NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Mechanical Engineering

Faculty of Engineering and Technology

Course Outline

SEMESTER – VII and VIII

W.E.F 2015 – 2016

North Maharashtra University, Jalgaon
Syllabus Structure for Final Year Mechanical Engineering w.e.f year 2015-16
Semester –VII

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Refrigeration and Air Conditioning	D	3	---	---	3	20	80	---	---	100	3
	Computer Aided Design and Computer Aided Manufacturing	D	3	---	---	3	20	80	---	---	100	3
	Interdisciplinary Elective	E	3	---	---	3	20	80	---	---	100	3
	Elective-I	E	3	---	---	3	20	80	---	---	100	3
	Operation Research	D	3	---	---	3	20	80	---	---	100	3
	CAD/CAM	D	---	---	2	2	---	---	25	25	50	1
	RAC	D	---	---	2	2	---	---	25	25 PR	50	1
	Elective-I	E	---	---	2	2	---	---	25	25	50	1
	Project–I	D	---	---	2	2	---	---	25	25	50	2
	Seminar-II	D	---	---	2	2	---	---	25	---	25	2
	Industrial Visit	D	---	---	---	---	---	---	25	---	25	1
	Total		15	---	10	25	100	400	150	100	750	23

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

	Interdisciplinary Elective		**Elective – I**
1	Operation Research Techniques	1	Mechatronics
2	Energy Resources and Technology	2	Advanced Machine Design
		3	Machine Tool Design
		4	Automobile Engineering – I

North Maharashtra University, Jalgaon
Syllabus Structure For Final Year Electrical Engineering w.e.f year 2015-16
Semester –VIII

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Mechanical Vibration	D	3	---	---	3	20	80	---	---	100	3
	Finite Element Analysis and Simulation Techniques	D	3	---	---	3	20	80	---	---	100	3
	Elective-II	E	3	---	---	3	20	80	---	---	100	3
	Elective-III	E	3	---	---	3	20	80	---	---	100	3
	Mechanical Vibration	D	---	---	2	2	---	---	25	25	50	1
	Finite Element Analysis and Simulation Techniques	D	---	---	2	2	---	---	25	25 PR	50	1
	Elective-II	D	---	---	2	2	---	---	25	25	50	1
	Industrial Lecture*	E	---	---	1*	1	---	---	50	---	50	2
	Project–II	D	---	---	4	4	---	---	75	75	150	6
	Total		12	---	11	23	80	320	200	150	750	23

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

	Elective-II		**Elective – III**
1	Tribology	1	Introduction to Robotics
2	Power Plant Engineering	2	Advanced Welding Technology
3	Process Equipment Design	3	Energy Conservation and Management
		4	Automobile Engineering – II
		5	Thermal Equipment design

Course Outline

Refrigeration and Air Conditioning **RAC**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course Familiarize under graduate students with the terminologies associated with refrigeration & air conditioning, basic principles of psychrometry and applied psychometrics, refrigerants; vapor compression refrigeration and multi-stage vapor compression systems, components of vapor compression systems and other types of cooling systems.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Engineering Thermodynamics, Applied Thermodynamic, and Heat Transfer

Outline of Content: This course contains:

UNIT-I

1.	**Refrigeration systems**	**No. of Lectures –9, Marks : 16**
	a	Introduction, standard rating of refrigerating machine, coefficient of performance of refrigerator and heat pump.
	b	Reversed Carnot cycle and its limitations, reversed Brayton cycle, application to air craft refrigeration, Bootstrap refrigeration cycle, reduced ambient air cooling system, regenerative air cycle system.
	c	Designation of refrigerant, selection of refrigerant, chemical, physical and thermodynamic requirements of refrigerants, lubricant in refrigerating system, secondary refrigerant, azeotropes and its uses.

UNIT-II

2.	Vapour compression refrigeration system	No. of Lectures–9, Marks : 16
	a	Vapour compression refrigeration system study of theoretical and actual vapour compression cycle, use of p-h & T-s charts, effect of evaporator and condenser pressure and temperature on the performance of the refrigeration cycle, effect of sub cooling and super heating.
	b	Compound vapour compression system with inter cooling, flash chamber, multi compressor and multi evaporators systems.
	c	Cascade refrigeration system, production of dry ice.

UNIT - III

3.	Vapour absorption refrigeration systems	No. of Lectures–8, Marks : 16
	a	Vapour absorption refrigeration simple & modified vapour absorption refrigeration systems, Electrolux refrigerator.
	b	Desirable properties of soIVent, absorbent & refrigerant combinations, aqua ammonia & lithium bromide refrigeration system use of enthalpy concentration charts.

UNIT - IV

4.	Basic of Psychometric	No. of Lectures –8, Marks : 16
	a	Psychometric- properties of moist air, psychometric chart and process, mixing of air stream, bypass factor, sensible heat factor, room sensible heat factor, Gross sensible heat factor, humidifying efficiency, air washer.
	b	Study of various types of psychometers, sling, aspirating, and industrial type.

UNIT-V

5.	Air Conditioning System	No. of Lectures –8, Marks : 16
	a	Introduction to industrial and comfort air conditioning, human requirements of comfort, effective temperature and comfort chart.
	b	Air conditioning load calculations, inside and outside design conditions, Building cooling & heating load calculation, Effective sensible heat factor advanced psychrometry.
	c	Window and central air conditioning systems year round air conditioning.

Text Book and Reference Books

1. Arora C. P., “Refrigeration and air conditioning”, TMH, New Delhi.
2. Monohar Prasad, “Refrigeration and air conditioning”, New Age Publishers, New Delhi.
3. Ananthnarayanan, “Basics of Refrigeration”, TMH, and New Delhi.
4. Stocker W. F. and Jones, “Refrigeration and air conditioning”, McGraw Hill.
5. Dossat, “Principles of Refrigeration”, John Wiley Inc.
6. Arora and Domkundawar, “Refrigeration and air conditioning”, Dhanpatrai and sons, New Delhi.
7. Faye C McQuistom, “Heating Ventilatgingnad Air conditioning”, Wiley India Pvt. Ltd. New Delhi

Course Outline

Computer Aided Design and Computer Aided Manufacturing CAD/CAM

Course Title: Short Title Course Code

Branch- Mechanical Engineering Year–Fourth Year

Course Description: The course presents the elements of solid modeling, creation of parts of increasing complexity and the assembly of parts to form a final design, along with mechanism simulation. The operation and programming of CNC machines is covered.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge about the Design and Automation of Manufacturing Process, Strength of Materials, Engineering Mechanics, etc

Outline of Content: This course contains:

UNIT-I

1.	**Introduction To CAD/CAM And Networking**	**No. of Lectures–9, Marks : 16**
	a	Define CAD/CAM, Product Life Cycle & CAD/CAM, and Application of Computers for Design Process, Selection of a CAD system, Desirable relationship of CAD/CAM database, Benefits & Application of CAD.
	b	Hardware in CAD, Introduction, The Design Work Station, The graphics terminal, Operator input/output devices,
	c	Computer communication, Principle of networking, Classification of network, Transmission media & interface, LAN system.

UNIT - II

2.	Computer Aided Graphics No. of Lectures –9, Marks : 16	
	a	Introduction, Graphic Primitives, Point plotting, Drawing of lines, Co ordinate system used in graphic element, Transformation in graphics,
	b	2D transformation, Homogeneous transformation, Concatenate co ordinate transformation, Translation, Rotation, Scaling, Mirror, Reflection, Inverse co ordinate transformation, clipping,
	c	3D transformation, View Port, Windowing, Standardization in graphics IGES files.

UNIT - III

3.	Computer Aided Modeling & Automation No. of Lectures–8, Marks : 16	
	a	Requirement of Geometric Modeling, Geometric Model, Geometric Model Construction Method: Wire Frame Modeling, Surface Modeling, Solid Modeling, Representation of Curve & Surfaces, Design of curve shape, Cubic Spline, Bezier curve, B-spline curve
	b	AUTOMATION: Concept of Automation, Types of Automation, Advantages & limitations of Automation, Levels of Automation, Advanced Automation Function.

UNIT - IV

4.	Computer Aided Manufacturing No. of Lectures –8, Marks : 16	
	a	INDUSTRIAL CONTROL SYSTEM Continuous control system, Discrete control system, Computer process control, Forms of CPC, Computer process Monitoring, Direct Digital Control, Numerical Control & Robotics, Programmable logic controller, Supervisory control, Distributed Control & Personnel Computers
	b	CNC PROGRAMMING Axis of CNC Machines, Manual Part Programming using G and M codes Adoptable to Fanuc Controller for Lathe.

UNIT-V

5.	Introduction to FMS, GT and Robotics No. of Lectures–8, Marks : 16	
	a	FMS – Introduction, Components of FMS, Types of FMS, Application & Benefits, Planning & implementation issue, Typical FMS layout.
	b	GT – Part families, Part classification & coding, optic coding system, Multiclass coding system, Application of GT.
	c	Robotics – Robot Anatomy, Robot Control System, End effectors, Sensors, Industrial Robot, Application and its selection.

Text Book and Reference Books

Text Book and References Books

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM – Theory and Practice Tata McGraw Hill Publishing Co. 2009
2. Ibraim Zeid, "Mastering CAD/CAM" – Tata McGraw Hill Publishing Co. 2000

3. Chandrupatla T.R. And Belegunda A.D. -Introduction to Finite Elements in Engineering" -Prentice Hall India
4. Segerling L.J. - Applied Finite Elements Analysis" John Wiley and Sons.
5. Rao P.N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
6. Groover M.P.-Automation, production systems and computer integrated manufacturing" -Prentice Hall of India
7. Yoram Koren - Robotics McGraw Hill Publishing Co.
8. James G. Keramas, Robot Technology Fundamentals, Delmar Publishers.
9. S.R.Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
10. Lakshiminarayana H. V. Finite Element Analysis (Procedures in Engineering), University Press, 2004.
11. Chandrupatla T. R., Finite Element Analysis for Engineering and Technology, University Press, 2009.
12. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010.
13. P. Radhkrishnan, S. Subramanyam, V. Raju ,"CAD/CAM/CIM" , New Age Publication.
14. Mikell P. Grover, Emory W. Zimmers ,"Computer Aided Design and Manufacturing", P.H.I.
15. Zeid ,"CAD/CAM" ,T.M.H.
16. B.S.Pabla, M.Adithan ,"CNC Machine ", New Age International(P) Ltd.
17. Rao, Tiwari, Kundra ,"Computer Aided Manufacturing" ,T.M.H.
18. CAD/CAM & AUTOMATION by FarazdakHaidri

Interdisciplinary Elective
Course Outline

Operation Research Techniques **ORT**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces under graduate students to imparting knowledge of various decision making techniques.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge about mathematics & statics.

Outline of Content: This course contains:

UNIT-I

1.	**Linear Programming**	**No. of Lectures –9, Marks : 16**
	a	**Operation Research – An Introductions** The history of OR, Definition, Features, of OR, models and modeling in OR, OR approach to problem soIVing, methods for soIVing OR models, phases of OR, Advantages of OR study, Shortcomings of OR approach, OR Models in Practice, Applications of OR.
	b	**Linear Programming**- Introduction, general Stricture of LP model, Assumption of an LP model, Advantages and Limitations of Linear programming, Applications areas of LP, steps of LP Model formulation, Graphical solution methods of LP problem, maximization, minimization, feasible, infeasible and unbounded solution.

UNIT - II

2.	**Linear Programming**	**No. of Lectures –9, Marks : 16**
	a	Linear programming – The simplex method Introduction, standard form of an LP problem, simplex algorithm (maximization, minimization case) Degeneracy in simplex problem, unbounded Infeasible solution.
	b	Duality in Linear programming, formulation of dual LPP, Advantages of duality, rules for constructing the Dual from primal, sensitivity Analysis in LP

UNIT - III

3.	Transportation Theory No. of Lectures –8, Marks : 16	
	a	Transportation problem introduction, mathematical model of transportation problem, Algorithm, methods for finding initial solution northwest corner method ,Least cost method, vogels Approximation method, test for optimality steps of MODI method, maximization problem, unbalanced, degeneracy, prohibited transportation Routes problem.
	b	Assignment problem- introduction, mathematical models of assignment problem, solution method of assignment problem, Hungarian method, maximization case, unbalanced Restrictions on assignment, travelling salesman, problem

UNIT - IV

4.	Decision Making Theory No. of Lectures –8, Marks : 16	
	a	Decision Theory- Introduction, steps in decision making process types of decision making Environments, Decision tree
	b	Theory of games- introduction ,Two person Zero sum game, pure strategies, maximin, minimax principles, game with saddle point, mixed strategy games, The principles of dominance ,games without saddle point,algebraic method, arithmetic method, sub game method, Graphical method.

UNIT-V

5.	Sequencing No. of Lectures –8, Marks : 16	
	a	Replacement and maintenance method- Introduction, types of failure- gradual failure ,sudden failure Replacement of items whose efficiency deteriorates with time, Replacement of items that completely fail, individual replacement policy, Group replacement policy, staffing problem ,failure trees.
	b	Sequencing problem- Introduction notations, Terminology, and assumptions of sequencing problem, Processing n jobs through two machines, Processing n jobs through three machines, Processing n jobs through four machines, Processing n jobs through five machines

Text Book and Reference Books

1. Hira , Gupta ,"Operation Research
2. Taha ,"Operation Research"
3. S.D. Sharma, "Operation Research", Khanna Publication
4. Manohar Mahajan, "Operation Research.
5. J. K. Sharma ,"Operation Research, Problem and Solution" , Macmillan
6. N. D. Vohra ,"Quantitative Techniques in Management" ,TATA McGraw Hill
7. Ravindran," Operation Research Principles and Practice ",Wiley India Pvt.Ltd. New Delhi

Interdisciplinary Elective

Course Outline

Energy Resources and Technology **ERT**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course provides an introduction to energy systems, renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technological applications. The course will explore society's present needs and future energy demands and also focus on renewable energy sources and technological aspects of solar, biomass, wind power, geothermal, and nuclear energy conservation methods.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Thermodynamics.

Outline of Content: This course contains:

UNIT-I

1.	**Energy Overview and Thermal Power Plants**	**No. of Lectures–9, Marks : 16**
	A	Energy Overview: Basics of energy – Types of energy and its utilization – Energy Characteristics – Energy Measures – global energy scenario – India energy scenario – Types of energy and its utilization, Environmental aspects of energy utilization – Public health issues related to environmental Pollution
	B	Overview of Thermal Power Plants, Types of fuels – Coal quality, By products of combustion, Thermal power plant cycle, General layout of modern thermal power plants, Environmental aspects of thermal power plants

UNIT - II

2.	Solar Photovoltaic Energy Conversion No. of Lectures–9, Marks : 16	
	a	Photovoltaic Conversion, Silicon Solar Cells, Photovoltaic Modules, Module efficiency, PV panels and arrays, Solar Photovoltaic Systems(SPS), Solar PV lighting systems, PV Lanterns, Solar water Pumping, PV Roof top technology, Life cycle cost estimates.

UNIT - III

3.	Solar Thermal Energy Conversion No. of Lectures –8, Marks : 16	
	a	Liquid Plat Plate collectors, transmissivity, heat losses and heat loss coefficients, thermal analysis, Concentrating collectors, types, performance analysis of cylindrical parabolic collector.
	b	Solar water heating system, solar cookers, Solar Distillation, Solar Cooling, Solar Ponds, Solar power plants, Concentrated Solar Power Plants.

UNIT - IV

4.	Wind and Nuclear Energy Conversion No. of Lectures–8, Marks : 16	
	a	Wind Energy Conversion-Principles of wind energy conversion, Site selection considerations, Wind, Power plant design, Types of wind power conversion systems, Operation, maintenance and economics.
	b	Nuclear Energy Conversion - Chemical and nuclear equations, Nuclear reactions, Fission and fusion , Energy from fission and fuel burn-up , Radioactivity , Neutron energies , Fission reactor types ,Nuclear power plants , Fast breeder reactor and power plants , Production of nuclear fuels.

UNIT-V

5.	Biomass, Geothermal and Ocean Thermal Energy Conversion No. of Lectures –8, Marks : 16	
	A	Energy from biomass - Sources of biomass ,Different species, Conversion of biomass into fuels, Energy through fermentation, Pyrolysis, gasification and combustion, Aerobic and anaerobic bio-conversion, Properties of biomass, Biogas plants, Types of plants, Design and operation, Properties and characteristics of biogas.
	B	Geothermal energy – Availability, system development and limitations Ocean thermal energy conversion – Wave and tidal energy – Scope and economics

Text Book and Reference Books

1. K.M. Mittal: Non-conventional Energy Systems-Principles, Progress and Prospects, Wheeler Publications, 1997.
2. Kothari: Renewable Energy Sources and Emerging Technologies, PHI, Eastern Economy Edition, 2012
3. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002.
4. M.M. E1- Wakil; Power Plant Technology, McGraw Hill, 1985.
5. M.M. E1-Wakil: Nuclear Power Engineering, McGraw Hill, 1962.
6. Mukherjee and Chakrabarti, Fundamentals of Renewable Energy systems, New age International Publishers, 2004.
7. S.P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage,Tata McGraw Hill,2003.

Elective-I

Course Outline

Mechatronics **MTX**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces to graduate students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and systems.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Prerequisite Course(s): Fundamental knowledge of Electrical and Electronic systems and Drives.

Outline of Content: This course contains:

UNIT-I

1.	**Introduction to Mechatronics system**	**No. of Lectures–9, Marks : 16**
	a	Mechatronics system, Modeling and Design, Design concept evolution, Application areas.
	b	Dynamic Models, Model types, Model Development, Lumped model of a distributed system, Kinetic energy equivalence, Natural frequency equivalence, Analogies to mechanical, electrical, thermal and fluid elements

UNIT - II

2.	**Component Interconnection and Signal Conditioning**	**No. of Lectures –9, Marks : 16**
	a	Introduction to Basic components, need of interconnections, impedance characteristics, resistance, inductors, capacitors, amplifiers.
	b	Introduction to Analog and digital filters, Analog to Digital and Digital to Analog converters, Bridge circuits (Wheatstone, Maxwell), Signal Analyzers and Display devices.

UNIT - III

3.	Sensors and Transducers	No. of Lectures –8, Marks : 16
	a	Motion transducers, potentiometer, variable inductance transducers, Permanent magnet transducers, variable capacitance transducers, Piezoelectric Sensors, Effort Sensors, strain gauges, torque sensors, tactile
	b	Optical sensor and Lasers, Thermo-Fluid Sensors, shaft encoders, optical encoders, Digital tachometer, Hall effect Sensors, Linear encoders, Digital resolvers

UNIT - IV

4.	Electrical Actuators	No. of Lectures –8, Marks : 16
	a	Stepper motors, construction and Principle of operation, torque motion characteristics, damping, control, selection and applications of stepper motors
	b	D.C. motors, construction and operations, static torque characteristic, brushless D. C. Motors, control and selection of D.C. Motor
	C	Induction Motors, construction, working, characteristic, torque speed relationship, Consecution, working and control of synchronous motors.

UNIT-V

5.	Mechanical Actuators	No. of Lectures –8, Marks : 16
	a	Linear Actuators, Hydraulic and Pneumatic actuators, components of Hydraulic control system
	b	Pumps, motors, valves, feedback control, constant flow systems, pump controlled hydraulic actuators, pneumatic control system, Flapper valves, and hydraulic circuits.

Text Book and Reference Books

1. Clarence W de SiIva, Mechatronics: An Integrated Approach, CRC Press ISBN 0849312744
2. W Bolton, Mechatronics: A multi-disciplinary approach, Fourth edition, Pearson education ISBN 9788131732533.
3. Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996.
4. HMT ltd. Mechatronics, Tata McGraw-Hill, New Delhi, 1988.
5. Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994.
6. Bolton, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999.

Elective-I

Course Outline

Advanced Machine Design **AMD**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course provides a broad treatment of stress, strain, and strength with reference to engineering design and analysis. Major emphasis is placed on the analytical and experimental methods of determination of stresses in relationship to the strength properties of machine elements under various loading conditions. Also considered are deflection, post-yield behavior, residual stresses, thermal stresses, creep, and extreme temperature effects as applied to the design of fasteners, shafts, power trains, and rotational machinery.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Theory of Machine, Machine Design.

Outline of Content: This course contains:

UNIT-I

1.	**CAMS**	**No. of Lectures –9, Marks : 16**
	a	Advanced curves: 2-3 polynomial, 3-4-5 polynomial, 4-5-6-7 polynomial & higher order polynomial.
	b	Polydyne cams: 3-4-5 cam, cycloidal cam.
	c	Pressure angle, radius of curvature, force on follower and cam, cam design with elasticity of part is considered, ramps.

UNIT - II

2.	Springs	No. of Lectures –9, Marks : 16
	a	Helical springs under static and fatigue or variable loading, buckling of helical compression spring, vibration and surging of helical springs, Optimum design of helical spring.
	b	Design analysis of Belleville springs, ring spring, volute spring, rubber springs and mountings.

UNIT - III

3.	Design Against Fatigue	No. of Lectures –8, Marks : 16
	a	Fatigue Damage theories, Cycle counting Techniques, Stress based fatigue Analysis & design: one dimensional analysis, multiaxial analysis, and Cumulative damage.
	b	Strain based fatigue Analysis & design: one dimensional analysis, multiaxial analysis .Surface integrity & fatigue life improvement.

UNIT - IV

4.	System Approach	No. of Lectures –8, Marks : 16
	a	Introduction, System approach to design mathematical model, Dynamic response to a distributed system, Dynamic response to a lumped system
	b	Modeling the elasticity's, Modeling the masses, Modeling the inertia, Modeling friction and damping
	C	Mathematical model for shock analysis, Cam system, Value engineering approach to design problem.

UNIT-V

5.	Optimum Design	No. of Lectures –8, Marks : 16
	a	Introduction to optimum design, Adequate design, Johnson's method of optimum design.
	b	Case of normal specifications, Case of redundant specifications, Case of incompatible specifications.

Text Book and Reference Books

1. Dr. Rajendra Karwa ," A text book of Machine Design", Laxmi Publications (P) Ltd, New Delhi.
2. J. Uicker, "Theory of Machines and Mechanism", 3ed., Oxford University Press, New Delhi.
3. FarazdakHaideri ," Machine Design", Nirali Prakashan.
4. M.F. Spotts," Design of Machine Elements", Pearson Education.
5. N. C. Pandya ," Element of Machine Design", Charotar book stall, Anand.
6. Norton ," Dynamics of Machinery", Tata Mc-Graw Hill, New Delhi.
7. P. C. Sharma ,"Machine Design", S K Katuria & Sons.
8. R. S. Khurmi ," A text book of Machine Design", Eurasis Publishing House Pvt. Ltd, Delhi.
9. R. B. Patil ,"Design of Machine Elements", Tech- Max Publications, Pune

Elective-I

Course Outline

Machine Tool Design **MTD**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: The course aim of imparting the knowledge of Machine tool Design the background required include a knowledge of Mathematics, Engineering materials, Theory of Machines, Engineering Mechanics.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Workshop Practice, Manufacturing Process.

Outline of Content: This course contains:

UNIT-I

1.	**Principles of Machine Tool Design and Drives**	**No. of Lectures–9, Marks : 16**
	a	Introduction – Machine tools, classification. Working and auxiliary motion in machine tools.
	b	Mechanical and Hydraulic transmission elements.
	c	Devices for Intermittent motion. Reversing and differential mechanism.
	d	General requirement of machine tool design. Engineering Design process applied to machine tools.
	e	Machine tool drive – Types of speed and feed regulation, classification of speed and feed boxes.
	f	Design of speed box - Stepped regulation of speed, selection of range ratio, geometric progression, structural diagram.
	g	Design of feed box in details.
	h	Development of gearing diagram.

UNIT - II

2.	Design of machine tool structure	No. of Lectures–9, Marks : 16
	a	Function of machine tool, structure and their requirements, design criteria for machine tool structure.
	b	Materials and its properties, dynamic and static stiffness.
	c	Profile of machine tool structure, factors affecting on the stiffness of machine tool structures.
	d	Basic design procedure machine tool structure.
	e	Design of beds and columns.
	f	Design of Housing, Design of bases and tables.
	g	Design of Cross rails, arms, saddle and carriages.
	h	Design of Rams.

UNIT - III

3.	Design of Guide ways and power Screws	No. of Lectures–8, Marks : 16
	a	Function and types of Guide ways, types of slide ways and types of anti friction ways.
	b	Design of slide ways – Shapes, materials, method of adjusting clearance in slide ways.
	c	Design criteria and calculation for slide ways – (i) for wear (ii) for stiffness
	d	Guide ways operating under liquid friction conditions – (i) hydrodynamic slide ways (ii) Hydrostatic slide ways
	e	Design of Aerostatic and anti-friction guide ways.
	f	Combination guide ways and protecting devices for slide ways.
	g	Design of Power screw – (i) Design of sliding friction power screw
	h	(ii) Design of rolling friction power screw.

UNIT - IV

4.	Design of Spindles and Spindle supports.	No. of Lectures–8, Marks :
	a	Function of spindle unit and requirement, material of spindle
	b	Effect of machine tool compliance on machinery accuracy.
	c	Design calculation of spindles – Deflection of spindle axes due to bending and compliance of spindle support. Optimum spacing between spindle support.
	d	Deflection due to compliance of tapered joint permissible deflection and design for stiffness.
	e	Anti-friction bearings and sliding bearings.
	f	Dynamics of machine tools – Forced vibration in machine tools.

	g	Dynamic characteristics of machine elements
	h	Stability analysis – Static and dynamic cutting processes, characteristics. Regenerative chatter.

UNIT-V

5.	**Control System in Machine tools and Industrial Robots. No. of Lectures–8, Marks : 16**	
	a	Function, requirements and classification, control system for changing speeds and feed with simple centralized control
	b	Control system for changing speeds and feed with pre-selective control Control system for changing speeds and feed with Selective control
	c	Control system for executing and forming auxiliary motion. Manual control system.
	d	Automatic control system and adaptive control system.
	e	Industrial robot and its application.- Introduction and basic function of robotic elements, mobility of robot.
	f	Reliability in operation and various control system in robots.
	g	Robot language – Robot language outline, general description of programming language. Real time, geometric modeling, movements.
	h	Sensors, tools, programming ARL, HARL, AL, VAL, AML, IRL, LM and MCL.

Text Book and Reference Books

1. D. K Pal, S. K. Basu, "Design of Machine Tool", 4th Edition. Oxford IBH 2005, ISBN 81-204-0968.
2. F. Koenigsberger, "Design Principles of Metal Cutting Machine Tools", The Macmillan Company New York 1964.
3. Bhattacharya and S. G. Sen., "Principles of Machine Tool", New central book agency Calcutta, ISBN 81-7381-1555.
4. N. S. Acherkan, "Machine Tool", Vol. I, II, III and IV, MIR publications.
5. N.K. Mehta, "Machine Tool Design", Tata McGraw Hill, ISBN 0-07-451775-9.
6. DR. V. P. Singh, "Mechanical Vibration", S. Chand &Sons., New Delhi.

Elective-I

Course Outline

Automobile Engineering I **AE-I**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: The course aim of imparting the knowledge of different parts uses in automobile, the background required include knowledge of Engineering materials, IC engine.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of IC engine, Theory of Machine.

Outline of Content: This course contains:

UNIT-I

1.	**Introduction to Automobile No. of Lectures –9, Marks : 16**	
	a	Introduction to Automobile, History of Automobile, Types of Automobile, Automobile Industry
	b	Special Purpose Vehicle, Chassis, Classification of Chassis, Integral and Chassis less Construction
	c	Frame, Function s of the frame, Types of the Frame, Defects in Frame, Sub Frame, Body
	d	Introduction to Safety System, Seat Belt System, Power Seats, Air Bag System, Electric Mirrors, Central Locking and Electric Window, Electric Horns, Windscreen Wiper System, Analog and Digital Speedometer

UNIT - II

2.	Automobile Suspension	No. of Lectures –9, Marks : 16
	a	Introduction, Function of Suspension system, Requirements of a Suspension System, Torque Rod
	b	Stabilizer Bar, Air Suspension, Hydraulic Suspension
	c	Types of Suspension Spring, Plastic springs for motor cars, Shackle, Shock Absorber
	d	Front Axle Suspension System, Rear Suspension System, Spring and Suspension trouble shooting chart

UNIT - III

3.	Automobile Steering	No. of Lectures –8, Marks : 16
	a	Introduction, Principle of Correct Steering, Requirements of steering system, Steering system functions
	b	General arrangement of steering system, Steering gears and linkages
	c	Power steering, Reversible and irreversible steering, Factor Affecting under-steering and over-steering
	d	Steering Gear, Steering gear ratio, Turning radius, Wheel alignment, Caster and Camber angle, Toe-in Toe-out, Steering Trouble and Causes, Factor Affecting the Steering Operation

UNIT - IV

4.	Automobile Wheels, Tyres and Tubes	No. of Lectures–8, Marks :
	a	Introduction, Wheel Assembly, Wheel and Tyre Sizes, Types of wheels, Wheels balance, Rims
	b	Tyres, Types of tyres, Tyres Construction and Constituents, Tyres thread Patterns, Load Ratings
	c	Tyres Selections and Tyre Properties, Tyres Pressure and wear, Causes of Tyre Wear, Tyre size, Tyres maintenance, Factors increase life of tyres
	d	Tubes , Types of Tubes, Wheels and tyre troubles

UNIT-V

5.	Automobile Transmission (Gear Box & Clutch)	No. of Lectures–8, Marks : 16
	a	Introduction, Purpose of Transmission, Types of Transmission, Gear-boxes with different speed gear, Three speed and Four speed Gear-box, Gear shifting, Gear box troubles Lubrication of gear box
	b	Introduction., Clutch and its functions, Principles of Operations, Requirement of Clutch, Main Parts of clutch, Types of friction materials, Properties of good clutch lining, Types of clutches, Clutch Maintenance, Clutch troubles and their causes Factors Affecting the Power Transmitted by the Clutch, Propeller Shaft, Universal Joint, Rear Axle

Text Book and Reference Books

1. Automobile Engineering Vol. 1 & 2 by Dr. Kripal Singh, (Standard Publishers Distributors)
2. A textbook of Automobile Engineering I & II by P. S. Gill, (S. K. Kataria& Son's).
3. Automobile Engineering by R. B. Gupta, (SatyaPrakashan).
4. Automobile Engineering by Dr. V. M. Domkundwar, (DhanpatRai&Company).
5. A textbook of Automobile Engineering by R. K. Rajput, (Laxmi Publication Pvt. Ltd.).
6. Automobile Engineering by K. M. Moeed, (S. K. Kataria& Son's).
7. Automobile Engineering by Dr. A. K. Basu, (S. Chand Company Pvt. Ltd.).

Course Outline

Operation Research **OR**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces under graduate students to imparting knowledge of various decision making techniques.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge about mathematics & statics.

Outline of Content: This course contains:

UNIT-I

1.	**Linear Programming**	**No. of Lectures –9, Marks : 16**
	a	**Operation Research – An Introductions** The history of OR, Definition, Features, of OR, models and modeling in OR, OR approach to problem solving, methods for solving OR models, phases of OR, Advantages of OR study, Shortcomings of OR approach, OR Models in Practice, Applications of OR.
	b	**Linear Programming**- Applications and model formulation, Introduction, general Stricture of LP model, Assumption of an LP model, Advantages and Limitations of Linear programming, Applications areas of LP, steps of LP Model formulation, Graphical solution methods of LP problem, maximization, minimization, feasible, infeasible and unbounded solution.

UNIT - II

2.	Linear Programming	No. of Lectures –9, Marks : 16
	a	Linear programming – The simplex method Introduction, standard form of an LP problem, simplex algorithm (maximization, minimisation case) Degeneracy in simplex problem, unbounded Infeasible solution.
	b	Duality in Linear programming, formulation of dual LPP, Advantages of duality, rules for constructing the Dual from primal, sensitivity Analysis in LP

UNIT - III

3.	Transportation Theory	No. of Lectures –8, Marks : 16
	a	Transportation problem introduction, mathematical model of transportation problem, Algorithm, methods for finding initial solution northwest corner method ,Least cost method, vogels Approximation method, test for optimality steps of MODI method, maximization problem, unbalanced, degeneracy, prohibited transportation Routes problem.
	b	Assignment problem- introduction, mathematical models of assignment problem, solution method of assignment problem, Hungarian method, maximization case, unbalanced Restrictions on assignment, travelling salesman, problem

UNIT - IV

4.	Decision Making Theory	No. of Lectures –8, Marks : 16
	a	Decision Theory- Introduction, steps in decision making process types of decision making Environments, Decision tree
	b	Theory of games- introduction ,Two person Zero sum game, pure strategies, maximin, minimax principles, game with saddle point, mixed strategy games, The principles of dominance ,games without saddle point,algebraic method, arithmetic method, sub game method, Graphical method.

UNIT-V

5.	Sequencing	No. of Lectures –8, Marks : 16
	a	Replacement and maintenance method- Introduction, types of failure- gradual failure ,sudden failure Replacement of items whose efficiency deteriorates with time, Replacement of items that completely fail, individual replacement policy, Group replacement policy, staffing problem ,failure trees.
	b	Sequencing problem- Introduction notations, Terminology, and assumptions of sequencing problem, Processing n jobs through two machines, Processing n jobs through three machines, Processing n jobs through four machines, Processing n jobs through five machines

Text Book and Reference Books

1. L.C. Jhamb ,"Quantities Techniques" Vol I and II, Everest Publication
2. Hira , Gupta ,"Operation Research
3. Taha ,"Operation Research".
4. S.D. Sharma, "Operation Research", Khanna Publication.
5. ManoharMahajan, "Operation Research.
6. J. K. Sharma ,"Operation Research, Problem and Solution" , Macmillan
7. N. D. Vohra ,"Quantitative Techniques in Management" ,TATA McGraw Hill.
8. Ravindran," Operation Research Principles and Practice ",Wiley India Pvt. Ltd. New Delhi

Lab Course Outline

Computer Aided Design & Computer Aided Manufacturing CAD/CAM LAB

Course Title : Short Title Course Code

Branch- Mechanical Engineering Year–Fourth Year

Course Description: The course presents the elements of solid modeling, creation of parts of increasing complexity and the assembly of parts to form a final design, along with mechanism simulation.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA) 25Marks 50Marks

End Semester exam (ESE) (OR) 25Marks

Prerequisite Course(s): Basic knowledge about of Engineering Drawing, Computer Graphics, SOM, Design & Manufacturing.

Outline of Content: This course contains:

A. Introduction to Modeling (Using any CAD software).

1. 2D drawing using sketcher- 2 Drawings 2 Hrs.
2. 3D modeling using 3D features (Modeling of Screw jack, Brake Pedal, Clutch, Steering linkages, Carburetor, F.I.P., *any four components*)
3. Assembling and drafting (Any 2 above mentioned assemblies) with proper mating conditions and interference checking.
4. Surface Modeling (Any 2 of the above assemblies). 4 Hrs.

B. Computer Aided Manufacturing

1. Manual Part programming on CNC Lathe and CNC Milling to generate tool Path, NC Code and optimization of tool path (to reduce machining time) Using any cam software. 4 Hrs.

Note : Oral will be based on the prescribed term-work presented in the form of certified journal.

Lab Course Outline

Refrigeration and Air Conditioning **RAC LAB**

Course Title : Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course Familiarize under graduate students with the terminologies associated with refrigeration & air conditioning, basic principles of psychrometry and applied psychometrics, refrigerants; vapor compression refrigeration and multi-stage vapor compression systems, components of vapor compression systems and other types of cooling systems.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (Practical)	25Marks	

Prerequisite Course(s): Basic knowledge of Engineering Thermodynamics, Applied Thermodynamic, and Heat Transfer.

Outline of Content: This course contains:

1.Trial on vapour compression refrigeration system.

2.Trial on ice plant/domestic refrigeration system.

3.Study and trial on vapour absorption refrigeration system.

4.Study and trial on window/central air conditioner.

5.Study and trial on heat pump test rig.

6.Study of construction of hermetically sealed compressor and actual viewing of a cut model of the same (reciprocating, rotary and car A/C compressor).

7.Study of evacuation and charging of refrigeration system.

8.Study and trial on cooling towers.

9.Study of expansion devices, solenoid vaIVe and safety devices used in vapor compression system.

10.Study of thermostat and humidistat, dryer, oil separator.

11.Study of measuring instruments and various tools used in refrigeration and air-conditioning systems.

12.Visit to cold storage/ice plant/ central air conditioning system.

13. Cooling load calculation of any laboratory / class room in the institute & suggest the requirement of Air conditioner unit in terms of capacity.

Note : Lab file should contain any eight experiments out of the above to be performed with minimum three trials.

ESE (Practical Examination)

ThePracticalExaminationwillcompriseofperformingtheexperimentandvivaonthe Practical's.

Instructions for practical Exam.:-

1.FourexperimentsshouldbeselectedforPracticalExamination.

2.TheNumberofStudentsforeachPracticalsetupshouldnotbemorethan5Students.

3.OralwillbebasedonthePracticalPerformedintheexaminationandtheexperimentsincludedintheJournal

Lab Course Outline
Elective- I

Course Title :	Short Title	Course Code
Mechatronics	**MTX LAB**	

Branch- Mechanical Engineering Year–Fourth Year

Course Description: This course introduces to graduate students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and systems.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (OR)	25Marks	

Prerequisite Course(s): Basic knowledge of Electrical and Electronic systems and Drives.

Outline of Content: This course contains any five experiments and three assignments.

1) Study of Basic block diagram of mechatronics system components.
2) Study and demonstration of motion / force transducers.
3) Study and demonstration of temperature / pressure transducers.
4) Study and demonstration of AD / DA converter
5) Study and demonstration of hydraulic actuator / pneumatic actuator.
6) Study and demonstration of graphic / magnetic tape recorders.
7) Study of Microprocessors and Microcontrollers
8) Study of Robot / Autonomous guided vehicle

Note : Oral will be based on the prescribed certified journal.

Lab Course Outline
Elective- I

Course Title :	Short Title	Course Code
Advanced Machine Design	**AMD LAB**	

Branch- Mechanical Engineering Year–Fourth Year

Course Description: This course provides a broad treatment of stress, strain, and strength with reference to engineering design and analysis. It consist study of deflection, post-yield behavior, residual stresses, thermal stresses, creep, and extreme temperature effects as applied to the design of fasteners, shafts, and rotational machinery.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA) 25Marks 50Marks

End Semester exam (ESE) (OR) 25Marks

Prerequisite Course(s): Fundamental knowledge of Theory of Machine, Machine Design.

Outline of Content: This course contains:

Term work shall consist of two assignments, two drawing sheets and two design software based problems based on above syllabus.

Lab Course Outline
Elective- I

Course Title :	Short Title	Course Code
Machine Tool Design	**MTD LAB**	

Branch- Mechanical Engineering Year–Fourth Year

Course Description: The course aim of imparting the knowledge of Machine tool Design the background required include a knowledge of Mathematics, Engineering materials, Theory of Machines, Engineering Mechanics.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA) 25Marks 50Marks

End Semester exam (ESE) (OR) 25Marks

Prerequisite Course(s): Basic knowledge of Workshop Practice, Manufacturing Process, Gear Design.

Outline of Content: This course contains:

Term work shall consist of minimum five assignments and drawing sheet based on above syllabus covering all units.

Lab Course Outline
Elective- I

Course Title :	Short Title	Course Code
Automobile Engineering – I	**AE-I LAB**	

Branch- Mechanical Engineering Year- Fourth Year

Course Description: The course aim of imparting the knowledge of different parts uses in automobile, the background required include knowledge of Engineering materials, IC engine.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (OR)	25Marks	

Prerequisite Course(s): Basic Knowledge of Engines, Working of Brakes and Clutches**.**

Outline of Content: This course contains:

1. Study of layout of a chassis and its different components of a vehicle.
2. To study model trends in automobile.
3. Study of trouble shooting in various suspension systems.
4. Study of trouble shooting in power steering.
5. Measurement of steering geometry angle for wheels alignment.
6. Study of impact on steering geometry angle of vehicle.
7. Study of different types of tyres, tubes and their defects.
8. Visit to wheel balancing and alignment center.

Term work consists of minimum six practical's from above list.

Course Title	Short Title	Course Code
Project-I	**P-I**	

Course Description:
The course explores the knowledge of design, experiment and analysis of data. The course develops ability to work on multidisciplinary teams, Identify, formulate, and soIVe engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Laboratory	**2**	**14**	**28**	**2**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.
General Objectives: The objectives of project are to develop ability to work in group. The scope of work is design and conduct experiments, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability. The project work provides plate form for planning, material procurement, preparing specification and execution of work. The project also develop to work on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and soIVe engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
7. Recognition of the need for, and an ability to engage in life-long learning.
8. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Project-I
(Lab Course Contents)

Semester-VII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical: 2 Hrs/Week **(ESE) End Semester Examination (OR): 25Marks**

- It is expected that the broad area of Project-I shall be finalized by the student in the beginning of the VII semester / extension of Minor project undertaken may be Project-I.
- A group of Minimum 3 and Maximum 5 students shall be allotted for Project-I and same project group for Project-II.
- Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students. The **Synopsis/Abstract** on the selected topic, after detail literature survey should be submitted to the Project coordinator appointed by Head of the department.
- Project-I may invoIVe literature survey, problem identification, work methodology preparing specification and material procurement, collection of data, conduction of experiments and analysis. The project work shall invoIVe sufficient work so that students get acquainted with different aspects of fabrication, design or analysis.
- Approximately more than 50% work should be completed by the end of VII semester.
- Each student group is required to maintain log book for documenting various activities of Project-I and submit group project report in the form of thermal bound at the end of semester –VII. Submit the progress report in following format:
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Problem identification and project objectives*
    e. *Literature survey*
    f. *Case study/Analysis/Design Methodology*
    g. *Work to be completed (Progress status)*
    h. *Expected result and conclusion*
    i. *References.*

- Evaluation Committee comprising of the Guide, Project Coordinator and Expert appointed by the Head of the department will award the marks based on the work completed by the end of semester and the presentation based on the project work.

Guide lines for ICA : The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Assessment of the project-I for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-A.**

Guide lines for ESE: The End Semester Examination for Project shall consist of demonstration if any, presentation and oral examinations based on the project report**.**

Assessment of Project-I

Name of the Project: _____
Name of the Guide: _____

Table-A

SN	Name of Student	Problem Identification and project objectives	Literature Survey	Project Methodology/Design/PCB/ hardware/ simulation/ programming	Progress Status	Presentation	Total
		5	5	5	5	5	25

Course Title Short Title Course Code

Seminar-II

Course Description: The course explores the knowledge of presentation and effective communication. The course develops ability to work on multidisciplinary teams, Identify, formulate, and solve engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**2**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.

General Objectives: The objectives of Seminar –II are to develop ability express our view, presentation and effective communication. The scope of seminar-II is study various national and international journal for design, experiments conduct, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand literature survey for selection of seminar topics.
2. Apply knowledge of mathematics, science, and engineering for effective presentation of selected topic.
3. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
4. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
5. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
6. Practice the use of various resources to locate and extract information using offline & online tools, journals.
7. Practice the preparation and presentation of scientific papers and seminars in an exhaustive manner.

Seminar-II

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical: 2 Hrs/Week

1. Each Student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.
2. Topic of Seminar shall be registered within a three weeks from commencement of VII Semester and shall be approved by the committee.
3. The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar-II. Seminar shall be related state of the art topic of his choice approved by the committee.
4. Each student should deliver a seminar in scheduled period (Specified in time table or time framed by department) and submit the seminar report (paper bound copy/Thermal bound)in following format:
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Literature survey*
    e. *Concept*
    f. *Functional and Technical Details*
    g. *Applications*
    h. Comparison with similar topics / methods
    i. *Future scope*
    j. *References*

ASSESSMENT OF SEMINAR-II

Guide lines for ICA: ICA shall be based on topic selection, presentation and Seminar-II report submitted by the student in the form of thermal bound. Assessment of the Seminar-II for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the guidelines given in **Table- B**

Name of Guide: _____

Table-B

SN	Name of Student	Seminar Topic	Topic Selection	Literature survey	Report writing	Depth of under-standing	Presentation	Total
			5	5	5	5	5	25

Course Title	Short Title	Course Code
Industrial Visit	**IV**	

Course Description: The course explores the knowledge industry organization, new trends in manufacturing, maintenance and safety. The industrial visit provides the practical visualization of theoretical study of various engineering subject.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Practical	**-**	**-**	**-**	**1**

General Objectives: The main objective behind these visits is to explain the working of industrial equipments in running conditions to the students and tell them about the expectations of the industrialists from the fresh engineers.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand organizational set up of an industry.
2. Develop our self for expectations of the industrialists from the fresh engineers.
3. Understand manufacturing, material handling, maintenance, safety standard and environmental consideration in industry.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Industrial Visit
(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

1. Industry visits to minimum two industries shall be carried out by each student preferably or college shall arrange the industrial visit during the vacation period otherwise during the regular VII semester.
2. The student should obtain appropriate certificates of visit from the concerned organizations just after the visits.
3. Every Student should submit Industrial Visit report individually at the end of Semester-VII(First Term of Final Year)
4. The report(Thermal Bound) should contain information about the following points:
   a. *The organization - activities of organization and administrative setup technical personnel and their main duties.*
   b. *The project / industry brief description with sketches and salient technical information.*
   c. *The work / processes observed with specification of materials, products, equipments etc. and role of engineers in that organization.*
   d. *Suggestions (if any) for improvement in the working of those organizations.*
5. The evaluation of the report of technical visits will be made by panel of three teachers appointed by Head of the department based on following points:

Guide lines for ICA : ICA shall be based on knowledge gain by student and Industrial Visit Report submitted by the student in the form of Thermal bound. Assessment of the Industrial Visit for award of ICA marks shall be done jointly by industrial visit coordinators departmental committee based on viva - voce as per the guidelines given in **Table- C**

Table-C

SN	Name of Student	Name of Industry	Report writing	Depth of Under-standing	Total
			15	**10**	**25**

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Syllabus for

Final Year Mechanical Engineering

Faculty of Engineering and Technology

Course Outline

SEMESTER –VIII

W.E.F 2015 – 2016

Course Outline

Mechanical Vibration **MV**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces undergraduate students to Mechanical Vibration. The background required includes a sound knowledge of Mathematics (Calculus), Engineering Mechanics, Strength of materials and Theory of mechanics of second year and Third year Level. The course aims at imparting knowledge of Mechanical vibration.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Mathematics (Calculus) at First year level and strength of Materials, Theory of Machines at Second year Level.

Outline of Content: This course contains:

UNIT-I

1.		**Fundamental of Vibrations & Undamped Free Vibrations** **No. of Lectures– 9, Marks : 16**
	a	**Fundamental of Vibrations :-** Introduction, Definitions, Vector method of representing harmonic motions, Addition of two simple harmonic motions of the same frequency, Beat phenomenon.
	b	Complex method of representing harmonic vibrations, Work done by a harmonic force on a harmonic motion.
	c	**Undamped Free Vibrations of Single Degree of Freedom Systems**: - Introduction, Derivation of differential equation, Solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method.

UNIT-II

2.		**Damped Free &Forced Vibrations of Single Degree of Freedom Systems No. of Lectures– 9, Marks : 16**
	a	**Damped Free Vibrations of Single Degree of Freedom Systems: -** Introduction, Different types of dampings, Free vibrations with viscous damping, Logarithmic decrement.
	b	Viscous dampers, Dry friction or coulomb damping, Solid or structural damping, Slip or interfacial damping.
	c	**Forced Vibrations of Single Degree of Freedom Systems:-** Introduction, Forced vibrations with constant harmonic excitation, Forced vibrations with rotating and reciprocating unbalance, Forced vibrations due to excitation of support.
	d	Energy dissipated by damping, Forced vibrations with coulomb damping, Forced vibrations with structural damping, Vibration isolation and transmissibility.

UNIT-III

3.		**Two Degree of Freedom Systems No. of Lectures–8, Marks : 16**
	a	Introduction, Principal modes of vibration, Other cases of simple two degree of freedom systems, Combined rectilinear and angular modes.
	b	Undamped forced vibrations with harmonic excitation, Vibration absorbers.
	c	Critical speed of shaft- Introduction, critical speed of light shaft having single disc without damping, critical speed of light shaft having single disc with damping

UNIT-IV

4.		**Multi Degree of Freedom Systems Exact Analysis& Numerical Methods No. of Lectures – 8, Marks : 16**
	a	**Multi Degree of Freedom Systems Exact Analysis**: - Introduction, Free vibrations equations of motion, Influence coefficients, Generalized coordinates and coordinate coupling.
	b	Natural frequencies and mode shapes, Forced vibrations by Newtons second law of motion, Torsion vibrations of multi-rotor systems.
	c	**Multi Degree of Freedom Systems Numerical Methods: -** Introduction, Rayleigh's method, Dunkerley's method, Stodola's method.

UNIT-V

5.		**Continuous Systems & Non-Linear Vibrations. No. of Lectures– 8, Marks : 16**
	a	**Continuous Systems: -** Vibrations of strings, Longitudinal vibrations of bars, Torsional vibrations of circular shafts, Lateral vibrations of beams.
	b	**Non-Linear Vibrations: -** Introduction, Examples of non-linear systems, Phase plane, Undamped free vibration with nonlinear spring forces.
	c	Pertubation method, Forced vibration with non-linear spring forces, Self excited vibrations.

Text Book and Reference Books

1. Dilip Kumar Adhwarjee "Theory and Applications of Mechanical Vibrations" Laxmi Publications (p) Ltd., New Delhi.
2. G.K. Grover "Mechanical Vibrations" New Chand & Bros Roorkee (U.P.)
3. Leonard Meirovitch "Element of Vibration Analysis" Tata McGraw-Hill Publishing Company Limited, New Delhi
4. Singiresu S. Rao "Mechanical Vibrations "Pearson Education Ptd. Ltd., Delhi.

5. S. Graham Kelly " Schaum'sOut lines Mechanical Vibrations " Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. Thompson," Theory of Vibration with Application", Pearson Education.
7. V. P. Singh "Mechanical Vibrations " Dhanpat Rai & Co. (P) Ltd., Delhi.
8. B. H. Tongue," Principles of Vibration", 2/ed. Oxford University Press, New Delhi.
9. Sadhu singh" Mechanical vibration & Noise control" published by Khanna Publisher New delhi.

Course Outline

Finite Element Analysis and Simulation Techniques **FEAST**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces undergraduate students to Finite Element Analysis and Simulation Technique. The background required includes a sound knowledge of Mathematics, Strength of materials and Machine Design. The course aims at imparting knowledge of Finite Element Analysis and Simulation Technique.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Outline of Content: This course contains:

UNIT-I

1.		**Introduction to FEA No. of Lectures –9, Marks : 16**
	a	Introductory Concepts: Introduction to FEM , Discritization going from part to whole approach, Physical problem, mathematical models and finite element solution, FEA as a integral part of CAD. FEM Software's - Preprocessing, processing and post processing. Advantages and disadvantages of FEM.
	b	Conventional Numerical Methods- Finite difference method, weighted residual techniques, method of Least squares, Galerkin methods, Rayleigh-Ritz method, and Boundary Value problems, Displacement methods, equilibrium method.
	c	Finite Elements Types: One dimensional element such as two nodded & three nodded Spar or truss element. Two and three dimensional elements, triangular, rectangular quadrilateral.

UNIT-II

2.		**One-Dimensional Analysis No. of Lectures –9, Marks : 16**
	a	Discritization. Derivation of Shape functions, interpolation function, Stiffness matrices, global stiffness matrix, application of boundary, and force vectors.
	b	Assembly of Matrices - solution of problems in one dimensional structural analysis, Stepped and Taper Bars, Torsion of circular shaft, thin vaIVe tubes steady state heat conduction& convection, laminar pipe flow.
	c	FEM direct approach elements stiffness, potential energy approach, treatment of boundary conditions, temperature effects.
	d	Analysis of Plane Trusses, Analysis of Beams.

UNIT-III

3.		**Two-Dimensional Analysis No. of Lectures – 8, Marks : 16**
	a	Introduction. Finite element analysis for two dimensional problems.
	b	Natural coordinates and coordinates transformations, Derivation of shape functions for triangular element.
	c	Application of heat transfer, analysis of structural vibration. Finite element formation of beams.

UNIT-IV

4.		**Two Dimensional Vector analysis No. of Lectures– 8, Marks : 16**
	a	Equations of elasticity – Plane stress, plane strain problems.
	b	Automatic mesh generation and imposition, Eigen value problems.
	c	Jacobian matrix, stress analysis of CST element.
	d	Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices.

UNIT-V

5.		**Simulation Theory and Application No. of Lectures– 8, Marks : 16**
	a	**System models and studies:** - concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modeling, types of models, principles used in modeling, types of system studies.
	b	**System simulation:-**The techniques of simulation, Monte Carlo method, comparison of simulation and analytical methods, analog computers and methods, hybrid computer, simulators, continuous system simulation languages, system dynamics, growth models, logistic curves, multi segments models, probability concepts in simulation, system simulation, events, representation of time, arrival pattern.

Text Book and Reference Books

1. J.N. Reddy, an Introduction to Nonlinear Finite Element Analysis, OUP.
2. C.S. Krishnamoorthy., Finite element analysis TMH.
3. J.N. Reddy, Finite element methods, McGraw hill publication ltd.
4. Robert Cook, Concept an application of Finite element analysis .
5. Klaus-Jurgen Bhate, finite element analysis, PHI .
6. C.S. Desai and J.F. Abel, Introduction to finite element methods ,CBS.
7. Tirapati R. Chandrupatla, Finite element analysis by, PHI.
8. Geoffery Gordon ,System simulation .
9. Narsingh Deo ,System simulation with digital computers .
10. Kenneth Lt. Huebner," The FEM for Engineers", Wiley India Pvt. Ltd. New Delhi

Elective- II
Course Outline

Tribology **TRB**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: The course aim of imparting the knowledge of Tribology. The background required includes knowledge of mathematics, chemistry, engineering materials, fluid mechanics. The objective of the course is to understand the tribilogical concept, bearing design and its application, lubrication practices.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental Knowledge of Physics, Chemistry, Engineering Maths, Fluid Mechanics, Machine Design and Engineering materials.

Outline of Content: This course contains:

UNIT-I

1.	**Introduction to Tribology and friction and Wear No. of Lectures–9, Marks : 16**	
	a	Introduction and scope, Tribology in design
	b	Tribology in Industry, Economical considerations.
	c	Friction of metals, kinds and measurements of frictions, stick slip oscillation (Vibration) and its elimination
	d	Theories of friction, frictional heating.
	e	Wear- Mechanism of wear, types of wear, measurement of wear (wear testing and wear debris analysis)
	f	Theory of wear, factor affecting on wear rate.

UNIT - II

2.	Lubrication and Hydrostatic bearings	No. of Lectures–9, Marks : 16
	a	Construction, operation, Advantages, Limitations and Application of Hydrostatic Bearing (Circular Step bearing)
	b	Flow rate and pressure distribution, Load carrying capacity and film thickness, Power losses and temperature rises in Hydrostatic Step bearing.
	c	Optimum design of hydrostatic step bearing,

UNIT - III

3.	Hydrodynamic Journal Bearing	No. of Lectures–8, Marks : 16
	a	Theory of hydrodynamic lubrication, Mechanism of Pressure development in oil film.
	b	Two dimensional Reynold Equation, (i) By Direct method (ii) By Navier's Stokes equation
	c	Infinitely long Journal Bearing, Infinitely short Journal bearing
	d	Finite length Journal bearing. Design consideration in hydrodynamic Journal bearing.
	e	Relations of variable (Raimondi & Boyd). Dimensionless parameters. Temperature rises and Heat Balance, Pettrof equation.
	f	Selection of bearing design parameters. Numerical on infinitely long bearing.

UNIT - IV

4.	Hydrodynamic Thrust Bearing and Elastro Hydrodynamic lubrication. No. of Lectures–8, Marks : 16	
	a	Introduction and analysis of flat pad thrust bearing (tapered pad thrust bearing)
	b	Analysis of tilting pad thrust bearing and tapper land fixed pad bearing
	c	Analysis of Reyligh step thrust bearing, spring mounted thrust bearing
	d	Hydrodynamic pocket thrust bearing, quantity of oil flow with circumferential groove and hole.
	e	Elastro hydrodynamic lubrication, basic concept, hydrodynamic equation, Hertz equation for pressure and deformation.
	f	Ertel-Grubin equation. Application of Elastro hydrodynamic lubrication.

UNIT-V

5.	Hydrostatic Squeeze film and gas lubrication.	No. of Lectures–8, Marks : 16
	a	Introduction, Practical Situation of Hydrostatic squeeze film lubrication. Analysis for a circular plate approaching a plane.

	b	Analysis for a approximation of square plate by using a circular plate. Analysis for rectangular plate approaching a plane.
	c	Gas Lubrication – Introduction, requirements, merits, demerits and application, Reynold Equation for a gas lubrication.
	d	Tilting pad air bearing, magnetic recording disc with flying head, porous gas bearings.
	e	Seals – Classification, functions and application in detail.

Text Book and Reference Books

1. Stolarski T.A., "Tribology of Machine Design", Butterworth Heinemann, Oxford, 2000.
2. Bowden F.P. and Tobor D., "Friction and Lubrication of Solids", Clarendon Press, Oxford, 1986.
3. B. C. Majumdar "Introduction Tribology and Bearings", H. Wheeler and Company Pvt. Ltd.
4. Fuller D. D., "Theory and Practice of Lubrication for Engineers". John Wiley and Sons.
5. Cameron A. "Basic Lubrication Theory, Wiley Eastern Ltd.
6. Hrassan & Powel, "Gas Bearing".
7. Halling J. "Principles of Tribology", McMillan Press Ltd.
8. Bharat Bhushan and Gupta B.K., "Handbook of Tribology", McGraw Hill, New Delhi, 1991

Elective- II
Course Outline

Power Plant Engineering **PPE**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course

Description: To understand the various components, operations and applications of different types ofpower plants.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Engineering Thermodynamic, Turbo Machinery.

Outline of Content: This course contains:

UNIT-I

1.		**Thermal Power Plants No. of Lectures –9, Marks : 16**
	a	Thermal power stations. Main components and working of power stations, thermodynamics cycles, fuel handling, combustion and combustion equipment, problem of ash disposal, circulating water schemes and supply of makeup water.
	b	Choice of pressure of steam generation and steam temperature, selection of appropriate vacuum economizer, air pre-heater, feed water heaters and dust collection. Characteristics of turbo alternators, steam power plant, heat balance and efficiency.
	c	Boilers and steam generation, general classification, fire tube and water tube boilers, natural circulation and forced circulation boilers, high pressure, high temperature boilers, supercritical pressure boilers, boiler mounting and accessories, feed pumps, economizers, super heaters, air pre-heaters; boiler furnaces, heat generation rates, water walls.

UNIT-II

2.		**Diesel and Gas turbine Power Plant No. of Lectures–9, Marks : 16**
	a	Diesel power plants: Diesel engine performance and operation, plant layout, log sheets, selections of engine size.
	b	Gas turbine plants: Plant layout, methods of improving output and performance fuel and fuel systems, methods of testing, open and closed cycle plants, operating characteristics

UNIT- III

3.		**Hydroelectric and Nuclear Power Plant No. of Lectures–8, Marks : 16**
	a	Hydroelectric plants: Penstocks, water turbines, specific speed, turbine governors, hydro-plant auxiliaries, plant layout, automatic and remote control of hydroplants, pumped projects, cost of hydroelectric project.
	b	Nuclear power plants: Elements of nuclear power plants, nuclear reactor fuel moderators, coolants, control.
	c	Fusion energy: Control through fusion of hydrogen and helium. Energy release rates-present status and problems. Future possibilities.

UNIT- IV

4.		**Renewable Energy Power Plant No. of Lectures–8, Marks : 16**
	a	Basic bio-conversion mechanism; source of waste; simple digester; composition and calorific values of bio-gas.
	b	Wind energy generation; Special characteristics; Turbine parameters and optimum operation; Electrical power generation from wind/tidal energy.
	c	Ocean thermal energy conversion; Geothermal energy-hot springs and steam injection; Power plant based on OTEC and geothermal springs.

UNIT-V

5.		**Solar Energy Power Plant No. of Lectures –8, Marks : 16**
	a	Energy from the sun: Techniques of collection; Storage and utilisation; Types of solar collectors; Selective surfaces; Solar thermal processes; Heating; Cooling; Drying; Power generation, etc.
	b	Direct energy conversion methods: Photoelectric, thermoelectric, thermionic, MHD (magneto-hydrodynamics) and electro-chemical devices; Solar cells, Solar Concentrators

Text Book and Reference Books

1. Domkundwar and Arora "Power Plant Engineering", DhanpatRai and Sons, New Delhi
2. E.I. Wakil, "Power Plant Engineering", Publications, New Delhi
3. P. K. Nag, "Power Plant Engineering", Tata McGraw Hill, New Delhi
4. R. K. Rajput," Power Plant Engineering", Laxmi Publications, New Delhi.
5. R. Yadav - Steam and Gas turbines, central publishing house, Allahabad
6. G. D. RaiNon conventional energy sources,

Elective- II
Course Outline

Process Equipment Design **PED**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: The student should have basic understanding of Mechanical and Process Design aspects of Process Equipment Design. Introduction to various codes (ASTM, API, Japanese, German etc.) used in chemical process industries and their application. Basic Engineering design approach and selection of pressure vessel components such as Head, closure, flanges, gasket, nozzles etc, Design of process vessel support Mechanical design of process equipment such as pressure vessel, shell & tube

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of mathematics, thermodynamic, machine design.

Outline of Content: This course contains:

UNIT-I

1.	**Introduction to Process Equipment Design No. of Lectures–9, Marks : 16**	
	a	Nature of process equipments, General design procedure.
	b	Fabrication techniques, choice of materials, resistance to corrosion, Design considerations.
	c	Stress, Elastic instability, theories of failure, creep, economic consideration

UNIT-II

2.	Design of Machine Elements No. of Lectures –9, Marks : 16	
	a	Introduction, shaft, keys and pins, couplings, bearing, belt and pulley.
	b	Chain drive, gear drives, joints, fasteners, brackets, gaskets, mechanical seal.

UNIT-III

3.	Design of Pressure Vessels No. of Lectures –8, Marks : 16	
	a	Introduction, operating condition, uses, codes.
	b	Selection of material, design conditions and stress.
	c	Design of shell and its components, supports, thermal stress

UNIT-IV

4.	Design of Heat Exchangers and Evaporators No. of Lectures–8, Marks : 16	
	a	Introduction, type of heat exchangers, design of shell.
	b	Design of tube heat exchangers
	c	Evaporators:- Introduction, types, materials, design considerations.

UNIT-V

5.	Process Equipment Design and Standards No. of Lectures–8, Marks : 16	
	a	Role of process equipment designers, basic process requirements of plants/projects.
	b	Introduction of design codes and standards IS, ASME, API, BS and its application.
	c	Plant design management system.

Text Book and Reference Books

1. Joshi M.V. and Mahajan V.V., "Process Equipment Design", McMillan, India, 1996.
2. Harvey J.F., "Pressure Vessels Design", Van Nostrand Co., 1974.
3. Singh K.P. &Soler A. L., "Mechanical Design of Heat Exchangers ", Arcturus Publishers, New Jersey, 1984.
4. Moss Demis R., "Pressure Vessel Design Manual", Gulf Publishing Co., Houston, 1987.
5. "Handbook of Piping Design", CRC Press, 1992.
6. IS 2825: 1969, Code for Unfired Pressure Vessels.
7. "ASHRAE Handbook : Fundamentals", ASHRAE, 1985. 8. ASME Code, Section 8th, Divison -I, Division-II.

Elective- III
Course Outline

Introduction to Robotics **Robotics**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course is aimed to provide exposure on the Robot anatomy, sensors, kinematics, applications and problems associated with their design.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of Mathematics, Automation, Mechatronics.

Outline of Content: This course contains:

UNIT-I

1.	**Basic Concept In Robotics No. of Lectures –9, Marks : 16**	
	a	Historical perspective of robot, classification of robot, automation and robotics, robot anatomy, basic structure of robotics.
	b	resolution, accuracy and repeatability, classification and structure of robotics system, point to point and continuous past system, control loop of
	c	Robotic application Current and future.

UNIT-II

2.	**Mechanical Systems: Components, Dynamics And Modeling No. of Lectures–9, Marks : 16**	
	a	Objectives, Motivation, Review elementary concept, Motion Conversion, Modeling of Mechanical systems.
	b	Kinematics chain, Forces encountered in Moving coordinate systems, Lagrange's Analysis of Manipulator.

UNIT-III

3.	**Drives And Control System No. of Lectures –8, Marks : 16**	
	a	Hydraulic, DC servomotors, basic control system, concept and models, control system analysis.
	b	Robot activation and feedback component, positional and velocity sensors.
	c	Actuators, power transmission system, Application of robot in manufacturing.

UNIT-IV

4.	**End Effectors, Sensors And Vision Systems No. of Lectures-8Marks:16**	
	a	End Effectors Types of end effectors, mechanical grippers, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper selection and
	b	Introduction to Sensors: Need of sensors in a robotic system, selection of sensors, photo sensors, limit switches.
	c	Range sensors, proximity sensors, touch / sensors. VISION SYSTEMS: concept of low level and high-level vision in a robotic system.

UNIT-V

5.	**Robot Programming No. of Lectures –8, Marks : 16**	
	a	Methods of robot programming, lead through programming methods, a robot program as a path in space.
	b	Motion interpolation WAIT, SIGNAL, AND DELAY commands.
	c	ROBOT LANGUAGES: The textural robot languages, generation of robot programming languages, robot language structure, constant, variables and

Text Book and Reference Books

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002.
2. Groover," Industrial Robotics", McGraw Hill Publication Co. Ltd.
3. John J. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education Inc.,
4. M. P. Groover, "Industrial Robotics - Technology, Programming and Applications".
5. Niku," Introduction to Robotics: Analysis System and Application", Pearson Education

Elective- III
Course Outline

Advanced Welding Technology **AWT**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course is aimed to provide deeper knowledge of materials technology of welding**,** quality techniques at production by welding**,** Knowledge of current computer systems and cost for welding operations**.**

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03
Practical	02	14	28	01

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of workshop technology, manufacturing process, material science.

Outline of Content: This course contains:

UNIT-I

1.		**Conventional welding Technology** **No. of Lectures–9, Marks : 16**
	a	Introduction: Importance and application of welding, classification of welding process. Selection of welding process
	b	Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electroslag welding, Friction welding etc. Welding of MS.CI, Al, and Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing.

UNIT-II

2.		**Advanced welding Techniques** **No. of Lectures–9, Marks : 16**
	a	Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

UNIT- III

3.		**Advanced welding Techniques No. of Lectures–8, Marks : 16**
	a	Advanced welding Techniques (continued): Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding / Metallising, Hard facing.

UNIT- IV

4.		**Metallurgy and Weld Life No. of Lectures –8, Marks : 16**
	a	Weld Design: Welding machines/equipments and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels.
	b	Life predication. 4 51 Thermal and Metallurgical consideration: Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves.
	c	Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties.

UNIT-V

5.		**Advance welding No. of Lectures –8, Marks : 16**
	a	Welding Under The Influence Of External Magnetic Field: Parallel Field, Transverse Magnetic Field, Longitudinal Magnetic Field, Improvement Of Weld Characteristics By The Application Of Magnetic Field, Magnetic Impelled Arc Welding.
	b	Fundamentals Of Underwater Welding- Art And Science: Comparison Of Underwater And Normal Air Welding, Welding Procedure, Types Of Underwater Welding, Underwater Wet Welding Process Development.

Text Book and Reference Books

1. Little R.L., "Welding Technology", Tata McGraw Hill, New Delhi, 1994.
2. Ghosh A. and Mallik A.K., "Manufacturing Science", East West Press, 1985.
3. Davies A.C., "The Science and Practice of Welding", Cambridge University, New York, 1989.
4. Balchin N.C., "Health and Safety in Welding and Allied Processes", Jaico Publishing House, Mumbai, 1989.
5. Rao P. N., "Manufacturing Technology", Tata McGraw Hill, 1990.
6. Mukharjee P. C., "Fundamental of Metal Casting Technology", Tata McGrew Hill, 1970.
7. Jeffus Larry “Welding Principles and Applications” Delmar Publishers, 1999.

Elective- III
Course Outline

Energy Conservation and Management **ECM**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: Compare and contrast energy management practices and opportunities, including monitoring. Describe and analyse energy efficiency tools. Describe key issues in energy resource management and green building. Discuss and discern the history of energy sources and the conservation of and future of resources needed to maintain our economy. Describe and discuss a variety of world and regional energy policies. Communicate reasons for environmental protection and renewable energy implementation. Explain energy accounting and analysis and how it is used in energy assessment. Demonstrate understanding of rate of return and life cycle cost analysis.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Fundamental knowledge of basic thermodynamic, energy conservation systems, Applied Thermodynamics and Fluid Mechanics.

Outline of Content: This course contains:

UNIT-I

1.	**Energy Scenario**	**No. of Lectures –9, Marks : 16**
	a	Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy
	b	2Sectoral energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy
	c	Energy security, energy conservation and its importance, energy strategy for the future, Energy Conservation Act 2001 and its features.

UNIT-II

2.	**Basics of Energy its various forms and conservation** **No. of Lectures–9, Marks : 16**	
	a	Electricity basics – Direct Current and Alternative Currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer.
	b	Evaluation of thermal performance – calculation of heat loss – heat gain, estimation of annual heating & cooling loads, factors that influence thermal performance, analysis of existing buildings setting up an energy management programme and use management – electricity saving

UNIT-III

3.	**Energy Management & Audit No. of Lectures –8, Marks : 16**	
	a	Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs.
	b	Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution.
	c	Financial Management: Investment-need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs).

UNIT-IV

4.	**Energy Monitoring and Measurement No. of Lectures–8, Marks : 16**	
	a	Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)
	b	Basic measurements – Electrical measurements, Light, Pressure, Temperature and heat flux, Velocity and Flow rate, Vibrations, etc. Instruments Used in Energy systems: Load and power factor measuring equipments, Wattmeter, flue gas analysis, Temperature and thermal loss measurements, air quality analysis etc. Mathematical and statistical modelling and analysis.

UNIT-V

5.	**Energy Efficiency in Thermal Utilities and systems** **No. of Lectures–8, Marks : 16**	
	a	Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers, lighting system, Motors belts and drives, refrigeration system.
	b	Heat Recovery and Co-generation:- Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles.

Text Book and Reference Books

1. Energy Engineering and Management Amlan Chakrabarti Prentice hall India 2011
2. Energy Management Principles, CB Smith, Pergamon Press, New York,
3. Bureau of energy efficiency –Hand outs New Delhi .
4. Energy Management Hand Book. W. C. Turner. John Wiley and sons
5. Handbook on Energy Efficiency, TERI, New Delhi, 2009
6. Energy Auditing and Conservation; Methods, Measurements, Management & Case Study, Hamies, Hemisphere Publishing , Washington, 1980.
7. Industrial Energy Management & Utilization, Write, Larry C Hemisphere Publishers, Washington, 1998.
8. Energy Conservation In Process Industry, W. F. Kenny

Elective- III
Course Outline

Automobile Engineering – II **AE-II**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces undergraduate students to Automobile Engineering.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Basic knowledge of theory of machine, IC Engine, Applied Thermodynamic.

Outline of Content: This course contains:

UNIT-I

1.		**Automobile Brakes No. of Lectures –9, Marks : 16**
	a	Introduction, Braking Requirements, Function of the brakes, Classification of the brakes
	b	Hydraulic Brakes, Power Brakes, Air Brakes, Brake Efficiency & Stopping Distance, Factor Controlling the Stop of an Automobile
	c	Brake Lining, Brake Testing & Testers, Brake Service

UNIT-II

2.		**Automobile Electrical System No. of Lectures–9, Marks : 16**
	a	Introduction to Starting System, Lead-Acid Battery, Recharging of Battery, Charging procedure, Battery voltage, Battery Capacity, Battery Rating, Battery Life, Factors affecting Battery life, Battery testing, Battery troubles
	b	Introduction to Ignition System-Types, Introduction Charging System, Spark Plug Introduction To Wiring System, Standard Color coding, Tracking faults in wiring, Functioning of the Electrical system in an Automobile, Improvement in Electrical system in an Automobile

UNIT- III

3.		**Automobile Heating, Ventilation and Air Conditioning** **No. of Lectures–8, Marks : 16**
	a	Nature of Heat, Heating System, Air Conditioning System and its Operational Principle, Air Conditioning System and its Operational Principle, Air Conditioning Components, Effect of Air Conditioning on Fuel Economy
	b	Air Conditioning System Refrigerant, Conventional Heating and Ventilation, Air Distribution Parts, Automatic Climate Control, Automatic Temperature Control System, Air Conditioning Troubleshooting, Heating System Troubleshooting

UNIT- IV

4.		**Alternative Fuelled Automobiles No. of Lectures–8, Marks : 16**
	a	Introduction, Battery of Electrical Vehicle(EV), Fuel Cell-as a Source of Energy, Solar Powered Automobiles, Hybrid Drives, Drive Motors
	b	Compressed Natural Gas (CNG) Operated Automobiles, Liquefied Petroleum Gas (LPG) as a Substitute Fuel
	c	Future Alternative Fuels for IC Engine, Particular tips for getting more Mileage, How to Save Fuel, Biodiesel- Another substitute for existing fuel, Future Trends in Automobile Development

UNIT-V

5.		**Automobile Emissions and its Control No. of Lectures–8, Marks : 16**
	a	Introduction, Air Pollution- Environment & Health Impacts, Major Pollutants and their Sources of Emission, Pollutants and Mechanism of their Formation, Mechanism of Pollutants Formation in SI Engine
	b	Smoke, Causes of Smoke, Factor Affecting Diesel Smoke, Comparison of Diesel & Gasoline Engine emission, Harmful Effects of Different Pollutants, Emission Control System
	c	Regulation and Norms on Exhaust Emission, Introduction to Green House Effect and Global Warming, Noise Pollution and its Control, EURO & Indian Emission Standards

Text Book and Reference Books

1. Automobile Engineering Vol. 1 & 2 by Dr. Kripal Singh, (Standard Publishers Distributors).
2. A textbook of Automobile Engineering I & II by P. S. Gill, (S. K. Kataria& Son's)
3. Automobile Engineering by R. B. Gupta, (Satya Prakashan)
4. Automobile Engineering by Dr. V. M. Domkundwar, (Dhanpat Rai& Company)
5. A textbook of Automobile Engineering by R. K. Rajput, (Laxmi Publication Pvt. Ltd.)
6. Automobile Engineering by K. M. Moeed, (S. K. Kataria & Son's)
7. Automobile Engineering by Dr. A. K. Basu, (S. Chand Company Pvt. Ltd.)

Elective- III
Course Outline

Thermal Equipment Design **TED**

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description: This course introduces undergraduate students to Thermal equipment design. The background required includes a sound knowledge of Mathematics, Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics, Heat transfer and Refrigeration and Air-conditioning. The course aims at imparting knowledge of design of thermal equipments.

Teaching Scheme:

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	03	14	42	03

Examination scheme:

End semester exam (ESE) 80 Marks Duration: 03 hours

Internal Sessional exam (ISE) 20 Marks

Purpose of Course: Degree Requirement

Prerequisite Course(s): Mathematics, Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics, Heat transfer and Refrigeration and Air-conditioning.

Outline of Content: This course contains:

UNIT-I

1.	**Engineering Design**	**No. of Lectures –9, Marks : 16**
	a	Introduction to engineering design, Decision in an Engineering undertaking, Design Vs Analysis, Synthesis for Design, Selection Vs Design.
	b	Designing a workable system: workable system design and analysis, creativity in concept selection, workable Vs. optimum system,
	c	Economics: Interest, Lump sum compounded annually and more than annually, compound amount factor, present worth factor, future and uniform series amount, Gradient factor, Shift in time, Taxes , Depreciation
	d	Decision making to design a food freezing plant
	e	Decision making to optimize thickness of insulation in refrigerated ware house
	f	Decision making to optimize of natural convection air cooled condenser

UNIT-II

2.	**Modeling of thermal equipments and simulation No. of Lectures–9, Marks : 16**	
	a	Matrices, Solution of simultaneous equation, Polynomial presentation(polynomial, one variable a function of other variable and n+1 data points),simplification.
	b	Method of Least square, the art of equation fitting,
	c	Selecting Vs simulating, (Heat exchanger), System simulation, Information flow diagrams, Successive substitution method, pitfalls in successive substitution method
	d	Newton Raphson method for multivariable and convergence characteristics, Compare successive substitution method and Newton Raphson method

UNIT-III

3.	**Optimization No. of Lectures –8, Marks : 16**	
	a	Introduction, levels of optimization, Mathematical representation of optimization problem
	b	Setting up the mathematical statement of optimization problems, Properties of objective function, Unconstrained optimization and Constrained optimization problem
	c	Mathematical proof of Lagrange multiplier method, Test of Maxima and minima, Kunhn-tuker conditions, Unimodal function and search method
	d	(Only basic introduction to all methods no numerical will be asked)Dichotomous search, Fibonacci search method, Introduction to multivariable optimization, Multivariable optimization, Conjugate gradient method

UNIT-IV

4.	**Mathematical Modeling- Thermodynamic properties No. of Lectures–8, Marks : 16**	
	a	Introduction, Criteria for fidelity of representation, Linear and non linear regression analysis.
	b	Thermodynamic properties, Internal energy, enthalpy, clayperon equation, P-T relation at saturated condition, specific heats, Maxwell relation.
	c	P-V-T equation (Vander walls equation),Building and full set of data.
	d	Introduction to steady state simulation, convergence and divergence in successive substitution, partial substitution in successive substitution, Evaluation of Newton Rapson Technique and characteristics for heat exchanger

UNIT-V

5.	Dynamic behavior of thermal system	No. of Lectures–8, Marks : 16
	a	Introduction, Significance, Scope, Approach,One dynamic element in stead state simulation for refrigeration plant etc. (Heat exchanger)
	b	Laplace Transform and Inverse of Laplace transforms, Blocks, Block Diagram and Transfer function, Feed control loop, Time constant block (Consider Temperature sensing bulb in a fluid duct)
	c	Stability analysis, Normalizing the variable for Inversion to the time (Take the case to regulate the air pressure in a reservoir)
	d	Translating the physical situation in block diagram (take example for air heating system and its control), non linearity's

Text Book and Reference Books

1. J.P. Holman 1992 "Heat Transfer" McGraw Hill VII Edition.
2. P. Kothandaraman "Fundamentals of Heat and Mass Transfer".
3. D.S. Kumar "Heat and Mass Transfer" D. S. Kumar S. K. Kataria& Sons, Delhi.
4. P. K. Nag "Heat Transfer" Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Thermal Design and Optimization, Adrian Bejan, George T satsaronis, Michael J. MoranJohn Wiley & Sons, 1996.
6. Design and Optimization of Thermal Systems, Second Edition (Mechanical Engineering)by Yogesh Jaluria.
7. Design of thermal systems, W. F. Stoecker, McGraw hill book company.

Lab Course Outline

Course Title :	Short Title	Course Code
Mechanical Vibration	**MV LAB**	

Branch- Mechanical Engineering **Year–Fourth Year**

Course Description:

This lab includes different practical of Mechanical Vibration. The course aims at imparting knowledge of natural frequency and modes of vibration.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (OR)	25Marks	

Prerequisite Course(s): Mathematics (Calculus) at First year level and strength of Materials, Theory of Machines at Second year Level.

Outline of Content: This course contains:

1) To study the torsional vibrations of single rotor system.
2) To study the torsional vibrations of two rotor system.
3) To study damped torsional vibrations of single rotor system.
4) To study undamped free vibrations of a spring.
5) To study the natural vibrations of a spring mass system.
6) To study forced damped vibrations of a spring mass system.
7) To study the forced damped vibrations of simply supported beam.
8) To determine critical speed of a single rotor system.

Note : Lab file should contain at list five experiments from above mentioned list.

ESE (Oral Examination). The Oral Examination will comprise of viva on the above experiments.

Lab Course Outline

Finite Element Analysis and Simulation Techniques FEAST LAB

Course Title: Short Title Course Code

Branch- Mechanical Engineering **Year-Fourth Year**

Course Description: The background required includes a sound knowledge of Mathematics, Strength of materials and Machine Design. The course aims at imparting knowledge of Finite Element Analysis and Simulation Technique.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam(ESE)(PR)	25Marks	

Prerequisite Course(s): Mathematics, Computational Methods, Design, Vibration, SOM etc.

Outline of Content: This course contains:

1 Analysis of I-cantilever beam.
2 Analyzing Flow in a System of Pipes.
3 Analysis of Trusses.
4 Modal Analysis of Spring-Mass System.
5 Modal Analysis of continuous System.
6 Thermal analysis of any component.
7 Stress strain analysis of any component.
8 Kinematic Analysis and simulation of slider crank Mechanism.

Note : Lab file should contain any five experiments by using any design software

ESE (Practical Examination) ThePracticalExaminationwillcompriseofperformingtheexperimentandvivaonthe Practical's.

Lab Course Outline
Elective- II

Tribology	**TRB LAB**	
Course Title :	Short Title	Course Code

Branch- Mechanical Engineering **Year-Fourth Year**

Course Description: The background required includes knowledge of mathematics, chemistry, engineering materials, fluid mechanics. The objective of the course is to understand the tribilogical concept, bearing design and its application, lubrication practices.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (OR)	25Marks	

Prerequisite Course(s): Fundamental Knowledge of Physics, Chemistry, Engineering Maths, Fluid Mechanics, Machine Design, and Engineering materials.

Outline of Content: This course contains:

Any EIGHT of the following performance practical and Assignments.

01 Practical on Journal Bearing apparatus.
02 Practical on Tilting pad thrust bearing apparatus
03 Friction in Journal Bearing
04 Practical on Brake line friction test rig.
05 Practical using Pin on disc test rig.

Note : Any 03experiments should be performing from above list and 03assignment include in the course based on curriculum of this course.

Guidelines for ICA: ICA will be based on Practical assignments submitted by the student in the form of journal.

Lab Course Outline
Elective- II

Course Title :	Short Title	Course Code
Power Plant Engineering	**PPE LAB**	

Branch- Mechanical Engineering Year- Fourth Year

Course Description: To understand the various components, operations and applications of different types of power plants.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment (ICA)	25Marks	50Marks
End Semester exam (ESE) (OR)	25Marks	

Prerequisite Course(s):

Outline of Content: This course contains:

1. Study of Fluidized Bed Combustor.
2. Study of Environmental Impact of Thermal Power Plant.
3. Study of Demand supply scenario of Electricity.
4. Study or visit of Co-generation Plant.
5. Study or visit of Non conventional power plant.
6. Efficiency measurement of Standalone Solar PV System.
7. Measurement of current-voltage characteristics of two solar cells connected a) in series and b) in parallel.

Note : Lab file should consist of any six experiments to be performed from above list

ESE (Oral Examination)
The Oral Examination will be based on the all five units of Power Plant Engineering.

Lab Course Outline
Elective- II

Process Equipment Design **PED LAB**

Course Title : Short Title Course Code

Branch- Mechanical Engineering Year- Fourth Year

Course Description: The student should have basic understanding of Mechanical and Process Design aspects of Process Equipment Design. Basic Engineering design approach and selection of pressure vessel components such as Head, closure, flanges, gasket, nozzles etc, Design of process vessel support Mechanical design of process equipment.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Laboratory	2	14	28	1

Evaluation scheme:

Internal Continuous Assessment(ICA) 25Marks 50Marks

End Semester exam (ESE) (OR) 25Marks

Prerequisite Course(s): Fundamental knowledge of mathematics, thermodynamic, machine design and engineering drawing.

Outline of Content: This course contains:

1. Design and drawing of pressure vessels.
2. Design and drawing of storage vessels.
3. Assignment on safety measure in process equipment design.
4. Study of pressure relief devices.
5. Study of vessels under external pressure.
6. Study of design codes and standards.

Note : Lab file should consist of minimum **five experiments**.

Guide lines for ICA :
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

Course Title	Short Title	Course Code
Industrial Lecture	**IL**	

Course Description:

The gap between industry's needs and the academic community's aspirations appears to be considerably large. There exists a strong feeling, at least in the academic circles, that unless technology driven initiatives find a surer place in the industrial sector in this country, the academia-industry interaction is likely to remain confined to developmental activities with limited exploratory or research-based content As institutes committed primarily to creation and growth of technological knowledge, technical institutes have an important role to play in the industrial sector of the country's economy. This fact by way of encouraging mechanisms to foster interaction between the academia and industry. Typically, academic interest in the multidimensionality of a problem leads to a tendency to explore a variety of options to arrive at a solution. This industrial lecture develops ability of student for expectations of the industrialists from the fresh engineers.

	Total Hours	**Semester Credits**
Lecture	**06**	**2**

General Objectives: The domains in which interaction is possible are:

a. Placement and entrepreneurship development.
b. Industry participation in technology development involving some exploratory work.
c. Academic intervention in solving specific industry problems.
d. Laboratory utilization by industry.
e. Continuing education programme.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand need, requirement and expectation of industry from fresh engineers.
2. Understand importance of laboratory practices throughout carrier of engineer. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively.
5. Identify, formulate, and soIVe engineering problems by understanding professional and ethical responsibility.
6. Recognition of the need for, and an ability to engage in life-long learning.
7. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Industrial Lecture
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 50Marks**
Lecture: 1 Hr

1. There is a need to create avenues for a close academia and industry interaction through all the phases of technology development, starting from conceptualization down to commercialization.
2. List of renowned persons from industry shall be prepared by the committee appointed by Head of the department. After approval from the Principal, Minimum five Industrial lectures in alternate week shall be arranged, which shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors / R&D Labs covering the various aspects.
3. Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum.
4. Students shall submit the report based on minimum five lectures giving summary of the lecture delivered.
5. The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in bullet point form.

Guide lines for ICA: Assessment of the Industrial Lecture for award of ICA marks shall be done jointly by departmental committee as per attendance in industrial lecture, report submitted by student and overall performance in semester as per the guidelines given in **Table- D**

Table-D

SN	Name of Student	Attendance (05 Marks per Lecture)	Dept of Understanding (03 Marks per Lecture)	Report Writing	Total
		25	15	10	50

Course Title	Short Title	Course Code
Project-II	**P-II**	

Course Description:
The course explores the knowledge of design, experiment and analysis of data. The course develops ability to work on multidisciplinary teams, Identify, formulate, and soIVe engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Laboratory	**4**	**14**	**56**	**6**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.
General Objectives: The objectives of project are to develop ability to work in group. The scope of work is design and conduct experiments, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability. The project work provides plate form for planning, material procurement, preparing specification and execution of work. The project also develop to work on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and soIVe engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
7. Recognition of the need for, and an ability to engage in life-long and self learning.
8. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Project-II
(Lab Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 75Marks**
Practical: 2 Hrs/Week **(ESE) End Semester Examination OR: 75Marks**

1. Project-I work decided in VII semester shall be continued as Project-II
2. Students should complete implementation of ideas given in synopsis/Abstract, so that project work should be completed before end of semester.
3. Project-II may invoIVe fabrication, design, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing , possible results and report writing
4. Each student's project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VIII in the form of Hard bound.
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Problem identification and project objectives*
    e. *Literature survey*
    f. *Case study/Analysis/Design Methodology*
    g. *Project design and implementation details*
    h. *Result and conclusion*
    i. *Future scope*
    j. *References.*

Guide lines for ICA: ICA shall be based on continuous evaluation of students' performance throughout semester in project-II and report submitted by the students' project group in the form hard bound. Assessment of the project-II for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-E.**

Guide lines for ESE:-
In ESE the student may be asked for demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Assessment of Project - II

Name of the Project: _____
Name of the Guide: _____

Table-E

		Assessment by Guide (50 Marks)				**Assessment by Committee (25 Marks)**		
SN	**Name of Student**	**Attendance, Participation and team work**	**Material procurement/ assembling/ Designing/Programming**	**Case study/ Execution**	**Project Report**	**Dept of Understanding**	**Presentation**	**Total**
Marks		**10**	**15**	**15**	**10**	**10**	**15**	**75**