (theoretical treatment only)	**CO3**	**(08)**
Unit 5	**Design of Bevel Gears** Bevel gears and its types, Terminology of Bevel gears, Application of bevel gears, Force analysis, Beam strength of bevel gears, Wear strength of bevel gears, effective load on bevel gear tooth. Spiral bevel gears, application.	**CO3**	**(06)**

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Govt. College of Engg., Karad

Unit 6	**Design of Thick Cylinders** Types of cylinders, Difference between thin and thick cylinders. Thick cylinders-Principal stress. Lame's equations to determine thickness for brittle materials. Clavarino's and Birnie's equation to determine thickness for ductile material. Design of Cylinders with external pressure. Autofrettage. Compound cylinders. Gasketed joints. Unfired pressure vessel: Types-category A, B, C, D, thickness of cylindrical and spherical shell enclosures.	**CO4**	**(06)**

Text Books	
1.	"*Design of Machine Elements*" by V. B. Bhandari, McGraw Hill Education (India) Pvt Ltd, New Delhi, 5th Edition, 2021. (Unit 1 to 6)
2.	"*Shigley's Mechanical Engineering Design*" by J. Keith Nisbett and Richard. G. Budynas, McGraw Hill, 12th Edition, 2024. (Unit 2 to 5)
3.	"*Schaum's Outlines of Machine Design, In SI Units*" by Alfred Hall, Hollowenko, Laughlin, McGraw Hill Education (India) Pvt Ltd, New Delhi. (Unit 1, 4, & 5)
Reference Books	
1.	"*Machine Elements in Mechanical Design"* by Robert. Mott, Pearson publication, 6th ed, 2018. (Unit 1 to 5)
2.	"*Machine Design An Integrated Approach*" by Robert. L Norton, Pearson Education Publication, 5th Edition, 2013. (Unit 1 to 5)
3.	"*Fundamentals of Machine Component Design*" by Robert C. Juvinall and Kurt. M. Marshek, Wiley Ltd., 6th Edition, 2017.
4.	"*Machine Design Data book*" by V. B. Bhandari, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2nd Edition, 2019.(Unit 2, 4, & 5)
Useful Links	
1.	https://nptel.ac.in/courses/112106137 "Machine Design II", Prof. K. Gopinath, Prof. M.M. Mayuram, IIT Madras
2.	https://onlinecourses.nptel.ac.in/noc25_me15/preview "Design of Mechanical Transmission systems", Prof. Ramkumar P, IIT Madras
3.	https://archive.nptel.ac.in/content/storage2/courses/112103024/module3/lec1/1.html Rolling Element Bearings
4.	https://www.youtube.com/playlist?list=PLO7NZcQ-pxa0OmKFBkBjCAzpV7VwarMHP "Machine Design II", Gaurang Deep, MIET, Meerut

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

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	10
Understand	4	4	10
Apply	4	4	20
Analyse	4	4	10
Evaluate	4	4	10
Create	-	-	-
TOTAL	20	20	60

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

ME3802: Industrial Engineering

Teaching Scheme			Examination Scheme	
Lectures	03 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Engineering Economics

Course Outcomes (CO): Students will be able to

CO1	Understand the concepts of Forecasting, Break-Even Analysis and Inventory Control in industrial engineering.
CO2	Apply tools and techniques of industrial engineering to improve productivity and operational efficiency.
CO3	Analyze work systems using Motion Study and Work Measurement techniques to reduce fatigue and optimize performance.
CO4	Evaluate the integration and application of industrial engineering in Job Evaluation and Merit Rating for enhancing employee productivity.

	Course Contents	CO	Hours
Unit 1	**Fundamentals of Industrial Engineering and Plant Layout** Definition, Scope, Responsibilities, Important contributors to I.E., Tools and techniques of Industrial engineering. **PlantsLayout**: process layout, product layout, fixed position layout, cellular layout, and combination layout.	**CO3**	**(06)**
Unit 2	**Production Planning** **A) Forecasting:** Qualitative and quantitative forecasting, Forecasting error analysis, MRP, Aggregate production planning. **B) CAPEX:** Meaning and importance, Role of CAPEX in industrial growth **C)Break Even Analysis:** BEP, Make or buy decision.	**CO1**	**(08)**
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.	**CO1**	**(06)**
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.	**CO2**	**(09)**
Unit 5	**Work Measurement (Time Study)** Definition, Objectives, Procedure, Time study equipment, Performance rating, Allowances, Concept and calculation of normal time standard time and takt Time, Work sampling, Predetermined motion time analysis.	**CO3**	**(05)**
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.	**CO4**	**(06)**

Assignments

	Assignments on each Unit-6 Nos.

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Text Books

1.	*"IndustrialEngineering"* by L. C. Zhamb, -Everest Publishing House,2023 (unit 1,2,6)
2.	*"Industrial Engineering and Management"* by O.P. Khanna, -DhanpatRaiPublisher,17th Edition 2017 (unit 3,4)
3.	*"IndustrialEngineeringand Production Management"* by Martand Telsang, , S. Chand Publisher, 3rd Edition2018 (unit 2,4,5)
4.	*"Industrial Engineering and Management"* by Pravin Kumar, Pearson Publication, 2020 (unit 5,6)

Reference Books	
1.	*"Modern Production/operations Management"*, by Buffa, Wiley Eastern, New York 1999 (unit 1,2,3,4)
2.	*"Production and Operation Management"*, Adam and Ebert Pearson Education Asia, Fifth Edition 2003 (unit 4,5,6)
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc26_me78/preview, "Principles of Industrial Engineering", by Prof. D K Dwivedi, IIT Roorkee
2.	https://onlinecourses.nptel.ac.in/noc25_me181/preview, "Industrial Engineering and Operations Research", by Prof. Uday Shanker Dixit, IIT Guwahati

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

1: Slight(Low) 2: Moderate (Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	10
Understand	4	4	-
Apply	4	4	10
Analyse	4	4	20
Evaluate	4	4	20
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
RM3803: Research Methodology				
Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		MSE	20
Tutorials	00 Hrs/week		ISE	20
Total Credits	03		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite: Basic understanding of core concepts, mathematics, statistics, critical/scientific thinking skills.

Course Outcomes (CO): Students will be able to

CO1	understand fundamentals of research, research process, methods and methodology.
CO2	apply research design and problem formulation techniques to solve research problem.
CO3	analyse data using statistical tools and methods. (Use of latest data processing tools)
CO4	prepare reports, research papers/ following research ethics and publish research in various forms.

	Course Contents	CO	Hours
Unit 1	**Introduction:** Meaning and objective of research, motivations in research, characteristics components of research work, criteria of good research, Research process, type of research, fundamental, pure or Theoretical research, Applied Research, Descriptive Research, Evaluation Research, Experimental research, Survey Research, Qualitative Research, Quantitative Research, interdisciplinary Research.	**CO1**	**(08)**
Unit 2	**Literature review**-purpose, sources, and importance, research gap, Objectives, problem statement. **Research Design:** Research design, definition, essentials of research design, Research problem steps in research design, good research design, important concepts.	**CO2**	**(08)**
Unit 3	**Data collection and Analysis:** Sources of data collection, Library sources, E-sources, primary data, secondary data, data collection methods, interviews, questionnaire schedule. Measurement, sampling, scaling - sample design, types of sample design, different scales, sampling error, Normal distribution.	**CO3**	**(06)**
Unit 4	**Data Analysis and tools:** Data processing, Classification, Statistical series, Qualitative vs Quantitative data analyses, Interpretation of data, Hypothesis testing, Measures of central tendency and dispersion, mean, media, mode, range, variance, standard deviation, Introduction to AI-assisted data processing tools, AI-assisted predictive analytics.	**CO3**	**(06)**
Unit 5	**Research Report Writing:** Research report, Different types, contents of report, executive summary, chapterization – contents of chapter, report writing, different report formats, bibliography/references, Use of AI tools in writing research articles. **Research and publication ethics:** significance of research ethics Citation, plagiarism, publishing process journal publication, journal metrics, responsible use of AI in academic writing. AI-assisted manuscript preparation and review.	**CO4**	**(07)**
Unit 6	**IPR: Meaning**, nature and scope of Intellectual property (IP), Importance of IPR in engineering, patents, copyrights, trademarks.	**CO4**	**(05)**

List of Submission: 1. Assignment questions on every unit shall be given to students.
2. Domain specific activity shall be given to learn and implement research methodology philosophies using AI & ML based tools.

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Text Books	
1.	Kothari, C. R., & Garg, G. Research Methodology: Methods and Techniques, 4th ed., New Age International Publishers, New Delhi, 2019. (Units 1, 2, 3 and 4)
2.	Panneerselvam, R. Research Methodology, 2nd ed., PHI Learning Pvt. Ltd., New Delhi, 2013. (Units 1, 2 and 3)
3	Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners, 4th ed., Pearson Education India, New Delhi, 2019. (Units 1 and 2)
4	Malhotra, N. K. Research Methodology: An Applied Orientation, 7th ed., Pearson Education India, New Delhi, 2020. (Units 3 and 4)
5	Pavithra, R. H. Research Methodology and Techniques of Data Analysis, Current Publications, New Delhi, 2023. (Unit 3)
6	Bhandari, M. K. Intellectual Property Rights, 4th ed., Central Law Publications, Allahabad, 2024. (Unit 6)
Reference Books	
1.	B. L. Garg, R. Kavdia, S. Agrawal, and U. K. Agarwal, Research Methodology. Jaipur, India: RBSA Publishers, 2019. (Unit 1 and 2)
2.	D. Deb, R. Dey, and V. E. Balas, Engineering Research Methodology. Singapore: Springer, 2019. (Unit 2)
3.	J. P. Lal, S. Bishla, and D. Singh, Research Methodology and Data Analysis. New Delhi, India: Publishing House, 2023. (Unit 3 and 4)
4	D. Chawla and N. Sondhi, Research Methodology. New Delhi, India: Vikas Publishing House, 2011. (Unit 1, 3 and 4)
5	P. K. Praveena and R. P. Thevannoor, Research Report Writing. New Delhi, India: Bharti Publications, Sept. 24, 2021. (Unit 5)
6	M. Vidhya Sree, M. K. Singh, P. Bisht, and Z. Beevi, Research Methodology and IPR Strategies. New Delhi, India: Technical Publications, 2022. (Unit 6)
Useful Links	
1.	https://youtu.be/1vf8ZvADxfY "Research methodology" by Dr Devika Bhatnagar
2.	https://www.youtube.com/watch?v=lfWlbjl1zzU "Research Methodology" by Prof. Edamana Prasad, Prof. Prathap Haridoss,IIT Madras.
3.	https://www.youtube.com/watch?v=E2gGF1rburw "Research Methodology in Natural Sciences" by Prof. Soumitro Banerjee, Department of Physical Sciences, IISER Kolkata.

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

Guideline for Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	20
Understand	5	5	10
Apply	5	5	10
Analyze	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3814: Total Quality Management (ProgrammeElective-III)				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Metrology and Quality Control

Course Outcomes (CO): Students will be able to

CO1	Understand the evolution, scope, and basic concepts of Total Quality Management.
CO2	Apply the principles of TQM and ISO 9000 systems in organizational applications.
CO3	Demonstrate concepts of implementation of Quality programs with confidence and knowledge.
CO4	Apply TQM tools and techniques.

	Course Contents	CO	Hours
Unit 1	**Introduction to Quality:** Definition of Quality, need for quality, Deming's 14 points, product quality and service quality; Quality statements, House of Quality, Costs to quality, Quality control tools, review of measuring instruments and testing equipment. Toyota case study on TQM	**CO1**	**(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	**CO1, CO2**	**(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	**CO3**	**(07)**
Unit 4	**TQM tools and techniques:** Quality circles, Poka-yoke, Control charts, process capability, concepts of six sigma,Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.Introduction toquality management systems, Budgeting and Capital Expenditure, Business Excellence case studies.	**CO4**	**(07)**

Text Books

1. "*Practical Reliability Engineering*"Patrick D.T. O'Connor & Andre Kleyner, Wiley Publication, 5th Edition, 2012 (Unit 4)
2. "*Total Quality Management: Text and Cases*" B. Janakiraman& R. K. Gopal, Prentice Hall India, 3rd Edition, 2008 (Unit 1, 2, 3, 4)
3. "*Total Quality Management*" Dr.Gunmala Suri & Dr. Puja Chhabra Sharma, Wiley Publication, 1st Edition, 2013 (Unit 1, 2, 3,)
4. "*Total Quality Management*" M. Sivakumar & S. Rajaram, Wiley Publication, 1st Edition, 2008 (Unit 2, 4)

Reference Books

1. "*Total Quality Management*" Dale H. Besterfield, Pearson Education, 3rd Edition, 2012 (Unit 1, 2, 3, 4)
2. "*Total Quality Management*" Dr.Poornima Charantimath, Pearson Education, 2nd Edition, 2011 (Unit 1, 2, 3,)
3. "*Fundamentals of Quality Control and Improvement*" AmitavaMitra, Pearson Education, 3rd Edition, 2016 (Unit 1)
4. "*Handbook of Total Quality Management*" R. P. Mohanty& R. R. Lakhe, Jaico Publishing House, 3rd Edition, 2015 (Unit 2, 3)

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Useful Links

1. https://nptel.ac.in/courses/110104080 "Total Quality Management", Prof. Raghu Nandan Sengupta, IIT Kanpur.
2. https://nptel.ac.in/courses/110104085 , Prof. Raghunandan Sengupta, IIT Kanpur.
3. https://onlinecourses.swayam2.ac.in/nou21_me04/preview , Dr.N.Venkateshwarlu, Indira Gandhi National Open University

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

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	10	5	20
Apply	5	5	15
Analyse	-	5	10
Evaluate	-	-	05
Create	-	-	-
TOTAL	20	20	60

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

ME3824: Power Plant Engineering (Programme Elective-III)

Teaching Scheme		**Examination Scheme**	
Lectures	02 Hrs/week	MSE	20
Tutorials	--	ISE	20
Total Credits	02	ESE	60
		Duration of ESE	02 Hrs 30 Min

Prerequisite : Basic Mechanical Engineering

Course Outcomes (CO): Students will able to

CO1	Understand power generation sectors, grid codes and power development.
CO2	Apply and compare the knowledge obtained in theory towards selection of various power plant components.
CO3	Analyze different power plant, energy storage technology and environmental aspects.
CO4	Evaluate the performance of Power Plant.

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction** Resources and development of power in India, NTPC, NHPC and their role in Power development in India, Power generation in Private sector, Power distribution, National Grid, Indian Electricity Grid Code, Structure of IEGC, Operating Policies and Procedures, Present Power position in India and Maharashtra.	**CO1**	**(05)**
Unit 2	**Power Plants** Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear and their characteristics, Combined Cycle, Pumped storage, Compressed Air storage power plants and their characteristics. Comparison of Power plants with respect to various parameters & Issues in Power plants. **Future trends in Power plants** MHD - steam plant, Fuel Cells, Thermoelectric Steam Plant, Thermionic Steam plant.	**CO1, CO2**	**(08)**
Unit 3	**Power Plant Analysis** Load Curves, Load duration curves, Performance and operational characteristics of power plants, Peak load, Intermediate load and Base load plants and their characteristics, Input output characteristics of power plants, Economic division of between Base load plant and peak load plants. Cost of energy generation, Tariff methods.	**CO2, CO3, CO4**	**(08)**
Unit 4	**Energy Storage Technology and Environmental Aspects in Power generation** **Energy Storage Technology -** Pumped Hydroelectric Storage, Compressed Air Energy Storage, Battery Technologies - Traditional and Advanced, Flywheels, Superconducting Magnetic Energy Storage **Environmental Aspects in Power generation** Different pollutants due to power plants and their effects on ecology control over different types of air and water pollution. Pollution control devices, National and International protocols on pollution control.	**CO3**	**(05)**

Assignments (minimum 4) One assignment on each unit.

Text Books

1. "*Power Plant Engineering*", Domkundwar and Arora, Dhanpatrai and Sons, 5th Edition , 2005 (Unit 1 to 3)
2. "*Power Plant Engineering*", R K Rajput ,Laxmi publication, 4th Edition , 2008, (Unit 3 to 4)
3. "*Power Plant Engineering*", K Ramalingam, SCITECH, 2010 (Unit 2, 3 to 4)

Reference Books

1. "*Power Plant Technology*", M.M.Wakil, McGraw Hill. Int edition. 5th reprint, 1984
2. "*Power System Analysis*", Grainger John J, and Stevenson Jr.. W.D., McGraw Hill , 20th Reprint 2012
3. "*Modern Power System Analysis*", D. P. Kothari, I. J. Nagrath, McGraw Hill, 4th Edition, 2012

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Useful Links

https://onlinecourses.nptel.ac.in/noc21_me86/preview "Power Plant Engineering" Prof. Ravi Kumar, IIT Roorkee

https://onlinecourses.nptel.ac.in/noc24_me57/preview "Power Plant System Engineering" By Prof. Niranjan Sahoo, IIT Guwahati

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	4	05
Understand	6	4	05
Apply	6	4	20
Analyse		4	20
Evaluate		4	10
Create		-	-
TOTAL	20	20	60

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Government College of Engineering, Karad

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

ME3834: Non-Conventional Machining (Programme Elective-III)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 hrs. 30 Min

Prerequisite : Manufacturing Engineering

Course Outcomes (CO): Students will be able to

CO1	Understand, compare and recognize traditional and non-traditional machining processes.
CO2	Acquaint USM, AJM, machining processes.
CO3	Analyse the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations ECM.
CO4	Analyse the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM.

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction to Non-traditional machining:** Need for Non-conventional machining process, Comparison between traditional and non-traditional machining, general classification Non- conventional machining processes, classification based on nature of energy employed in machining, selection of non-conventional machining processes, Specific advantages, limitations and applications of non-traditional machining processes **Micromachining and Precision Machining:** Introduction, need for micromachining and precision machining, principles, characteristics, comparison between micromachining and precision machining, process capabilities, accuracy and surface finish, applications in microelectronics, biomedical devices, aerospace, and precision engineering, advantages and limitations	**CO1**	**(08)**
Unit 2	**a) Ultrasonic Machining (USM)** Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM. **b) Abrasive Jet Machining (AJM)** Introduction, Equipment and process of material removal, process variables: Carrier gases, type of abrasive, stand-off distance (SOD). Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.	**CO2**	**(08)**
Unit 3	**Electrochemical Machining (ECM)** Introduction, Principle of ECM, equipment, Chemistry of ECM. ECM Process characteristics: Material removal rate, accuracy, surface finish. Process parameters: Current density, Tool feed rate, Gap between tool & work piece, velocity of electrolyte flow, type of electrolyte, its concentration temperature, and choice of electrolytes. ECM Tooling: ECM tooling technique & example, Tool & insulation materials. Applications ECM: Electrochemical grinding. Advantages, disadvantages and application of ECG.	**CO3**	**(06)**
Unit 4	**Electrical Discharge Machining (EDM)** Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. Flushing types; pressure flushing, suction flushing, side flushing, pulsed flushing. EDM process parameters: Spark frequency, current & spark gap, surface finish. Heat Affected Zone. Advantages, limitations & applications of EDM	**CO4**	**(06)**

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Govt. College of Engg., Karad

Text Books

1.	*"Modern Machining Process"* P.CPandey and H SShah, McGraw Hill Education India Pvt. Ltd.2017 (Unit 1)
2.	*"Non-traditional Machining Processes"* Research Advances, Joao Paulo Davim, Springer, New York, 2013.

	(Unit 2, 3)
3.	*"Non-ConventionalMachining"*, P. K. Mishra, Narosa Publishing House, New Delhi, 2007 (Unit 3, 4)
4.	*"Advanced Machining Processes"*,Vijaya Kumar Jain, Allied Publishers Pvt. Ltd., New Delhi, 2009 (Unit 2, 3, 4)
Reference Books	
1.	Production technology, HMT, McGraw HillEducation India Pvt. Ltd. 2018
2.	AdvancedMachiningProcesses:Non-traditionalandHybridMachiningProcesses,HassanEl-Hofy,McGraw-Hill Professional, New Delhi, 2005
Useful Links	
1.	https://onlinecourses.nptel.ac.in/noc21_me05/preview , "Non-Tranditional Machining", Prof. Asimava Roy Choudhury, IIT Kharagpur
2.	https://onlinecourses.nptel.ac.in/noc26_me45/preview , "Advanced Machining", Prof. Shantanu Bhattacharya, IIT Kanpur

Mapping of COs and POs

PO→ CO↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	1	-	-	-	1	3	2	2
CO2	3	3	3	2	2	2	1	-	-	-	2	3	2	2
CO3	3	3	3	2	3	2	1	-	-	-	2	3	2	2
CO4	3	3	3	2	3	2	1	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	10
Understand	4	4	10
Apply	4	4	10
Analyse	4	4	15
Evaluate	4	4	15
Create	-	-	-
TOTAL	20	20	60

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Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3844: Supply chain management (Programme Elective-III)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Nil

Course Outcomes (CO): Students will be able to

CO1	Understand the fundamentals of supply chain management and logistics.
CO2	Analyze supply chain network design, inventory management concepts, and supplier collaboration strategies.
CO3	Apply strategic considerations in SCM and understand the role of IT to evaluate supply chain effectiveness.
CO4	Evaluate the basics of transportation, warehousing, distribution management, and facility location, and understand logistics control mechanisms for efficient material and information flow.

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction to Supply Chain Management & Logistics** Definition, scope, and importance of logistics and SCM. SCM for competitive advantage, decision phases (strategic, tactical, operational), key drivers of performance, and common obstacles. SCM in manufacturing and mechanical industries with simple examples.	**CO1**	**(06)**
Unit 2	**Supply Chain Network Design & Inventory Management** Introduction to distribution in supply chains, factors affecting network design, and design options (centralized vs decentralized). Basic inventory management concepts—cycle inventory and safety stock—and simple sourcing strategies. Supplier selection and collaboration with practical relevance.	**CO2**	**(06)**
Unit 3	**Strategic Considerations & IT in SCM** Supply chain strategies, performance measurement, and logistics engineering concepts. IT applications in SCM, including ERP and logistics information systems, with emphasis on practical examples. lead time, fill rate, and inventory turnover (Numerical treatment).	**CO3**	**(07)**
Unit 4	**Transportation, Warehousing & Distribution Management** Basics of transportation, warehousing, order processing, inbound and outbound logistics, and supplier partnerships. Introduction to facility location and strategic planning models. Concepts of logistics audit and multi-level supply chain control.	**CO4**	**(07)**

Tutorials- -- Assignments on each Unit- 4 Nos.

Text Books

1.	Supply Chain Management: Strategy, Planning, and Operation – Sunil Chopra & Peter Meindl, Pearson Education, 7th Edition, 2019 (Unit 1, 2, 3)
2.	Business Logistics / Supply Chain Management – Ronald H. Ballou, Pearson Education, 5th Edition, 2011 (Unit 1, 2, 4)
3.	Logistics Management – K. Shridhara Bhat, Himalaya Publishing House, 3rd Edition, 2021 (Unit 1, 4)
4	Supply Chain Logistics Management – Donald J. Bowersox, David J. Closs & M. Bixby Cooper, McGraw-Hill Education, 5th Edition, 2020 (Unit 1, 2, 3, 4)
5.	Introduction to Supply Chain Management – Robert B. Handfield, Stanley E. Fawcett, Amydee M. Whitten & Shardul Bhattacharya, Pearson Education, 2nd Indian Edition, 2022 (Unit 1, 2, 3)

Reference Books

1.	Logistics and Supply Chain Management: Creating Value-Adding Networks – Martin Christopher, Pearson Education, 6th Edition, 2023(Unit 1, 3)
2.	Enterprise Resource Planning: Fundamentals of Design and Implementation – David L. Olson & Subba Rao Venkatachalam, Pearson Education, 2nd Edition, 2015(Unit 3)
3.	The Logic of Logistics: Theory, Algorithms, and Applications – David Simchi-Levi, Xin Chen & Julien Bramel, Springer, 3rd Edition, 2014 (Unit 2, 4)
4.	Supply Chain Management: A Logistics Perspective – C. John Langley Jr., Robert A. Novack, Brian J.

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Govt. College of Engg., Karad

	Gibson & John J. Coyle, Cengage Learning, 11th Edition, 2021(Unit 1, 2, 4)
5.	Global Logistics and Supply Chain Management – John Mangan, Chandra Lalwani & Agustina Calatayud, Wiley, 4th Edition, 2021(Unit 1, 3, 4)
Useful Links	
1.	https://nptel.ac.in/courses/110106045 "Operations and Supply Chain Management" Prof. G. Srinivasan, IIT Madras
2.	https://onlinecourses.nptel.ac.in/noc24_hs128/preview "Logistics & Supply Chain Management" Prof. Vikas Thakur, IIT Kharagpur

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	PSO 1	PSO 2	PSO 3
CO 1	2	1	–	–	1	1	–	–	1	–	1	2	1	2
CO 2	2	3	2	2	2	1	–	1	1	2	1	3	2	3
CO 3	2	2	3	2	3	2	-	1	2	3	2	3	2	3
CO 4	2	3	3	2	2	2	1	1	2	3	1	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	10
Understand	10	5	20
Apply	5	5	15
Analyse	-	5	10
Evaluate	-	-	05
Create	-	-	-
TOTAL	20	20	60

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Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3854: Welding Technology (Programme Elective-III)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 hrs. 30 Min

Prerequisite : Basic Mechanical Engineering , Workshop Practice – II, Manufacturing Engineering

Course Outcomes (CO): Students will be able to

CO1	Understand fundamentals, classification of welding processes, symbols, joints, and preparatory operations.
CO2	Apply conventional arc welding processes for industrial applications.
CO3	Analyze gas and resistance welding processes, equipment, variables, and applications.
CO4	Evaluate weld quality, defects, inspection methods, and modern welding and automation processes.

	Course Contents	**CO**	**Hours**
Unit 1	**Fundamentals and Classification of Welding Processes** Introduction and classification of Welding processes. Comparison with other joining processes, Welding Symbols. Basic & supplementary weld symbols, types of weld Joints, Selection of Weld Joint, and edge preparation. **Preparatory Operations:** Different metal cutting methods used in fabrication, straightening methods, bending on roll bending machine, press, press brake. different edge preparation and cleaning methods	**CO1**	**(05)**
Unit 2	**Arc Welding Processes and Equipment's** Definition, types of processes, Carbon Arc Welding, Flux Shielded Metal Arc Welding, Submerged Arc Welding, Tungsten Inert Gas Welding, Metal Inert Gas Welding, Electro Gas Welding, Plasma Arc Welding, Arc Welding equipment's.	**CO2**	**(05)**
Unit 3	**Gas Welding & Resistance Welding** Principle of operation, types of flames, Gas welding Techniques, filler material and fluxes, Gas welding equipment's, advantages and applications **Resistance welding:** Definition, Fundamentals, variables, advantages and application, Spot Welding, Heat Shrinkage, Heat Balance Methods, Equipment, Electrodes, Seam, Projection Butt (up sets and flash).	**CO3**	**(06)**
Unit 4	**Weld Quality, Defects and Inspection** failure of welds, inspection and testing of welds, I.S. code for welding and weld metals, microstructure for weld joints, welding defects and remedies **Inspection and Testing of Welds:** Destructive testing of weld – Tensile, Bend, Impact, Nick Break, Hardness, Etch Tests, Non-Destructive Testing of Welds – Visual, Leak, X- ray and Gamma ray Radiography, Ultrasonic Inspection & Eddy Current Testing.	**CO4**	**(05)**
Unit 5	**Modern Welding Processes and Automation** EBW, LBW, diffusion bonding, ultrasonic welding, pulsed current welding processes, and friction welding. Welding of ceramics, plastics and composites **Welding Automation and Robotics**: Introduction, Automation options, Robotic welding, Modular Automation, Programmable control, Remote Control Slave and Automated Systems	**CO4**	**(05)**

Text Books

1. *"Welding Technology"* by B.S. Raghuwanshi, Tata McGraw-Hill Education, New Delhi, 2018 (unit 1, 2)
2. *"Welding Engineering and Technology"* by R.S. Parmar, Khanna Publishers, New Delhi, 2016 (unit 1, 5)
3. *"A Textbook of Production Technology (Manufacturing Processes – Vol. II)"*, by O.P. Khanna, Dhanpat Rai Publications, New Delhi, 2017 (unit 2, 3, 4)
4. *"Welding and Fabrication Technology"*, by R.K. Rajput, S. Chand & Company Ltd., New Delhi, (unit 4, 5)

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Reference Books	
1.	"*Modern Welding Technology*", by H.B. Cary and S.C. Helzer, Pearson Education, New Delhi, 2012 (unit 1,2,3)
2.	"*Automation, Production Systems and Computer Integrated Manufacturing*", by M.P. Groover, , Pearson Education, New Delhi, 2015 (unit 2, 4, 5)
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc26_mm46/preview, "Welding Processes" by Prof. Murugaiyan Amirthalingam, IIT Madras
2	https://onlinecourses.nptel.ac.in/noc20_me67/preview , "Fundamentals of manufacturing processes", by Prof. D K Dwivedi, IIT Roorkee
3	https://onlinecourses.nptel.ac.in/noc24_me84/preview , "Manufacturing Processes - Casting and Joining" by Prof. Sounak Kumar Choudhury , IIT Kanpur

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	10
Understand	4	4	10
Apply	4	4	10
Analyse	4	4	15
Evaluate	4	4	15
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad

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

ME3855: Design of Turbomachinery (Programme Elective-IV)

Teaching Scheme		**Examination Scheme**	
Lectures	02 Hrs. /week	MSE	20
Tutorials	--	ISE	20
Total Credits	02	ESE	60
		Duration of ESE	2 Hrs 30 min.

Prerequisite : Fluid Mechanics, Thermodynamics, Turbomachinery

Course Outcomes (CO): At the end of this course, student will be able to:

CO1	Understand principle of operation and classification of turbo machines.
CO2	Apply design principles of turbo machinery to draw velocity diagrams, calculate performance parameters.
CO3	Apply Euler's equation, dimensional analysis for centrifugal turbo machines.
CO4	Evaluate the design considerations and material selection for different types of turbo machinery.

	Course Contents	**CO**	**Hours**
Unit 1	**Fundamentals of Turbo machines:** Classification of Turbo machines, Turbines, Pumps and compressors, Fans and blowers, Incompressible and compressible flow machine, Stages: Axial, radial, mixed, reaction and impulse. Variable reaction stage, Multistage, Stage velocity triangle, Design and off-design conditions.	**CO1**	**(06)**
Unit 2	**Design Fundamentals of Axial Flow Compressors and Turbines:** Introduction to stage theory and performance parameters (work done, efficiency). Application of continuity, momentum, and energy equations to axial flow blading. Design methodologies for blade geometry using mean line analysis and velocity triangles. Introduction to blade element theory and performance maps.	**CO2**	**(07)**
Unit 3	**Design Principles of Centrifugal Compressors and Pumps**: Overview of centrifugal compressor and pump stages. Application of Euler's equation for impeller design and performance prediction. Volute casing design principles for efficient flow guidance. Dimensional analysis and scaling laws for centrifugal machines.	**CO3**	**(07)**
Unit 4	**Material Selection and Stress Analysis for Turbomachinery components :** Selection of appropriate materials for blades, disks, and shafts based on strength, fatigue, and creep resistance.	**CO4**	**(06)**

Assignments (minimum 4) One assignment on each unit.

Text Books

1.	*"Fluid Mechanics and hydraulic machines"*, Dr. R. K. Bansal, Laxmi Publications; 10th edition 2019.
2.	*"Hydraulic Machines"* R. K. Rajput, S. Chand and Co. Ltd.,
3.	*"Turbo machinery: Design and Theory"*, Rama S.R. Gorla and Aijaz A. Khan, Marcel Dekker Inc. 10th ed 2003
4.	"*Hydraulics, Fluid Mechanics and machinery*", P. N. Modi and S.N. Seth, Standard Book House, New Delhi, 22nd Edition, 2019

Reference Books

1.	*"Fluid Dynamics and Heat Transfer of Turbo machinery"* , Budugur Lakshminarayana, A John Wiley & Sons, Inc., Publication, 1st edition, 1996
2.	*"Centrifugal Compressor Design and Performance"*, David Japikse, Concepts ETI, 1996
3.	*"Principles of Turbo machinery"* , Seppo A. Korpela, A John Wiley & Sons, Inc., Publication, 1st edition, 2011
4.	*"Computational Fluid Dynamics: The Basics with Applications"*, J.D. Anderson, McGraw-Hill, 8th edition, 1995

Useful Links

1.	https://www.nptel.ac.in/
2.	http://www.swayam.gov.in/

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Govt. College of Engg., Karad

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	-
Understand	4	4	10
Apply	4	4	10
Analyze	4	4	20
Evaluate	4	4	20
Create	-	-	-
TOTAL	20	20	60

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Government College of Engineering, Karad

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

ME3864: Turbo Machinery Auxiliary Systems (Programme Elective-III)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Engineering Thermodynamics, Heat and Mass Transfer, Turbomachinery

Course Outcomes (CO): Students will able to

CO1	Understand the role, importance, and functional interdependence of auxiliary systems in rotating machinery.
CO2	Apply principles of lubrication systems and oil conditioning to identify suitable lubrication types, select appropriate lubricants for turbines, compressors, pumps, and motors.
CO3	Analyze the thermal management and cooling requirements of rotating equipment by evaluating cooling systems, heat exchanger configurations, air flow and ventilation strategies.
CO4	Evaluate the effectiveness and reliability of sealing systems and working-fluid handling arrangements.

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction to Auxiliary Systems & P&ID Fundamentals** Importance and role of auxiliary systems in rotating machinery, Common auxiliary systems across compressors, turbines, pumps, Functional blocks: lubrication, cooling, sealing, fuel/working-fluid systems, air handling, protection, monitoring, Basics of Piping & Instrumentation Diagrams (P&ID): symbols, tags, control loops, Functional interdependence of auxiliaries with prime movers	**CO1**	**(06)**
Unit 2	**Lubrication Systems & Oil Conditioning** Types of lubrication systems: pressure-fed, mist, splash, circulating oil systems. Components: oil pumps, coolers, filters, strainers, reservoirs, temperature control. Oil conditioning and contamination control. Lubricant selection for turbines, compressors, pumps, motors. Common failures: low oil pressure, overheating, varnish formation, air entrainment. Health monitoring of lubrication systems	**CO2**	**(07)**
Unit 3	**Cooling Systems, Heat Exchangers & Thermal Management** Cooling requirements for rotating machines. Jacket cooling, intercoolers, aftercoolers, lube oil cooling. Types of heat exchangers: plate, shell-and-tube, finned-tube. Air intake cooling, ventilation systems, exhaust management. Thermal stresses and temperature control strategies. Common issues: scaling, fouling, inadequate flow, hotspot formation	**CO3**	**(07)**
Unit 4	**Sealing Systems & Working-Fluid Handling** Mechanical seals, labyrinth seals, dry gas seals, gland sealing. Seal support systems (API 682 concepts). Working-fluid handling systems: gas conditioning, steam/condensate systems, fuel systems. Air handling systems: filters, silencers, ducting, pulsation control Priming, venting, drain systems for pumps and compressors. Failure modes: seal leakage, flashback, moisture ingress, suction issues	**CO4**	**(07)**

Assignments (minimum 4) One assignment on each unit.

Text Books

1. "*Plant Maintenance and Reliability Engineering*" N. V. S. Raju BSP Books / BS Publications
2. "*Turbines, Compressors & Fans*" S. M. Yahya Tata McGraw Hill Education
3. "*Textbook* of Power Plant Engineering" R. K. Rajput Laxmi Publications
4. "*An Introduction to Energy Conversion*", Vol. III: Turbo machinery V. Kadambi and Manohar Prasad New Age International Publishers

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Reference Books

1. "*Course in Power Plant Engineering*" S. C. Arora and S. Domkundwar Dhanpatrai & Co
2. "*Tribology - Lubrication, Wear and Friction*" Archana Sharma, B. K. Jain S. K. Kataria & Sons
3. "*Textbook of Reliability and Maintenance Engineering*" Mohit S. Maheshwarkar, Pallavi Maheshwarkar S.K. Kataria & Sons
4. "*Power Plant Engineering*" P. K. Nag Tata McGraw Hill Education

Useful Links
National Power Training Institute (NPTI) Courses https://npti.gov.in/en/training-programes
NPTEL (IIT Madras) Course https://onlinecourses.nptel.ac.in/noc25_me132/preview
Indian Oil (SERVO) Lubricants https://www.hindustanlubes.com/upload/page/ioc_product_line.pdf

Mapping of COs and POs

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	4	05
Understand	6	4	05
Apply	6	4	20
Analyse		4	20
Evaluate		4	10
Create		-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3815: Finite Element Analysis (Programme Elective –IV)

Teaching Scheme			Examination Scheme	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 min.

Prerequisite : -Strength of Materials, Numerical Methods

Course Outcomes (CO): Students will be able to

CO1	Understand FEA and its procedure to analyze 1D structural problems
CO2	Apply FEA concept to 2D elements
CO3	Analyze 1D dynamic analysis problems
CO4	Illustrate the computer implementation of the Finite Element Method using commercial software and explain its applications in various engineering fields.

	Course Contents	CO	Hours
Unit 1	**Introduction to Finite Element Analysis** Introduction to FEA, Brief History, General FEM procedure, Various terminologies associated with FEA (Discretization, nodes and element), Stiffness matrix and its properties.). Advantages and Disadvantages of FEA **Analysis of Bar, Composite Bar, Trusses** Stepped Bar, Truss (truss problems with 2 elements only) and single element beam problems, shape function and convergent criteria	**CO1**	**(06)**
Unit 2	**Approximate methods to solve differential equations** **Variational Principle** Principal of minimum potential energy, Rayleigh-Ritz method (application on 1D element) **Weighted Residual method** Galerkin's method (application on 1D element)	**CO1**	**(07)**
Unit 3	**2D Element** Introduction to 2D elements, Derivation of shape function for Rectangular Elements. Introduction to Isoparametric, Serendipity elements.	**CO2**	**(04)**
Unit 4	**Dynamic Analysis** Concept of point mass and distributed masses, Consistent element mass matrix of one-dimensional bar element. Lumped mass matrix of bar element. Evaluation of Eigen values and Eigen vectors- Applications to bar element only.	**CO3**	**(05)**
Unit 5	**Computer Implementation of the Finite Element Method** Introduction to commercial software (most preferred in Industry), Pre-processing (Application of Boundary Conditions, Elements and it's selection in commercial software packages, Materials Library, Meshing and its methods, Convergence requirements), Solution (Solvers: Direct, Iterative, RK based, Explicit, and Implicit). Application of FEM in various fields.	**CO4**	**(04)**

Text Books

1. "*Textbook of Finite Element Analysis*" P. Seshu, PHI Learning Pvt. Ltd., 2024 (Unit 1, 2, 3, 4)
2. "*A First Course in the Finite Element Method*" Daryl Logan, Sixth Edition, Cengage Learning India Private Limited, 2023 (Unit 1, 2, 3, 4, 5)
3. "*Practical Finite Element Analysis*" N.S. Gokhale, Finite to Infinite publication, 2008, (Unit 1, 2, 3, 5)

Reference Books

1. "*Introduction to Finite Element Method*" J. N. Reddy, 3rd Edition, Tata McGraw Hill publication co. ltd., 2017 (Unit 1, 2, 3, 4, 5)
2. "*Finite Element Procedures*" K.J. Bathe, PHI Learning Pvt. Ltd., 2nd edition, 2014 (Unit 1, 2, 3, 4, 5)
3. "*Introduction to Finite Elements in Engineering*", Tirupathi R. Chandrupatla, Ashok D. Belegundu, Cambridge University Press, 2022 (Unit 1, 2, 3, 4, 5)

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Useful Links

1. https://nptel.ac.in/courses/112104193 "Basics of Finite Element Analysis – I", Prof. Nachiketa Tiwari, IIT Kanpur
2. https://ocw.mit.edu/courses/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/ "Finite Elements Analysis of Solids and Fluids I", Klaus Jurgen Bathe, Department of Mechanical Engineering, MIT

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

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	2	-	-
Understand	6	4	10
Apply	4	4	10
Analyse	4	6	20
Evaluate	4	6	20
Create	-	-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3825: Industrial Fluid Power (Programme Elective-IV)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs. /week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs. 30 min.

Prerequisite : Fluid Mechanics

Course Outcomes (CO): At the end of this course, student will be able to:

CO1	Understand principles of hydraulics, pneumatics, fluid properties, ISO/JIC Symbols, and industrial applications of fluid power systems.
CO2	Apply appropriate fluid power accessories such as Direction Control valves, Pressure valves, seals for fluid power applications.
CO3	Analyse performance of different pumps, cylinders, actuators, used in fluid power systems.
CO4	Develop hydraulic/pneumatic circuits for different industrial operations.

	Course Contents	**CO**	**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	**CO1**	**(06)**
Unit 2	**Hydraulic System Elements:** Pumps types: Gear, lobe, screw, vane, piston, selection of pumps, pump performance – efficiencies. Hydraulic Cylinders: Types, single acting, double acting, telescopic and tandem, Hydraulic cushioning, cylinder force, velocity and power, acceleration and deceleration of cylinder loads, load calculations for vertical, horizontal and inclined cylinders Hydraulic Motors: Types, gear, vane and piston. Seals- Classification, Accumulators- types, selection, sizing accumulators, applications, fluid conditioners, filters and strainers, heat exchangers, hydraulic lines-sizing. **Pneumatic Systems** Compressors: Types, piston, screw and vane, power required to drive compressors, Fluid conditioners- Filters, Regulator, Lubricator, Muffler, FRL unit, air dryers, Air control Valves, Quick Exhaust Valves, Pneumatic actuators.	**CO1, CO3**	**(08)**
Unit 3	**Fluid Power Control Valves :** **Hydraulic Systems** Direction control valves: Types, check valves, two way, three way, shuttle valves, methods of actuation, Principle of pressure control valves, directly operated and pilot operated valves **Pneumatic Systems** Direction control valves (two way, three way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve.	**CO1, CO2**	**(06)**
Unit 4	**Basic Fluid Power Circuits :** **Hydraulic Systems** Control of a single and double acting hydraulic cylinder, Regenerative cylinder circuit, Counterbalance application, Hydraulic cylinder sequencing circuits, Speed control of hydraulic cylinder/motor. **Pneumatic Systems:** Manual control of single acting and double acting cylinder, Unidirectional and bi-directional speed control single acting cylinder, OR control of single acting cylinder, AND control of single acting cylinder, Bidirectional speed control of a double acting cylinder	**CO1, CO2, CO3, CO4**	**(06)**

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Govt. College of Engg., Karad

Text Books

1.	*"Oil hydraulics Systems"*, S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2017 (Unit 1, 2)
2.	*"Pneumatic Systems"*, S. R. Mujumdar, Tata McGraw Hill Publication, 1st Edition, 2017 (Unit 1, 2, 3)
3.	*"Fundamentals of Pneumatics and Hydraulics"* Md. Abdus Salam, Springer Singapore, 1st Ed 2022 (Unit 1, 2,3)
4.	*"Fluid Power with Applications"*, Anthony Esposito, Pearson Education Limited, 7th ed 2014 (Unit 1, 2, 3, 4)

Reference Books	
1.	"Hydraulics and Pneumatics", A. K. Upadhyay, S.K. Kataria and Sons.,1st Ed2009 (reprinted 2024) (Unit 2, 3)
2.	*"Fluid Power Engineering"*, M. Galal Rabie, McGraw Hill Education, 2nd Ed 2023 (Unit 2, 3, 4)
3.	*"Introduction to Hydraulic and Pneumatics"*, S. Ilango and V. Soundararajan, Prentice Hall of India, 2nd Ed, 2013.(Unit 1, 2)
4.	*"Fluid Power Systems"*, Patrick J. Klette, American Technical Publishers, 3rd Ed, 2022. (Unit 1, 2, 3, 4)
Useful Links	
1.	https://nptel.ac.in/courses/112105423"Introduction to power hydraulics", Prof. Niranjan Kumar, Department of mechanical Engineering, IIT (ISM) Dhanbad.
2.	https://nptel.ac.in/courses/112106300"Introduction to Oil Hydraulics and Pneumatics", Prof. Soma Shekhar S, Department of mechanical Engineering, IIT Madras.
3.	https://nptel.ac.in/courses/112105047"Fundamentals of Industrial Oil Hydraulics and Pneumatics", Prof. R. N. Maiti, Department of mechanical Engineering, IIT Kharagpur.

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

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	-
Understand	4	4	10
Apply	4	4	10
Analyze	4	4	20
Evaluate	4	4	20
Create	-	-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3835: Automobile Engineering (Programme Elective-IV)

Teaching Scheme			**Examination Scheme**	
Lectures	02Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Basic Mechanical Engineering

Course Outcomes (CO): Students will able to

CO1	Understand the components, layout and safety of automobile.
CO2	Apply the knowledge obtained in theory towards design and analysis of various automobile systems.
CO3	Analyze the effect of various factors on subsystems of automobile and remedies can be proposed.
CO4	Evaluate the performance of automobile.

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction to Automobile layout and transmission system** **Automobile layout** Classification of automobiles, Automobile subsystems, vehicle construction and layouts including EV layouts, chassis, frame and body, vehicle aerodynamics, function and materials. **Automobile transmission system** Classification of clutches, single plate, multi plate, cone, diaphragm spring, centrifugal, Clutch materials, Clutch plate, Vacuum operated clutch, fluid flywheel. Necessity of gear box, Manual gear box-constant mesh, sliding mesh, synchromesh, epicyclic, torque convertor, Continuous variable transmission, Electronic transmission control, Propeller shaft, Universal joint, Differential and final drive.	**CO1, CO2, CO3**	**(08)**
Unit 2	**Front axle and steering mechanism :** Front Axle, Bearing loads on the front axle, Fundamental condition for true rolling, Function of steering system, Steering geometry, Steering characteristics, Steering linkages & gearbox, Ackerman steering gear, Davis steering gear, Power steering-hydraulic and electric	**CO2, CO3**	**(04)**
Unit 3	**Suspension System** **Suspension: F**unctions, Types of suspension linkages, Types of spring - leaf, coil, air springs, telescopic shock absorber, Torsion bar, Hydro gas suspension, Rubber suspension, Interconnected suspension, Self-levelling suspension advances in suspension system, Air suspension.	**CO2, CO3**	**(06)**
Unit 4	**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)	**CO4**	**(08)**

Assignments (minimum 5) One assignment on each unit.

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Govt. College of Engg., Karad

Text Books

1.	"*Automobile Engineering*", G.B.S. Narang, Khanna Publication,3rd Edition, 1992, (Unit 1 to 3)
2.	"*Automobile Engineering*", Dr.Kirpal Singh (Vol. I) Standard Publishers, New Delhi 13th edition, 2014 (Unit 1 to 5)
3.	"*Automobile Mechanics*", N. K. Giri, Khanna Publishers, Delhi 12th edition, 2024 (Unit 1 to 4)
4.	"*MotorVehicle*" K. Newton and W. Seeds, T.K. Garrett, Elsevier publications, 13th Edition, 2001 (Unit 1 to 3)

Reference Books

1.	"*Automobile Mechanics*", W. H. Crouse, Tata McGraw Hill Publishing Co. 10th edition, 1993 (Unit 1 to 3)
2.	"*Automotive Mechanics*" , Heitner J. , 2nd ed., East-West Press, 1999 (Unit 1 to 3)

3.	"*Automobile Engineering*", R. B. Gupta, SatyaPrakashan, 10th edition, 2021 (Unit 1 to 4)
Useful Links	
1.	https://nptel.ac.in/courses/107106088 "Fundamentals of Automotive Systems", Prof. C. S. Shankar Ram, IIT Madras
2.	http://www.sae.org/automotive/ "Automobile transmission system", SAE.
3.	https://www.araiindia.com/#, ARAI, Ministry of Heavy Industries, Government of India

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

1: Slight(Low) 2: Moderate (Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	4	05
Understand	6	4	05
Apply	6	4	20
Analyse		4	20
Evaluate		4	10
Create		-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3845: Refrigeration & Air Conditioning (Programme Elective-IV)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	02 Hrs 30 Min

Prerequisite : Engineering Thermodynamics, Heat and Mass Transfer

Course Outcomes (CO): Students will able to

CO1	Understand fundamentals of refrigeration systems and its various applications
CO2	Apply knowledge for various multi-pressure systems of refrigeration.
CO3	Evaluate moist air properties, heat load in the context of air conditioning.
CO4	Analyze various non-conventional refrigeration systems and refrigerants.

	Course Contents	**CO**	**Hours**
Unit 1	**Recapitulation of Fundamentals** Methods of Refrigerations, Commercial unit of Refrigeration, Reversed Carnot cycle, Limitations of Carnot cycle., Energy Efficiency Ratios (EER), BEE star rating **Simple Vapour Compression System** Standard VCRS, Representation on P-h, T-S diagram, Actual VCR cycle	**CO1**	**(07)**
Unit 2	**Multi Pressure System** **Effect of operating conditions:** Need & Applications of Multi circuit Refrigerations system in industry, effect of evaporator pressure, effect of condenser pressure, effect of suction vapour superheat, effect of liquid sub cooling, Multi evaporator, Multi-compressor, Individual and multiple expansion valves, cascade system- Introduction only. **Maintenance & Troubleshooting of Refrigerations system.** Leak detection, evacuation, gas charging, brazing, and electrical circuit troubleshooting	**CO2**	**(05)**
Unit 3	**Air-conditioning Introduction** Properties of moist air, psychrometric chart usage, and air conditioning processes (heating, cooling, humidification, dehumidification). Psychometric processes on psychometric chart. Types of AC (Window, Split, Package), Centralized AC plants, automobile AC systems, and HVAC components (fans, blowers, filters, AHU, ATU, FCU, AFU etc.). Heat load calculations- identification of heat source – theoretical Treatment only. (HVAC system Design Aspect discussion)	**CO3**	**(06)**
Unit 4	**Refrigerants** Classification & ASHRAE nomenclature of refrigerants, Desirable properties of refrigerants. Commonly used refrigerants, Effect on Ozone depletion and global warming. Environmental protection protocol and India's commitment. **Latest Trends in Industry** Inverter AC, Variable Frequency drive, Magnetic Bearing Compressor (MBC), Screw Compressor, Trans critical CO_2 Refrigeration System, IOT applications of RAC system, Role of AI in domestic and industrial Refrigerations systems.	**CO4**	**(08)**

Assignments (minimum 4) One assignment on each unit

Text Books

1.	"*Refrigeration & Air-Conditioning*" by C. P. Arora, Tata McGraw Hill, 4rd edition, 2020 (Unit 1 to 4)
2.	"*A course in Refrigeration & Air Conditioning*" by Arora, Domukundwar, Dhanpat Rai Publications, 8th Edition, 2022 (Unit 1, 2, 3)
3.	"*Refrigeration & Air-Conditioning*" by Manohar Prasad, New Age International Publications, 3rd Edition, 2015 (Unit 3, 4)
4.	"*Refrigeration and Air conditioning*" by R. K Rajput, S.K. Kataria & Sons, 3rd Edition, 2015 (Unit 1, 2)

Reference Books

1.	ASHRAE Handbook Fundamentals, 2021, (Unit 4)

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Govt. College of Engg. Karad

2.	Carrier Handbook of Air Conditioning System Design, McGraw-Hill, 2021, (Unit 4)
3.	"*Principles of Refrigeration"* by Roy J. Dossat, Wiley Eastern Limited, New Delhi, 4th Edition 2006 (Unit 1, 2)
4.	"*Basic Refrigeration and Air Conditioning*" by P. N. Ananthanarayan, Tata McGraw Hill publishing Company Ltd., New Delhi, 3rd Edition, 2016 (Unit 1 to 4)
Useful Links	
1.	http://nptel.ac.in/courses/112105128/ , "Refrigeration and Air Conditioning", Prof. R.C. Arora, Prof. M. Ramgopal, IIT Kharagpur
2.	nptel.ac.in/courses/112107208/ "Refrigeration and Air Conditioning", Prof. Ravi Kumar, IIT Roorkee
3.	https://www.youtube.com/watch?v=zqXgmVnI3L8&list=PL803FA9B14AD00A5B "Refrigeration and Air Conditioning", Prof. M. Ramgopal, IIT Kharagpur

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	4	05
Understand	6	4	05
Apply	6	4	20
Analyse		4	20
Evaluate		4	10
Create		-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3855: Design of Turbomachinery (Programme Elective-IV)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs. /week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60
			Duration of ESE	2 Hrs 30 min.

Prerequisite : Fluid Mechanics, Thermodynamics, Turbomachinery

Course Outcomes (CO): At the end of this course, student will be able to:

CO1	Understand principle of operation and classification of turbo machines.
CO2	Apply design principles of turbo machinery to draw velocity diagrams, calculate performance parameters.
CO3	Apply Euler's equation, dimensional analysis for centrifugal turbo machines.
CO4	Evaluate the design considerations and material selection for different types of turbo machinery.

	Course Contents	**CO**	**Hours**
Unit 1	**Fundamentals of Turbo machines:** Classification of Turbo machines, Turbines, Pumps and compressors, Fans and blowers, Incompressible and compressible flow machine, Stages: Axial, radial, mixed, reaction and impulse. Variable reaction stage, Multistage, Stage velocity triangle, Design and off-design conditions.	**CO1**	**(06)**
Unit 2	**Design Fundamentals of Axial Flow Compressors and Turbines:** Introduction to stage theory and performance parameters (work done, efficiency). Application of continuity, momentum, and energy equations to axial flow blading. Design methodologies for blade geometry using mean line analysis and velocity triangles. Introduction to blade element theory and performance maps.	**CO2**	**(07)**
Unit 3	**Design Principles of Centrifugal Compressors and Pumps**: Overview of centrifugal compressor and pump stages. Application of Euler's equation for impeller design and performance prediction. Volute casing design principles for efficient flow guidance. Dimensional analysis and scaling laws for centrifugal machines.	**CO3**	**(07)**
Unit 4	**Material Selection and Stress Analysis for Turbomachinery components :** Selection of appropriate materials for blades, disks, and shafts based on strength, fatigue, and creep resistance.	**CO4**	**(06)**

Assignments (minimum 4) One assignment on each unit.

Text Books

1. *"Fluid Mechanics and hydraulic machines"*, Dr. R. K. Bansal, Laxmi Publications; 10th edition 2019.
2. *"Hydraulic Machines"* R. K. Rajput, S. Chand and Co. Ltd.,
3. *"Turbo machinery: Design and Theory"*, Rama S.R. Gorla and Aijaz A. Khan, Marcel Dekker Inc. 10th ed 2003
4. "*Hydraulics, Fluid Mechanics and machinery*", P. N. Modi and S.N. Seth, Standard Book House, New Delhi, 22nd Edition, 2019

Reference Books

1. *"Fluid Dynamics and Heat Transfer of Turbo machinery"* , Budugur Lakshminarayana, A John Wiley & Sons, Inc., Publication, 1st edition, 1996
2. *"Centrifugal Compressor Design and Performance"*, David Japikse, Concepts ETI, 1996
3. *"Principles of Turbo machinery"* , Seppo A. Korpela, A John Wiley & Sons, Inc., Publication, 1st edition, 2011
4. *"Computational Fluid Dynamics: The Basics with Applications"*, J.D. Anderson, McGraw-Hill, 8th edition, 1995

Useful Links

1. https://www.nptel.ac.in/
2. http://www.swayam.gov.in/

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	4	4	-
Understand	4	4	10
Apply	4	4	10
Analyze	4	4	20
Evaluate	4	4	20
Create	-	-	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3806: Mechanical System Design (Multi-disciplinary Minor-06)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60

Prerequisite : Nil

Course Outcomes (CO): Students will able to

CO1	Understand broad perspective and design process, standards and codes used in design practice.
CO2	Apply principles of aesthetics and ergonomics design principles in design.
CO3	Apply principles of design for manufacture in casting, forging machining & welding components.
CO4	Analyze and Apply design principles in real life engineering applications.

	Course Contents	**CO**	**Hours**
Unit 1	**Mechanical Engineering Design in broad perspective:** Definitions, skills needed in mechanical design, Basic procedure of machine design, basic requirements of machine elements in a machine. Traditional design methods, Design synthesis. Use of standards and codes in design, selection of preferred sizes (Numerical treatment also).	**CO1**	**(04)**
Unit 2	**Aesthetics and Ergonomics considerations in design** Aesthetics in product design, basic types of product forms, designing for appearance. Ergonomics in design, man-machine closed loop systems, design considerations in displays, design considerations in controls, layout of panels. Characteristics of human, general workplace environment	**CO2**	**(04)**
Unit 3	**Design for Manufacture, assembly and safety (casting & forging)** Introduction, principles for design for manufacture and assembly, design principles in casting, design principals in forging. Design principles in machining, design principles in welding. Selective Assembly, Design for safety.	**CO3**	**(07)**
Unit 4	**Statistical considerations in design** Statistics and design, variance, standard deviation and standard variable. Normal distribution and Gaussian distribution, confidence intervals, design and natural tolerances, statistical considerations for factor of safety.	**CO3**	**(07)**
Unit 5	**Other aspects of Design** (at basic level only) Mechanical Reliability and uncertainty, break even analysis, concurrent engineering, reverse engineering, Design for patents.	**CO4**	**(04)**

Assignments - One assignment on each unit.

Text Books

1.	"*Design of Machine Elements*" by V. B. Bhandari, McGraw Hill Education (India) Pvt Ltd, New Delhi, 5th Edition, 2021. (Unit 1, 2)
2.	"*Shigley's Mechanical Engineering Design*" by J. Keith Nisbett and Richard. G. Budynas, McGraw Hill, 12th Edition, 2024. (Unit 2, 3, 4)
3.	"Mechanical system design", Farazdak Haideri, Nirali Publication (Tech-Neo Pub), Pune, 4th edition, 2023 (Unit 3, 4)

Reference Books

1.	"*Machine Elements in Mechanical Design*" by Robert. Mott, Pearson publication, 6th ed., 2018 (Unit 1 to 6)
2.	"*Fundamentals of Machine Component Design*" by Robert C. Juvinall and Kurt. M. Marshek, Wiley Ltd., 6th Edition, 2017. (Unit 1 to 6)

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Useful Links

1	nptel.ac.in/courses/107103004 "Ergonomics for beginners: Industrial design perspective", Prof. Debkumar Chakrabarti, IIT Guwahati

2	nptel.ac.in/courses/107103012 "Design for Manufacture and Assembly(DFMA)", Abinash Kumar Swain, IIT Guwahati

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	6	10
Understand	6	6	10
Apply	6	4	20
Analyse		4	20
Evaluate		-	--
Create		--	-
TOTAL	20	20	60

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3807: Machine Design II Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite : Strength of Material, Machine Design I

Course Outcomes (CO): Students will be able to

CO1	Design and draw machine elements using standard design principles.
CO2	Perform design calculations and select appropriate machine elements based on design requirements.
CO3	Develop interactive MATLAB GUI applications for machine element design.
CO4	Analyze machine design problems using modern engineering approaches and case studies.

	Course Contents	CO
Experiment 1	Design and drawing of any one type of clutch	**CO1**
Experiment 2	Design and drawing of any one type of brakes	**CO1**
Experiment 3	Design of load calculation and selection of appropriate Roller bearing	**CO2**
Experiment 4	Design of any one type of hydrodynamic bearing.	**CO2**
Experiment 5	Write a MATLAB program to calculate the basic dimensions of a spur gear pair based on the transmitted power and speed.	**CO3**
Experiment 6	Development of an Interactive GUI for the Design of a Single Plate Clutch / helical spring / spur gear using MATLAB App Designer	**CO3**
Experiment 7	**Design Report** A detail design report and assembly drawing on A2 Size sheet containing working of Design of gear box using Spur /Bevel Gears (single stage only).	**CO4**
Experiment 8	**Case Study** A detailed case study on any one topic from the list given below or a related engineering problem, incorporating modern design approaches such as machine learning, or surrogate modeling. • Data-Driven Design of High-Pressure Cylinders • Surrogate Model for Lightweight Gearbox Components • Digital Twin-Based Bearing Life Prediction	**CO4**

List of Submission: Any Five experiments from Exp no. 1 to 6, Exp no. 7 and Exp no. 8 are mandatory

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Govt. College of Engg., Karad

Assessment Pattern:

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

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3808: Computer Integrated Manufacturing Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite : Machine Tools & Processes , Manufacturing Engineering, Non- Conventional Machining

CourseOutcomes(CO)

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

CO1	Understand the concept of manufacturing automation and factory automation
CO2	Design and develop a simple component using CNC Turning Operations
CO3	Design and develop a simple component using CNC Milling Operations
CO4	Demonstrate and perform the various advanced machining operations

	ListofExperiments	**CO**
Term work should consist of any 08 experiments from the following.		
Experiment 1	Robotpickand place programming	**CO1**
Experiment 2	Programming of ASRS	**CO1**
Experiment 3	Understanding construction of CNC lathe machine and learning G and M codes	**CO2**
Experiment 4	Programming for simple components on CNC Lathe machine	**CO2**
Experiment 5	Graphic simulations of CNC lathe operations for simple components	**CO2**
Experiment 6	Understanding construction of CNC milling machine and learning G and M codes	**CO3**
Experiment 7	Programming for simple components on CNC millingmachine	**CO3**
Experiment 8	Graphic simulation of CNC milling operations for simple components	**CO3**
Experiment 9	Demonstration of Electro Discharge Machining (EDM)	**CO4**
Experiment 10	Industrial Visit for Computer Integrated Manufacturing	**CO1, CO2, CO3, CO4**

MappingofCOs 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	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	2	3	2		1	2	2	3	3	3	3
CO 2	3	3	3	3	3	2		1	2	2	2	3	2	2
CO 3	3	3	3	3	3	2		1	2	2	2	3	2	2
CO 4	3	3	3	3	3	2		1	2	2	2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg., Karad

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

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3819: Finite Element Analysis Lab (Programme Elective –IV Lab)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite : Strength of Materials, Numerical Methods

Course Outcomes (CO): Students will be able to

CO1	Apply concepts of Finite Element Methods to solve 1D problems using coding platform
CO2	Illustrate use of commercial FEA software with appropriate use of element types, meshing etc.
CO3	Analyze 1D/2D/3D practical problem for structural/Fatigue/ Crash/ Multi-Body analysis using commercial FEA software
CO4	Evaluate natural frequency, mode shapes and temperature distribution using commercial FEA software

	Course Contents	**CO**
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	**CO1**
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	**CO1**
Experiment 3	Introduction to Finite Element Analysis software - assignment on modeling and meshing – Types of elements, choice of elements, type of meshing – automatic, mapped, meshing in critical areas	**CO2**
Experiment 4	FEA Modeling and Simulation of 1D problems using commercial software (ANSYS) and compare results with experiment 1/2 and hand calculations	**CO2,3**
Experiment 5	FEA Modeling and Simulation of 2D practical problems (plane stress/ plane strain/ axi-symmetric using commercial software.	**CO2,3**
Experiment 6	FEAModeling and Simulations of 1D/2D/3D practical problem: Static StructuralAnalysis	**CO2,3**
Experiment 7	FEA Modeling and Simulations of 1D/2D/3D practical problem: Modal Analysis	**CO2,4**
Experiment 8	FEA Modeling and Simulations of 1D/2D/3D practical problem: Heat Transfer Analysis	**CO2,4**
Experiment 9	FEA Modeling and Simulations of 1D/2D/3D practical problem: Buckling Analysis	**CO2,3**
Experiment 10	FEA Modeling and Simulations of 1D/2D/3D practical problem: Multi-Body Dynamic Analysis/ Crash Analysis etc.	**CO2,3**
Experiment 11	FEA Modeling and Simulations of 1D/2D/3D practical problem: Fatigue/ Harmonic/ Thermo-mechanical Analysis	**CO2,3**
Experiment 12	FEA Modeling and Simulations of any current industrial/ Research paper based problem	**CO2,CO3**

List of Submission: Minimum 10 experiments of the above

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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Govt. College of Engg., Karad

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	Exp10	Avg
Task I	10	10	10	10	10	10	10	10	10	10	10
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	5	5	5	5	5	5	5	5	5	5	5
ISE	25	25	25	25	25	25	25	25	25	25	25

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Govt. College of Engg., Karad

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3829: Industrial Fluid Power Lab (Programme Elective –IV Lab)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Prerequisite : Fluid Mechanics

Course Outcomes (CO): At the end of this course, student will be able to:

CO1	Describe basic hydraulic and pneumatic system, different types of control valves used in hydraulic and pneumatic systems.
CO2	Explain construction and working principle of different components used in hydraulic and pneumatic systems with their specific applications.
CO3	Develop a simple hydraulic/ pneumatic circuits using hydraulic / pneumatic trainer kit.
CO4	Design and simulate basic hydraulic/ pneumatic circuits using fluid simulation software for different input parameters.

Course Contents		CO
Experiment 1	Demonstration of basic hydraulic and pneumatic system	**CO1**
Experiment 2	Demonstration of different types of control valves used in hydraulic and pneumatic system	**CO1**
Experiment 3	Demonstration of actuators, accumulators, intensifiers and ancillary components used in hydraulic and pneumatic systems	**CO2**
Experiment 4	Preparation of circuits on Hydraulic trainer kit (Minimum 2)	**CO3**
Experiment 5	Preparation of circuits on Pneumatic trainer kit (Minimum 2)	**CO3**
Experiment 6	Preparation of hydraulic circuits using Fluid Simulation Software (Minimum 2).	**CO4**
Experiment 7	Preparation of pneumatic circuits using Fluid Simulation Software (Minimum 2).	**CO4**
Experiment 8	Design of hydraulic / pneumatic system with related components for any one of the industrial applications	**CO3**
Experiment 9	Preparation of circuits on Electro Hydraulic trainer kit	**CO3**
Experiment 10	Industrial visits are recommended to study basics, working operation and circuit diagram of pneumatic and hydraulic system applications and their reports.	**CO1, CO2**

List of Submission: All experiments from the above list.

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	Exp10	Avg
Task I	10	10	10	10	10	10	10	10	10	10	10
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	5	5	5	5	5	5	5	5	5	5	5
ISE	25	25	25	25	25	25	25	25	25	25	25

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3839: Automobile Engineering Lab (Programme Elective –IV Lab)				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		ISE	25
Total Credits	01		ESE	-

Course Outcomes (CO): Students will be able to

CO1	Understand four wheeler chassis layout and safety devices.
CO2	Conversant with different transmission system like clutch, gear box, final drive and differential.
CO3	Apply knowledge steering system, suspension system and braking system
CO4	Apply and Analyze knowledge of electronic ignition system, fuel supply system and automobile air condition system and To make student conversant about wheel alignment and balancing.

Course Contents		CO
Group A		
Experiment 1	Study and demonstration of four wheeler chassis layout and vehicle components	**CO1**
Experiment 2	Study and Demonstration of working of single plate and multiplate automobile clutch	**CO2**
Experiment 3	Study and demonstration of automatic transmission	**CO2**
Experiment 4	Study and demonstration of final drive and differential	**CO2**
Experiment 5	Study and demonstration of suspension system of a four-wheeler	**CO3**
Experiment 6	Study and demonstration of working air braking system and brake booster system	**CO3**
Experiment 7	Study and demonstration of fuel supply system of petrol engine	**CO4**
Experiment 8	Study and demonstration of automobile air conditioning system	**CO4**
Experiment 9	Study and demonstration of Two wheeled electric vehicle chassis layout.	**CO1**
Group B		
Experiment 10	Study of different safety devices in the vehicle	**CO1**
Experiment 11	Study of Wheel and tyre construction, Wheel alignment and balancing, Type of tyres, tyre specification, Tyre materials, Experiment on wheel balancing	**CO4**
Experiment 12	Visit to servicing station for study of vehicle maintenance, repairs and report	**CO1, CO2, CO3, CO4**

Term work should consist of any 07 experiments from the group A and All experiments from group B.

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	Exp10	Avg
Task I	10	10	10	10	10	10	10	10	10	10	10
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	5	5	5	5	5	5	5	5	5	5	5
ISE	25	25	25	25	25	25	25	25	25	25	25

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Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME 3849: Refrigeration and Air Conditioning Lab (Programme Elective –IV Lab)

Teaching Scheme			**Examination Scheme**	
Practical	02 Hrs/week		ISE	25
Tutorials	-		ESE	-
Total Credits	01			

Prerequisite : Engineering Thermodynamics, Heat and Mass Transfer

Course Outcomes (CO): At the end of this course, student will be able to:

CO1	Understand basics of refrigeration system
CO2	Apply the knowledge of refrigeration for selection of various system components and accessories
CO3	Evaluate performance of Refrigeration and Air Conditioning Systems
CO4	Analyze 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, demonstration & selection of various refrigerant compressors (Scroll, Reciprocating rotary, screw, centrifugal etc.)
Experiment 2	Study, demonstration & Selection of various Evaporator (Shell & Tube, PHE, Flooded Evaporator, DX Evaporator etc.)
Experiment 3	Study, demonstration & Selection of various Condenser (Shell & Tube, Coil & Fin, Air Cooled, Water Cooled etc.)
Experiment 4	Study, demonstration & Selection of various Expansion Valve (Thermostatic Bulb Type, Electronic Expansion valve type etc.)
Experiment 5	Study and demonstration of dehydration, leak testing and charging, Vacuuming of refrigeration system.
Experiment 6	Study of refrigeration Components, tools & Accessories including Different Valves (Ball Valve, Butterfly valve, Schrader Valve, check valve, Packless valve, Check & Stop Valve etc.
Experiment 7	Study and demonstration of Refrigerations controls and safety devices in refrigeration and air conditioning.
Experiment 8	Study and trial on cascade refrigeration system.
Experiment 9	Trial on air conditioning test rig
Experiment 10	Industrial visit to cold storage / dairy plant/Refrigeration Industry to study refrigeration system.
Experiment 11	Study, demonstration & selection electrical circuit diagram for any RAC systems
Experiment 12	Trial on any chilled water systems.

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.

List of Submission: Any 9 experiments from the above list with compulsory Group Activity.

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

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	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

Government College of Engineering, Karad					
Final Year (Sem – VIII) B. Tech. Mechanical Engineering					
ME3859: Design of Turbomachinery Lab (Programme Elective Lab-IV)					
Laboratory Scheme:			**Examination Scheme:**		
Practical	02 Hrs/week		ISE	25	
Total Credits	01		ESE	-	
Prerequisite : Fluid Mechanics, Thermodynamics, Turbomachinery					
Course Outcomes (CO): Students will be able to					
CO1	Understand functions and working of different turbo-machines.				
CO2	Apply design procedure for designing of Impulse turbines.				
CO3	Apply design procedure for designing of Reaction turbines.				
CO4	Apply design procedure for designing of centrifugal pumps and compressors				

	Course Contents	**CO**
Experiment 1	Design of Impulse turbine (Pelton wheel) and study of the performance characteristics curves.	**CO1, 2**
Experiment 2	Design of reaction turbine (Francis) and study of the performance characteristics curves.	**CO1, 3**
Experiment 3	Design of reaction turbine (Kaplan) and study of the performance characteristics curves.	**CO1, 3**
Experiment 4	Design of centrifugal pump and study of the performance characteristics curves.	**CO1, 4**
Experiment 5	Design of Axial flow compressor and study of the performance characteristics curves.	**CO1, 4**
Project	Detailed Case study on CFD analysis of any one (Turbines / pumps/ compressor) turbo machinery.	**CO1, 2, 3, 4**
List of Submission: Any 4 out of experiment no. 1 to 5 & Project is mandatory		

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Avg.
Task I	10	10	10	10	10	10
Task II	10	10	10	10	10	10
Task III	5	5	5	5	5	5
ISE	25	25	25	25	25	25

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad				
Final Year (Sem – VIII) B. Tech. Mechanical Engineering				
ME3810: Major Project				
Laboratory Scheme:			**Examination Scheme:**	
Practical	08 Hrs/week		ISE	75
Total Credits	04		ESE	50

Course Outcomes (CO)

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

CO1	Participate in team oriented, open ended activities that prepare them to work in integrated engineering teams both as team members and as leaders to communicate effectively using modern tools.
CO2	Communicate to improve the professional competency, ethics, innovative and research aptitude in relevant area.
CO3	Generate and implement innovative and sustainable ideas for social and technological benefit.
CO4	Develop the work practice in students to apply theoretical and modern tools/techniques to solve real life problems related to industry and current research.

Course Contents

Project load: Students have to form a group of minimum two to maximum five.

Guidelines:

Students should conduct literature survey / visit industry / analyze current trends and identify the problem for Project and finalize in consultation with Guide. Students should attempt solution to the problem by experimental / simulation methods. The solution to be validated with proper justification and report to be compiled in standard format.

Guidelines for Project Identification :

Project work shall be based on any of the following:

1. Design / Fabrication of product / testing setup of an experimentation unit / apparatus / small equipment, in a group with engineering analysis / performance analysis / modeling *etc.*
2. Experimental verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.
4. Students should maintain project diary/project workbook as per format provided by department.
5. Students should do the report writing preferably using LaTex.

Project Evaluation

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 Project report 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 project report. The final evaluation of the project shall be done by external evaluator.

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. Left Margin: 1.5 inches
3. Top, bottom and right margin: 1.00 inch
4. Para Text: Times New Roman 12 point font
5. Line Spacing: 1.5 Lines
6. Page Numbers: Right Aligned at Footer. Font 11 Point Times New Roman
7. Headings: Times New Roman, 14 Point Bold face
8. 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
9. Index of Report: i) Title Sheet ii) Certificate iii) Acknowledgement iv) Table of Contents. v) List of Abbreviations / Figures / Tables / symbols.
10. Report writing of the project describing introduction, literature review, design, process, fabrication, results and discussion, conclusion and future scope in maximum six chapters followed by references.
11. References should have the following format For Books: Authors, "Title of Book", Publisher, Edition For Papers: "Title of Paper", Authors, Journal/Conference Details, Year
12. 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
13. Presentation: The group has to make a presentation in front of the examination panel at the end of semester.

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg., Karad

Guidelines for presentation

Follow these rules for presentation

- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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
  - Keep the text content to a minimum
  - Use large font sizes
  - Make sure fonts are readable
  - Use color sparingly
  - Enhance the data with charts and graphs
  - Design for wide screen formats
  - Be consistent with style settings
  - Use animations sparingly
  - Proofread everything
  - 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?
8. What pollution measures were taken / understood while doing this project for waste disposal?
9. What is most important part of project you remember?
10. What is current issue in technical field you find most challenging?
11. Do you think this project is useful? What is its use?
12. Is there any scope for research you find while undergoing this project?

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg., Karad

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	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	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	ESE
Remember	10	5
Understand	10	5
Apply	15	10
Analyse	15	10
Evaluate	15	10
Create	10	10
TOTAL	75	50

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FINAL YEAR

B.TECH MECHANICAL ENGINEERING

COURSE SYLLABI

FOR

SEMESTER VIII

(Mode-1-Internship)

Government College of Engineering, Karad

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

ME3811: MOOC I

Teaching Scheme			**Examination Scheme**	
Lectures	-		MSE	-
Tutorials	-		ISE	-
Total Credits	3		ESE	100

Contents

Guidelines

- Students must enroll**only in approved MOOC** available on **SWAYAM/NPTEL** platforms.
- The department will provide a list of eligible and recommended courses**.**
- Mode-1 students are permitted to enroll in MOOC courses of Semester VIII during Semester VII with prior approval of the respective Head of Department. The results of these MOOC courses will be considered in Semester VIII.
- **Prior approval from the BoS Chairman/ HOD** is mandatory before course enrollment.
- The **final list of enrolled MOOC** will be approved and recorded by the department **before course commencement**.
- Each MOOC must have a **duration of minimum 8weeks**.
- Students may select any **one specialization area** from the following:
  Thermal and Fluid Sciences,
  Manufacturing Engineering,
  Design and Analysis,
  CAD, CAM, CIM,
  Robotics and Automation,
  Computational Mechanics,
  Mechatronics,

Any other Emerging Technology in mechanical engineering

Students must:

- Attend/view all lecture videos regularly.
- Complete and submit all assignments and quizzes on time
- Appear for and pass the **final proctored examination** conducted by the MOOC platform.

Upon completion

- Submit the**MOOC completion certificate** to the Departmental MOOC Coordinator.
- The Coordinator will **verify authenticity** and maintain semester-wise records.
- Verified certificates will be **forwarded to the Controller of Examinations (COE), GCE Karad.**

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3812: MOOC II

Teaching Scheme			**Examination Scheme**	
Lectures	-		MSE	-
Tutorials	-		ISE	-
Total Credits	3		ESE	100

Guidelines

- Students must enroll**only in approved MOOC** available on **SWAYAM/NPTEL** platforms.
- The department will provide a list of eligible and recommended courses.
- Mode-1 students are permitted to enroll in MOOC courses of Semester VIII during Semester VII with prior approval of the respective Head of Department. The results of these MOOC courses will be considered in Semester VIII.
- **Prior approval from the BoS Chairman/ HOD** is mandatory before course enrollment.
- The **final list of enrolled MOOC** will be approved and recorded by the department **before course commencement**.
- Each MOOC must have a **duration of minimum 8 weeks**.
- Students may select any **one specialization area** from the following:
  Thermal and Fluid Sciences,
  Manufacturing Engineering,
  Design and Analysis,
  Robotics and Automation,
  Computational Mechanics,

Any other Emerging Technology in mechanical engineering

Students must:

- Attend/view all lecture videos regularly.
- Complete and submit all assignments and quizzes on time
- Appear for and pass the **final proctored examination** conducted by the MOOC platform.

Upon completion

- Submit the**MOOC completion certificate** to the Departmental MOOC Coordinator.
- The Coordinator will **verify authenticity** and maintain semester-wise records.
- Verified certificates will be **forwarded to the Controller of Examinations (COE), GCE Karad.**

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3813: Internship

Teaching Scheme			Examination Scheme	
Lectures	-		MSE	-
Tutorials	-		ISE	250
Total Credits	12		ESE	250

Course Outcomes (CO): Students will be able to

CO1	Apply theoretical and technical knowledge to solve practical problems encountered in industry or research environments.
CO2	Analyze professional challenges and implement appropriate engineering solutions.
CO3	Develop effective teamwork, communication, and project management skills through hands-on experience.
CO4	Demonstrate professional ethics, discipline, and adaptability in real-world engineering contexts.

Guidelines for Semester VII (Mode–2 Internship)

The internship under **Mode–2** is applicable to students opting for a **six-month internship during Semester VII** of the B. Tech program. This provision facilitates **early industry or research engagement** immediately after the completion of the VI semester. Students must choose either **Mode–1** or **Mode–2** at the beginning of the semester.Department will allot the Guide to student at the start of semester.

The internship shall be of **six months (one full semester) duration**. Students can undertake their internship at:

- **Recognized industries or Organizations** such as Maharatna / Navratna / Miniratna PSU's, reputed MNC's and Limited, Private Limited, MSME companies, Service industries relevant to their specialization.
- **Research institutions or government organizations** such as DRDO, ISRO, BARC, IGTR, CMTI, MSEB, Power Plant (Thermal/Hydro), MSRTC workshop, Central Railway workshop, BEST, METRO, Marathwada Autocluster, CIPET or reputed universities.
- **Start-ups and innovation centers** working in areas like IoT, additive manufacturing, product design, machine learning and automation etc.
- **Authorized training centers or industrial partners**

All internships shall be undertaken **with prior approval** as per the **Institution's Internship Policy**. The internship is **mandatory** and shall be treated as a **head of passing** for the award of the B.Tech degree. It aims to provide **experiential learning, professional exposure, and practical application of theoretical knowledge** to real-world scenarios.

Mode of Internship

a) Research Internship

- **Location:** Reputed research Organizations, R&D laboratories, Centers of Excellence, or Incubation Centers.
- **Objective:** To gain exposure to research methodologies, advanced tools, and analytical techniques.
- **Expected Outcome:** Development of analytical reasoning, experimental proficiency, and technical writing skills for higher research or academic progression.

b) Industry Internship

- **Location:** Recognized industries, MSMEs, start-ups, or technology-driven companies.
- **Objective:** To gain hands-on experience in industrial environments and apply engineering knowledge to solve professional challenges.
- **Expected Outcome:** Strengthened professional competencies, teamwork, adaptability, and real-world problem-solving abilities.

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg. Karad

*For any odd cases arising final decision will be taken by BoS Chairman and as per the Institute internship policy

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

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	ISE	ESE
Remember	25	25
Understand	25	25
Apply	75	75
Analyse	75	75
Evaluate	25	25
Create	25	25
TOTAL	250	250

Chairman BoS
Mechanical Engineering Dept.
Govt. College of Engg., Karad

Government College of Engineering, Karad

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

ME3806: Mechanical System Design (Multi-disciplinary Minor-06)

Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		MSE	20
Tutorials	--		ISE	20
Total Credits	02		ESE	60

Prerequisite : Nil

Course Outcomes (CO): Students will able to

CO1	Understand broad perspective and design process, standards and codes used in design practice.
CO2	Apply principles of aesthetics and ergonomics design principles in design.
CO3	Apply principles of design for manufacture in casting, forging machining & welding components.
CO4	Analyze and Apply design principles in real life engineering applications.

	Course Contents	**CO**	**Hours**
Unit 1	**Mechanical Engineering Design in broad perspective:** Definitions, skills needed in mechanical design, Basic procedure of machine design, basic requirements of machine elements in a machine. Traditional design methods, Design synthesis. Use of standards and codes in design, selection of preferred sizes (Numerical treatment also).	**CO1**	**(04)**
Unit 2	**Aesthetics and Ergonomics considerations in design** Aesthetics in product design, basic types of product forms, designing for appearance. Ergonomics in design, man-machine closed loop systems, design considerations in displays, design considerations in controls, layout of panels. Characteristics of human, general workplace environment	**CO2**	**(04)**
Unit 3	**Design for Manufacture, assembly and safety (casting & forging)** Introduction, principles for design for manufacture and assembly, design principles in casting, design principals in forging. Design principles in machining, design principles in welding. Selective Assembly, Design for safety.	**CO3**	**(07)**
Unit 4	**Statistical considerations in design** Statistics and design, variance, standard deviation and standard variable. Normal distribution and Gaussian distribution, confidence intervals, design and natural tolerances, statistical considerations for factor of safety.	**CO3**	**(07)**
Unit 5	**Other aspects of Design** (at basic level only) Mechanical Reliability and uncertainty, break even analysis, concurrent engineering, reverse engineering, Design for patents.	**CO4**	**(04)**

Assignments - One assignment on each unit.

Text Books

1.	"*Design of Machine Elements*" by V. B. Bhandari, McGraw Hill Education (India) Pvt Ltd, New Delhi, 5th Edition, 2021. (Unit 1, 2)
2.	"*Shigley's Mechanical Engineering Design*" by J. Keith Nisbett and Richard. G. Budynas, McGraw Hill, 12th Edition, 2024. (Unit 2, 3, 4)
3.	"Mechanical system design", Farazdak Haideri, Nirali Publication (Tech-Neo Pub), Pune, 4th edition, 2023 (Unit 3, 4)

Reference Books

1.	"*Machine Elements in Mechanical Design*" by Robert. Mott, Pearson publication, 6th ed., 2018 (Unit 1 to 6)
2.	"*Fundamentals of Machine Component Design*" by Robert C. Juvinall and Kurt. M. Marshek, Wiley Ltd., 6th Edition, 2017. (Unit 1 to 6)

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Mechanical Engineering Dept.
Govt. College of Engg., Karad

Useful Links

1	nptel.ac.in/courses/107103004 "Ergonomics for beginners: Industrial design perspective", Prof. Debkumar Chakrabarti, IIT Guwahati

2	nptel.ac.in/courses/107103012 "Design for Manufacture and Assembly(DFMA)", Abinash Kumar Swain, IIT Guwahati

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	MSE	ISE	ESE
Remember	8	6	10
Understand	6	6	10
Apply	6	4	20
Analyse		4	20
Evaluate		-	--
Create		--	-
TOTAL	20	20	60

Note: For MDM 6 Industry mode students, lectures will be conducted in online mode (with the flexibility of sharing recorded lectures) while MSE & ESE evaluation will be in offline mode.

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