Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Third Year Engineering
(Automobile Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – V&VI

W.E.F. 2020 – 21

Subject Group Code and Subject Groups

Sr. No.	GROUP	Category	Breakup of Credits (Total 160)
1	A	Humanities and Social Sciences including Management Courses (HSMC)	10
2	B	Basic Science Courses (BSC)	26
3	C	Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computer etc. (ESC)	26
4	D	Professional Core Courses (PCC)	53
5	E	Professional Elective Courses relevant to chosen specialization/branch (PEC)	18
6	F	Open subjects – Electives from other technical and /or emerging subjects (OEC)	12
7	G	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad (PROJ)	15
8	H	Mandatory Courses (MC) [Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
		Total	160

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Syllabus Structure & Contents of Third Year of Engineering

Semester-V

w.e.f. 2020 – 2021

Syllabus Structure for Third Year Engineering (Semester – V) (Automobile Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Heat Transfer	**D**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Manufacturing Processes	**D**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Strength of Materials	**D**	**3**	**--**	**--**	**3**	40	60	--	--	100	**3**
Professional Elective Course – I	**E**	**3**	**--**	**--**	**3**	40	60	-	-	100	**3**
Open Elective Course – I	**F**	**3**	**--**	**--**	**3**	40	60	-	-	100	**3**
Heat Transfer Lab	**D**	**--**	**--**	**2**	**2**	--	--	25	25 (PR)	50	**1**
Manufacturing Processes Lab	**D**	**--**	**--**	**2**	**2**	--	--	25	25 (OR)	50	**1**
Machine Drawing Lab	**D**	**--**	**--**	**2**	**2**	-	-	25	25 (OR)	50	**1**
Minor Project – I (Stage –I)	**G**	**--**	**--**	**6**	**6**	-	-	50	-	50	**3**
Constitution of India	**H**	**--**	**--**	**--**	**--**	--	--	--	--		**0**
		15	**--**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

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

Professional Elective Course – I	Open Elective Course – I
1) Automobile Engines	**1) Principles of Management**
2) Transport Management and Safety Regulations	**2) Renewable Energy Sources & Technology**
3) Automobile Dynamics	**3) Total Quality Management**

Syllabus Structure for Third Year Engineering (Semester – VI) (Automobile Engineering) (w.e.f. 2020 – 21)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Kinematics and Theory of Machines	**D**	3	--	--	3	40	60	--	--	100	**3**
Manufacturing Technology	**D**	3	--	--	3	40	60	--	--	100	**3**
Automobile Service and Repairs	**D**	3	--	--	3	40	60	--	--	100	**3**
Professional Elective Course – II	**E**	3	--	--	3	40	60	-	-	100	**3**
Open Elective Course – II	**F**	3	--	--	3	40	60	-	-	100	**3**
Kinematics & Theory of Machines Lab	**D**	--	--	2	2	--	--	25	25 (OR)	50	**1**
Manufacturing Technology Lab	**D**	--	--	2	2	--	--	25	25 (OR)	50	**1**
Automobile Service and Repairs Lab	**D**	--	--	2	2	--	--	25	-	25	**1**
Minor Project	**G**	--	--	6	6	-	-	50	25 (OR)	75	**3**
Internship*	**H**	-	-	-	-	-	-	-	-	-	-
		15	**--**	**12**	**27**	**200**	**300**	**125**	**75**	**700**	**21**

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

Professional Elective Course – II	Open Elective Course – II
1) Automotive Ergonomics & Styling	**1) Instrumentation and Control**
2) Automotive Aerodynamics	**2) Mechanical Estimation & Costing**
3) Automobile Fuels & Emissions	**3) Introduction to Micro Electro Mechanical Systems**

NOTE: * Internship is a mandatory and non-credit course. It shall be during summer vacation after Semester – VI. The satisfactory completion of Internship should be submitted to University at the end of Semester – VIII.

HEAT TRANSFER

COURSE OUTLINE

Course Title:	HEAT TRANSFER	Short Title:	HT	Course Code:	

Course description:

This course introduces undergraduate students to Heat Transfer. The background required includes a sound knowledge of Mathematics (Calculus), Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics of second year Level. The course aims at imparting knowledge of Heat Transfer and modes of Heat Transfer.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	3

Prerequisite course(s):

Mathematics (Calculus) at first year level and Engineering
Thermodynamics, Applied Thermodynamics and Fluid Mechanics at Second Year Level.

Course objectives:

(1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
(2) Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
(3) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Course outcomes:

Upon Successful completion of this course, students will be able to understand:

1. formulate and analyze the steady state heat transfer in conduction
2. design, analyze and interpret the data for fins and transient heat conduction
3. obtain exact solution by analysing the correlation for natural and force convection in heat transfer model
4. apply knowledge of radiation law, analyze problems and find shape factor for various bodies.
5. design, analyze, performance evaluation of heat exchanger.

COURSE CONTENT

HEAT TRANSFER		Semester:	V
Teaching Scheme:		Examination scheme	
Lectures:	3 hours/week	End semester exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Steady State Conductive Heat transfer:

Concepts and Mechanism of heat flow: Steady and unsteady state heat transfer, Modes of heat transfer, their physical mechanism.

Laws of heat transfer, thermal conductivity, heat transfer coefficient, radiation heat transfer coefficient. Isotropic and an-isotropic materials, Insulation materials, Thermal resistance and thermal conductance.
One dimensional heat conduction Boundary conditions, Steady state heat conduction without heat generation in plane wall, cylinder and sphere, Thermal contact resistance, critical thickness of insulation on cylindrical bodies.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Steady and Unsteady State Conductive Heat transfer:
One-dimension Steady state heat conduction with heat generation in plane wall, cylinder and sphere
Heat transfer from extended surface.: Types of fins, governing equation for pin fin for infinite long fin and fin with negligible heat loss, Fin performance, fin efficiency, fin effectiveness, overall fin effectiveness
Unsteady state heat conduction, Introduction to lumped system approximation and Biot number. Importance and use of Heissler charts.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Convection Heat Transfer:
Natural and forced convection; Dimensional analysis; Thermal boundary layer.
Convection boundary layers: laminar, turbulent, Laminar flow over bodies, turbulent flow inside circular and non- circular ducts, Reynolds Colburn analogy for flow over flat plate and flow inside tube.
Heat transfer in fully developed flow, Natural convection over vertical planes, use of empirical correlation for convection
Principle of condensation and boiling, Pool boiling curve (No numerical treatment). Introduction mass transfer, Similarity between heat and mass transfer (No numerical treatment).

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Radiation Heat Transfer:
Thermal radiation: Concept, Black body radiation, Spectral and total emissive power, Stefan Boltzmann law, Radiation laws. Irradiation and radiosity, Surface absorption, reflection and transmission, emissivity.
Radiation view factor, Properties of view factor, (numerical treatment on view factor on square cavity, triangular cavity, hemispherical cavity, concentric cylinder and sphere only)
Radiation heat exchange between two diffuse gray parallel surface, radiation shields.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Heat Exchangers:
Classification of heat exchangers, temperature distribution in parallel, counter flow arrangement, condenser and evaporator, Overall heat transfer coefficient, fouling factor.
Log-mean temperature difference method and NTU –effectiveness method of analysis for rating and sizing of heat exchangers.
Construction aspects in brief. For good heat exchanger, Design aspects of Condensers, Reboilers and Evaporators.

Text Books:

1. J.P.Holman 1992 "Heat Transfer" McGraw Hill VII Edition.
2. P. Kothandaraman"Fundamentals of Heat and Mass Transfer".
3. R.K.Rajput"Heat and Mass Transfer", S.Chand& Company Ltd., New Delhi.
4. D.S.Kumar "Heat and Mass Transfer" D.S.KumarS.K.Kataria& Sons, Delhi.
5. P.K.Nag "Heat Transfer" Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Sachdeva R.C., "Fundamentals of Heat and Mass Transfer" Wiley Eastern Limited, Third Edition.
7. Sukhatme S.P, "A Text Book on Heat Transfer" (1989), IIIrdEdition, Orient Longmans Ltd., New Delhi.
8. Arora S.C. & Domkundwar S., "A Course in Heat and Mass Transfer" (1994), Dhanpat Rai & Sons, IVthEdition.
9. Chapman A.J., "Heat Transfer" (1989), IVth Edition.
10. Yunus A. Cengel, "Heat Transfer –A Practical Approach" (Tata McGraw Hill)
11. M. M. Rathore "Engineering Heat and Mass Transfer", 2nd Edition, Laxmi Publications, New
Delhi.
12. M. Thirumalseshwar, "Fundamentals of Heat and Mass Transfer" Pearson Education.
13. R. Rudramoorthy, K. Mayilsomy, "Heat Transfer", Pearson Education.

Reference Books:

1. Bejan, A., A. D. Kraus, "Heat Transfer Handbook", John Wiley (2003).
2. W. J. McCabe, J. Smith, P. Harriot, "Unit Operations of Chemical Engineering", Sixth Edition, McGraw Hill (2005).
3. Holman, J. P., S. Bhattacharya, "Heat Transfer", 10th Ed., Tata McGraw-Hill (2011).
4. D. Q. Kern, "Process Heat Transfer", Tata-McGraw Hill (1997).
5. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, "Fundamentals of Momentum, Heat and Mass Transfer", 4th Ed.,Wiley (2007).
6. F.P.Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley, Sixth Edition, 2007.
7. Massoud Kaviany, "Principles of Heat Transfer", John Wiley, 2002
8. Yunus A Cengel, "Heat Transfer : A Practical Approach", McGraw Hill, 2002

MANUFACTURING PROCESSES					
COURSE OUTLINE					
Course Title:	**Manufacturing Processes**	**Short Title:**	**MP**	**Course Code:**	

Course description:

This course is designed to introduce students with different manufacturing processes. The course will help students understand the manufacturing and joining processes and their applications. Students will be able to solve the problems related to load design for forming process and poring time in casting processes. They will be familiarized with different machining process and machine tools such as lathe machine, shaper machine and planer machine.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	03	14	42	3

Prerequisite course(s):

Workshop practice, Physics.

Course objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course outcomes:

Upon Successful completion of this course, students will be able to understand:

1. Understand metal casting process, calculate pouring time, elements of gating system and defects in it.
2. Understand principle of metal forming and working of various metal forming processes.
3. Understand meaning, use of welding, techniques and types of it.
4. Understand working of machines used in manufacturing and their use.
5. Understand process of powder metallurgy, use and properties of products.

COURSE CONTENT

Manufacturing Processes		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Metal Casting Process: Casting and moulding: Casting, Patterns; types, material and design including pattern allowances; Moulding sands; composition, preparation, properties and testing; Core; Purpose, definition, materials, preparation and applications; Gating system; elements of gating system, characteristics, Classification, Estimation of pouring time for top gate and bottom gate type moulds. Heat transfer and Solidification, Inspection of casting, Special casting processes, Defects in casting processes. Design of gating system; pouring basin, sprue, runner and risers; Advantages.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Metal Forming Processes: Theoretical basis for metal forming process, Advantages and disadvantages of metal forming, Classification of metal forming, Effect of variables on metal forming, forging; Classification, considerations for sound forging, forging defects, rolling; Hot and cold rolling, Mechanism of rolling, Analysis of rolling process, Types of rolling mill, rolling defects, Drawing; Wire, Rod and Tube. Extrusion; types of extrusion, Advantages and disadvantages.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Welding/ Joining Process: Welding; Definition, Advantages, Limitations, Applications, Classification of welding process, Gas welding processes, types of flame, Torch angle, Factors influencing torch angle, welding techniques in gas welding, use of filler rod and fluxes. Arc welding operation, Design of weld bead, Electrode, designation of electrode, Crowning, Spatter, Magnetic arc blow, TIG welding, MIG welding, Soldering, Brazing and Braze welding operation, Thermit welding, Electro-slag welding, Defects in welding.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Machining: Lathe machine; Parts of lathe machines (Tail stock, Head stock, Carriage, Bed), Operations on lathe (Plain turning, Taper turning, Thread cutting, Chamfering, Knurling). Shapers and Planners; Introduction, Shaper machine, cutting tools used in shaping, Planning machine, Principal of working. Milling Process; Introduction, Basic Milling process, types of milling process; peripheral milling, Face milling, End Milling, Milling machines. Grinding; Introduction, Specification of grinding wheel, Glazing.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Powder Metallurgy: Introduction, Advantages and limitations of P/M, Manufacturing of metal powders, Mixing and blending, Compaction, Sintering, Secondary operations, Recent trends in powder metallurgy, properties of powder metallurgy parts, Comparison of P/M parts with other processes.		
Text Books:		
1. Dr. P. C. Sharma, "Production Technology (Manufacturing Processes)", S. Chand & Company Ltd. 2. Dr. P. C. Sharma, "Production Engineering", S. Chand & Company Ltd. 3. H. N. Gupta, R. C. Gupta, Arun Mittal, "Manufacturing Processes", New Age International Publishers 4. Kalpakjian and Schmid, "Manufacturing processes for engineering materials", (5th Edition) Pearson India, 2014. 5. Mikell P. Groover, "Fundamentals of modern manufacturing", John Wiley and Sons, Inc. 6. Degarmo, Black & Kohser, "Materials and Processes in Manufacturing".		
Reference Books:		
1. R. K. Jain, "Production Technology", Khanna Publishers. 2. P. N. Rao, "Manufacturing technology, Vol-I & II", McGraw Hill publications. 3. Hajara Choudhari, Bose S.K., "Elements of Workshop Technology Volume I & II".		

4. H. S. Shah, “Manufacturing process Vol-I”, Pearson, New Delhi.
5. Serope Kalpakjian, “Manufacturing Processes”, Pearson New Delhi.
6. Amitabha Ghosh, Asok Kumar Mallik, “Manufacturing Science”, Pearson, India.

STRENGTH OF MATERIALS					
COURSE OUTLINE					
Course Title:	**Strength of Materials**	**Short Title:**	**SOM**	**Course Code:**	

Course description:

The course is designed to understand the basic concepts of stress, strain and their variations due to different type of loading. The concept of Mechanical properties, Poisson's ratio, bulk modulus, elastic modulus, modulus of rigidity, combined stress and strain, principal stress, principal plane, bending moment and shear force in beam under various loading conditions.
It focuses on the concepts of bending stresses and shear stresses in beams. Understanding of torsional shear stress in solid and hollow shaft; principal and maximum shear stress in a circular shaft subjected to combined stresses.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	3

Prerequisite course(s):

Mathematics (Calculus) and Engineering Mechanics

Course objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading**.**

Course outcomes:

After successful completion of this course the student will be able to:

1. Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. Evaluate principal stresses, strains and apply the concept for design and Draw the SFD and BMD for different types of loads and support conditions
3. Determine the stresses and strains in the members subjected bending and Evaluate the slope and deflection of beams subjected to loads
4. Determine the stresses and strains in the members subjected to torsional loads.
5. Determine the stresses and strains in the pressure vessels due to intensity of pressure

COURSE CONTENT

Strength of Materials		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Deformation in solids- Hooke's law, stress and strain, tension, compression and shear Stresses, elastic constants and their relations, volumetric, linear and shear strains, bars with cross-sections

varying in steps, bars subjected to varying loads, indeterminate structural problems, compound bars.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Principal stresses and principal planes, Mohr's circle. Beams and type's transverse loading on beams, shear force and bend moment diagrams, Types of beam supports, simply supported and over-hanging beams, cantilevers.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. Deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.		
Text Books:		
1. S. Ramamruthan, "Strength of Materials", Dhanpat Rai & Co. (p) Ltd. New Delhi, 2001. 2. R. Subramanian, "Strength of Materials", Oxford University Press, 2007. 3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, "Mechanics of Materials", Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.		
Reference Books:		
1. Pytel A H and Singer F L, "Strength of Materials", Harper Collins, New Delhi. 2. Beer P F and Johston (Jr) E R, "Mechanics of Materials", SI Version, McGraw Hill, NY. 3. Popov E P, "Engineering Mechanics of Solids", SI Version, Prentice Hall, New Delhi. 4. Timoshenko S P and Young D H, "Elements of Strength of Materials", East West Press, New Delhi. 5. Shames, I. H., Pitarresi, J. M., "Introduction to Solid Mechanics," Prentice-Hall, NJ. 6. NPTEL courses, http://nptel.iitm.ac.in/courses.php, web and video courses on Strength of Materials by Prof. Sharma, S. C., and Prof. Harsha, S. P.		

AUTOMOBILE ENGINES					
COURSE OUTLINE					
Course Title:	**Automobile Engines**	**Short Title:**	**AE**	**Course Code:**	
Course description:					
This subject includes various engine operations and their operations along with fuels and their combustion process and engine performance.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
Internal Combustion Engine, Automobile System					
Course objectives:					
To study various engines and their operation, Fuels, Combustion process					
Course outcomes:					
After successful completion of this course the student will be able to distinguish I.C. engines and their operations, fuels, combustion process, valve timings					
COURSE CONTENT					
Automobile Engines		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**	
		Duration of ESE:		**03 hours**	
		Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**			
BASIC CONCEPTS AND ENGINE CYCLES **Introduction:** Classification, engine components and their functions, Terminology, Work (indicated and brake), mean effective pressure, torque and power (brake and indicated), mechanical efficiency, thermal and volumetric efficiencies of engine, air fuel ratio, specific fuel consumption. **Air Standard Cycles:** Assumptions, Otto, Diesel, Dual Combustion cycle, derivation of their efficiency equation, work done and mean effective pressure. Comparison on the basis of heat input, compression ratio, Maximum pressure and temperature, Actual cycle, deviation from theoretical cycles. Pumping losses, time losses.					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			
FUEL FEEDING SYSTEMS a) Charge, intake valve and manifold, valve timing diagram, valve overlap, choked flow. **Carburetion:** Requirement, types of carburetors according to fluid flow, simple carburetor, Air fuel ratio calculation, effect of altitude, disadvantages of simple Carburetor, compensating devices for starting, economy range, acceleration, compensating jet etc. additional systems in modern carburetors, Solex carburetor.					

Disadvantages of carburetion and gasoline injection, MPFI.
Fuel feeding systems in CI engines: Requirement, classification, fuel feed pump, jerk type injection fuel pump, distributor type pump, injection pump governor, fuel Injector and nozzles.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

OPERATING SYSTEM
Cooling systems: requirement, types of cooling systems, thermostat and additives.
Lubrication System: Mechanism of lubrication, different methods, important properties of lubricating oils.
Starting methods of engines: Types of superchargers, Super charging, effect of super charging, limitations and advantages of supercharging, and turbo charging of engines.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

COMBUSTION IN SI AND CI ENGINES
Homogeneous and heterogeneous mixtures,
Combustion in SI engines: Stages in combustion, Ignition lag, velocity of flame propagation, factors influencing flame speed, rate of pressure rise, Detonation, factors affecting the detonation, pre-ignition. Rating of SI engines fuels, Dopes, combustion chamber of SI engines.
Combustion in CI engine: stages of combustion, factors affecting the delay period. Diesel knock, Effect of engine variables on Diesel knock, Rating of CI engine fuels: Cetane number, performance number, comparison of knock in SI and CI engines. Combustion chamber for CI engines.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

ENGINE TESTING AND PERFORMANCE
Measurement of indicated power, brake power, Morse test, energy balance and Efficiency calculations.
BIS specification. Recent trends in internal combustion engines. Engine emission, air pollution due to engines, various Euro norms, Unburnt hydrocarbon emission in two stroke and CI engines, CO and Nox emission, particulate traps, EGR, emission control methods catalytic converters (Introductory), crank blow by losses

Text Books:

1) V. Ganeshan, “Internal Combustion Engines”, 2/e, Tata McGraw Hill, New Delhi.
2) R. K. Rajput , “Internal Combustion Engines”’, Laxmi Publications, New Delhi.
3) W. W. Pulkrabek , “Fundamentals of Internal Combustion Engines”, Prentice Hall of India (P) Ltd., New Delhi.
4) E. F. Obert , “Internal Combustion Engines and Air Pollution”, Harper and Row, New York.

Reference Books:

1) Ferguson C. R , “Internal Combustion Engines”, Wiley Inc. New York.
2) Sharma R.P. and Mathur M.L., “Internal Combustion Engines”, Standard Publications, New Delhi.

3) Domkundwar, ., “Internal Combustion Engines”, Dhanpat Rai & Co. New Delhi.
4) Willard W Pulkrabek. “Internal Combustion Engines”, Pearson Education
5) Shyam K. Agrawal, “Internal Combustion Engines”, New Edge International Publication.
6) K.K. Ramalingam, “Internal Combustion Engines”, Scitech Publication.

TRANSPORT MANAGEMENT AND SAFETY REGULATIONS					
COURSE OUTLINE					
Course Title:	**Transport Management and Safety Regulations.**	**Short Title:**	**TMSR**	**Course Code:**	
Course description:					
This subject includes Central Motor Vehicle Act 1988					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
Automobile System					
Course objectives:					
To study various acts related to registration, Driving License, Permits, Tax, and Safety, This course also introduces undergraduate students to imparting knowledge of Central motor vehicle act, taxation, insurance, fleet management, garage layouts, and safety aspects on the road. The course aims provide knowledge of the basic transport management which is automotive engineer must take into consideration.					
Course outcomes:					
At the end of the course the students are able to 1. Have a critical understanding of current developments in transport and logistics systems. 2. Demonstrate critical awareness of the strategic significance of Transport and Logistics systems. 3. Be able to understand the transport and logistics theoretical frameworks. 4. Be capable of interpretation, and critical analysis of transport and logistics strategies. 5. Be able to using current theories, and reflect on their work experience to produce better transport and logistics performance.					
COURSE CONTENT					
Transport Management and Safety Regulations.		**Semester:**	**TMSR**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**	
		Duration of ESE:		**03 hours**	
		Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Motor Vehicle Act-1989 Short Titles and definitions laws governing use of motor vehicle & vehicle transport. Licensing of drivers and conductor, Registration of vehicle, state and interstate permits. Taxation structure and methods of laving taxation, insurance type and significance. Furnishing particulars of vehicles involved in accident, award of claim tribunal. Duty of driver & conductor in case of accident, traffic rules, signals and e controls, accidents causes and analysis. Liabilities and preventive measures, Design of road complex, Responsibility					

of driver, Public authorities, offences, penalties and procedures. Different types of forms, Government administration structure, personnel authorities and duties.		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transport terminology - Important terms used in road transport organization like HMV , LMV, Fleet utilization , breakdown rate, accident rate, route, seat km etc. Cost of Services - Capital cost & operating cost, fixed cost & variable cost, direct & indirect cost, excess capacity and effect on route Operational productivity and efficiency Productivity in road transportation organization, the environment of road transport system, Optimizing fleet and vehicle utilization, conservation of fuel and economy, control of breakdown, effective traffic operation.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Infrastructure in road transportation organization Garages, essential requirements of garages, fleet maintenance record , bus station , bus shelter, bus stop, essential requirement, staffing, management of transport Organization and it's of objectives, Typical depot layout structure of passages and goods transport organization. **Motor industry** Manufacturing techniques and quality control of automobile components such as piston, cylinder, valves, crankshaft, camshaft, and bearings.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Significance of Road Transportations Road transportation as an agent of change and development ,National scene, transport policy and co-ordination, operating characteristic s in transportation, engineering flexibility ,speed and acceleration, dependability and safety performance criteria, Transport planning Strategic planning, management control, operational control		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Road safety and Health Driving comfort, avoiding fatigue, the road to exhaustation, poisonous car fumes, car sickness, drugs & driving first aid for motorist, first aid kits, braking & stopping interpreting the signs ,rain, floods, hot, mist care &precaution , ice snow Skidding, emergencies & road observations. **Accidents** Definition of accident, legal obligation, causes of accident, Insurance, Documentation, Analysis & preventions of accidents, Road Safety & Drivers Role, Defensive driver, driver selection test, Drivers training. **Security Devices** Dog Restraint, Rear fog lamp, guard lamp, reversing light, bonnet, brakes locks, vibrator alarm, fog lamp, Toe bar, Roof racks and Luggage containers.		
Text Books:		
1. P. G. Patankar, Road passenger Transport in India, C.I.T.T. Publication		

Reference Books:
1. Government Publication, The Motor vehicle Act, 1989. 2. Kadiyali. L. R., Traffic engineering and Transport Planning. 3. Santosh Sharma, Productivity In Road Transportation, A.S.R.T.V.Publication 4. Transport Terms- C.I.R.T.Pune.

AUTOMOBILE DYNAMICS					
COURSE OUTLINE					
Course Title:	**Automobile Dynamics**	**Short Title:**	AD	**Course Code:**	
Course description:					
This subject includes various engine performances, system performance and their operations along with their working conditions.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
Automobile Design, Automobile System					
Course objectives:					
This course introduces undergraduate students to imparting knowledge of automobile dynamics. The background required a sound knowledge of mathematics, Mechanics, Automobile layouts and automobile engineering.					
Course outcomes:					
After successful completion of this course the student will be able to test engine, steering geometry, brakes, handling characteristic.					
COURSE CONTENT					
Automobile Dynamics		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**	
		Duration of ESE:		**03 hours**	
		Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Performance of Automobile Power for Propulsion, Traction And Tractive effort, Relation between Engine revolutions, N and Vehicle Speed, V. Road Performance curves: Acceleration, Gradiability and Drawbar Pull. Calculation of Equivalent Weight, We. Gear Ratio for Maximum Acceleration, Distribution of Weight, Stability of Vehicle on Slope, Calculation of maximum Acceleration, Maximum Tractive Effort and Reactions for Different Drive. Dynamic of Vehicle Running on a Banked Track, Stability of Vehicle Taking a Turn.					
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**			
Vehicle Vibration Some Definitions, Vehicle Vibration and Human Comfort. Vehicle Vibration with Single Degree of Freedom, Vibration with two Degree of freedom					
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**			

Frame, Suspension, Springs and Wheel

The Frame, Vehicle Dynamics and Suspension Requirement, Suspension System.
Suspension Control Devices, Suspension Services, Chassis Springs. Theory of Chassis Springs, Mechanics of an Independent Suspension System, The Roll Axis and the Vehicle Under the Action of Side Forces, The Wheel. Tyre, Tyre Construction and Manufacturing, Tyre Design Consideration and Features, tyre Operation and Service.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Handling Characteristic

Steering Geometry, Fundamental condition of true rolling, Ackerman steering gear, Davis steering gear.
Steady state handling, neutral steering, over steering, over steering, steady state response, yaw velocity, lateral acceleration, curvature response and directional stability.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Braking Performance

Braking of vehicle – Braking applied to gear wheels, front wheels and all four wheels on straight and curved paths. Mass transfer & its effects, Braking Efficiency, Stopping distance reaction time.
Brake Locking and antilock devices, Calculation of mean lining pressure and heat generation during braking, Braking of vehicle moving in a curved path.

Text Books:

1. Wong J. Y, Theory of Ground Vehicles, John Willey & Sons Inc. 3rd edition.
2. Giri N.K., Problems in Automobile Dynamics

Reference Books:

1. Gillespie, Fundamentals of vehicle dynamics
2. Grover, Mechanical vibration
3. Eills, Vehicle dynamics.

PRINCIPLES OF MANAGEMENT					
COURSE OUTLINE					
Course Title:	**Principles of Management**	**Short Title:**	POM	**Course Code:**	
Course description:					
This course is designed to be an overview of the major functions of management. Emphasis is on planning, organizing, controlling, directing, and communicating. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
English					
Course objectives:					
To understand the principles of management and their application to the functioning of an organization					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. Get a clear understanding of management functions in an organization 2. Explain strategic management in business operations. 3. Define management, quality management, and project management. 4. Identify relevant issues in human resource management					
COURSE CONTENT					
Principles of Management		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**		
		Duration of ESE:	**03 hours**		
		Internal Sessional Exams (ISE):	**40 marks**		
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**			
Definition of management, science or art, manager vs. entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.					
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**			
Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.					

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, Effective communication.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.		
Text Books:		
1. Tripathy P C & Reddy PN, Principles of Management, Tata McGraw Hill, 1999. 2. L.M. Prasad.Principal and Practice of Management 3. R. K. Sharma. Business Organisation & Management, 4. C.B. Gupta, Business Organisation & Management,		
Reference Books:		
1. Hellriegel, Slocum & Jackson, Management - A Competency Based Approach, Thomson South Western, 10th edition, 2007. 2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global 3. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009. 4. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education		

RENEWABLE ENERGY SOURCES & TECHNOLOGY					
COURSE OUTLINE					
Course Title:	**Renewable Energy Sources & Technology**	**Short Title:**	REST	**Course Code:**	
Course description:					
This course is designed to understand & analyze the pattern of Renewable Energy Resources Suggest Methodologies / Technologies for its utilization. Economics of the Utilization and Environmental Merits					
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	3	14	42	3	
Prerequisite course(s):					
English, Thermodynamics					
Course objectives:					
1. Understanding basic characteristics of renewable sources of energy and technologies for their utilisation 2. To give review on utilisation trends of renewable sources of energy 3. To give review on legislative and regulatory rules related to utilisation of renewable sources of energy					
Course outcomes:					
After successful completion of this course the student will be able to:					
1. define basic properties of different renewable sources of energy and technologies for their utilisation, 2. describe main elements of technical systems designed for utilisation of renewable sources of energy, 3. interpret advantages and disadvantages of different renewable sources of energy 4. undertake simple analysis of energy potential of renewable sources of energy, 5. explain the correlation between different operational parameters,					
COURSE CONTENT					
Renewable Energy Sources & Technology		**Semester:**	**V**		
Teaching Scheme:		**Examination scheme**			
Lectures:	**3 hours/week**	**End semester exam (ESE):**		**60 marks**	
		Duration of ESE:		**03 hours**	
		Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**			
Introduction to energy technology and energy sciences, Energy and environment laws of conservation of energy. Essential subsystems in a solar energy plant, Phenomena of light and energy, energy from sun, Solar constant, power density for various wavelength of sun light, clarity index and angle of latitude. Solar insolation at different geographical locations. Solar thermal collectors and its types.					
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**			

Introduction to solar photovoltaic system, Merit and limitations, economic considerations of solar PV system, Principle and characteristic of solar cell, Efficiency of solar cell, Configuration of solar PV panel, Solar PV cell technologies, Small solar PV system for residence & for rural areas.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to geothermal energy, Geothermal energy resources, origin of geothermal Resources, Geothermal gradients, hydro geothermal resources, Geo pressure geothermal resources, Geothermal fluid for electric power plants, Classification and type of geothermal power plants.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to wind energy, Nature of wind energy conversion system, Wind power density, Forces on the blades of a propeller, Wind turbine efficiency, Wind velocity duration characteristic, Type of wind turbine-generator unit, Planning of wind farm and grid connection.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to biomass energy resources, Biomass conversion process, Direct combustion of biomass, gaseous fuels from biomass, Gaseous fuels from biomass, Introduction to urban solid waste –to- energy by incineration process, Waste –to- energy incineration process and energy plant, location of plants, wood and wood waste as primary energy source and cogeneration plant.		
Text Books:		
1. Rai. G. D., Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 1999 2. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997		
Reference Books:		
1. S Rao & Dr. B B Parulekar, Energy Technology, Khanna Publishers. 2. Dr. H S Mukunda, Understanding Clean Energy and fuels from Biomass, Wiley India		

TOTAL QUALITY MANAGEMENT						
COURSE OUTLINE						
Course Title:	**Total Quality Management**		**Short Title:**	TQM	**Course Code:**	
Course description:						
This course is designed to understand & analyze the pattern of Renewable Energy Resources Suggest Methodologies / Technologies for its utilization. Economics of the Utilization and Environmental Merits						
Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**		
	3	14	42	3		
Prerequisite course(s):						
English, Thermodynamics						
Course objectives:						
1. Understanding basic characteristics of renewable sources of energy and technologies for their utilisation 2. To give review on utilisation trends of renewable sources of energy 3. To give review on legislative and regulatory rules related to utilisation of renewable sources of energy						
Course outcomes:						
After successful completion of this course the student will be able to:						
1. define basic properties of different renewable sources of energy and technologies for their utilisation, 2. describe main elements of technical systems designed for utilisation of renewable sources of energy, 3. interpret advantages and disadvantages of different renewable sources of energy 4. undertake simple analysis of energy potential of renewable sources of energy, 5. explain the correlation between different operational parameters,						
COURSE CONTENT						
Total Quality Management			**Semester:**	**V**		
Teaching Scheme:			**Examination scheme**			
Lectures:	**3 hours/week**		**End semester exam (ESE):**		**60 marks**	
			Duration of ESE:		**03 hours**	
			Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**			
Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints and Customer retention.						
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**			

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures. Concepts of six sigma,

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000– ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration-
ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

Text Books:

1. Poornima M. Charantimath, TQM, Pearson Education
2. V. Vijayan, H. Ramakrishnan, TQM, S Chand

Reference Books:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, 8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Janakiraman. B and Gopal R. K., Total Quality Management – Text and Cases, Prentice Hall (India) Pvt. Ltd., 2006.

3. Suganthi.L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd., 2006.

4. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

5. ISO9001-2015 standards

HEAT TRANSFER LAB

LAB COURSE OUTLINE

Course Title:	Heat Transfer Lab	Short Title:	HT lab	Course Code:	

Course description:

This lab includes different practical of Heat Transfer. The course aims at imparting knowledge of Heat Transfer and its modes.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	2	14	28	1

End Semester Exam (ESE) Pattern:	Practical (PR)

Prerequisite course(s):

The knowledge of basic heat flow and differential equation of heat transfer is required. The student must be aware about correlation and analogies to cope up with practical.
Mathematics (Calculus) at first year level and Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics at Second Year Level.

Course objectives:

The lab work should clear the vision about all the modes of heat transfer. The practical knowledge should enhance the approach of student to the subject, which should facilitate him for solving derivations and numerical.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

Understand the modes of heat transfer. The boundary conditions in different modes of heat transfer.

LAB COURSE CONTENT

Heat transfer Lab		Semester:	V
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

1. Determination of thermal conductivity of metal rod, insulating powder and composite wall.
2. Determination of heat transfer coefficient in natural convection and forced convection.
3. Determination of temperature distribution, fin efficiency, effectiveness in natural convection and forced convection
4. Determination of emissivity of a test surface.
5. Determination of Stefan Boltzmann constant.
6. Determination of LMTD, overall heat transfer coefficient and effectiveness of heat exchanger in parallel and counter flow arrangement and compare them.
7. Study of pool boiling phenomenon and determination of critical heat flux.
8. Determination / Study of Calorific Value of a given fuel and its flash & fire point.
9. Determination of convective heat transfer coefficient for flow over a heated plate.
10. Determination / Study of specific heat of object.

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

Text Books:

1. J.P.Holman, 1992 "Heat Transfer" McGraw Hill VII Edition.
2. P.Kothandaraman, 'Fundamentals of Heat and Mass Transfer".
3. R.K.Rajput, "Heat and Mass Transfer", S. Chand& Company Ltd., New Delhi.
4. D.S.Kumar "Heat and Mass Transfer" D. S. Kumar, S. K. Kataria & Sons, Delhi.
5. P.K.Nag "Heat Transfer" Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Sachdeva R.C., "Fundamentals of Heat and Mass Transfer" Wiley Eastern Limited, Third Edition.
7. Sukhatme S.P, "A Text Book on Heat Transfer" (1989), IIIrd Edition, Orient Longmans Ltd., New Delhi.
8. Arora S.C. &Domkundwar S., "A Course in Heat and Mass Transfer" (1994), Dhanpat Rai& Sons, IVth Edition.
9. Chapman A.J., "Heat Transfer" (1989), IVth Edition.
10. Yunus A. Cengel, "Heat Transfer –A Practical Approach" (Tata McGraw Hill)
11. M. M. Rathore "Engineering Heat and Mass Transfer", 2nd Edition, Laxmi Publications, New Delhi.
12. M. Thirumalseshwar, 'Fundamentals of Heat and Mass Transfer" Pearson Education.
13. R. Rudramoorthy, K. Mayilsomy, "Heat Transfer", Pearson Education.

Reference Books:

1. Bejan, A., A. D. Kraus, Heat Transfer Handbook, John Wiley (2003).
2. W. J. McCabe, J. Smith, P. Harriot, Unit Operations of Chemical Engineering, Sixth Edition, McGraw Hill (2005).
3. Holman, J. P., S. Bhattacharya, Heat Transfer, 10th Ed., Tata McGraw-Hill (2011).
4. D. Q. Kern, Process Heat Transfer, Tata-McGraw Hill (1997).
5. R. Welty, C. E. Wicks, R. E. Wilson, G. Rorrer, Fundamentals of Momentum, Heat and Mass Transfer, 4th Ed.,Wiley (2007).

Guide lines for ICA:

Lab file should contain EIGHT experiments conducted in lab

Guidelines for ESE:

The Practical Examination will comprise of performing the experiment and viva on the Practical

Instructions for practical Exam. :-

1. Five experiments should be selected for Practical Examination.
2. The Number of Students for each Practical set up should not be more than 5 Students.

MANUFACTURING PROCESSES LAB

LAB COURSE OUTLINE

Course Title:	Manufacturing Processes Lab	Short Title:	MPL	Course Code:	

Course description:
The lab is to gain a practical understanding of various manufacturing processes in a hands-on environment.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	02	14	28	01

End Semester Exam (ESE) Pattern: ***Practical (PR) / Oral (OR)***

Prerequisite course(s):

Engineering Graphics; Workshop Practice

Course objectives:

In this laboratory you will be exposed to the common manufacturing processes such as casting, metal forming, and welding processing. Laboratory experiments will consist of hands expression and demonstration of the above mentioned processes.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Develop a practical understanding of basic manufacturing processes and capabilities of each.
2. Set-up and conduct engineering experiments related to various manufacturing processes.
3. Learn to make engineering judgments

LAB COURSE CONTENT

Manufacturing Processes Lab		Semester:	V
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

1. To prepare a sheet metal product (Funnel)
2. To prepare a pattern for given object for lost form casting.
3. To prepare a Green sand mold from the prepared pattern.
4. To melt and pour Aluminium metal into the mold.
5. To study and observe the Powder Metallurgy techniques through demonstration
6. To study and observe the Closed Die Forging techniques through demonstration

Text Books:

1. R. K. Jain, Production Technology, Khanna Publishers.
2. P. N. Rao, Manufacturing technology, Vol-I & II McGraw Hill publications
3. Hajara Choudhari, Bose S.K Elements of Workshop Technology Volume I & II

Reference Books:
1. G.S. Upadhyaya and A. Upadhyaya, Materials Science & Engineering 2. M.P. Groover, Fundamentals of Modern Manufacturing 3. G.K. Lal and S.K. Choudhury, Fundamentals of Manufacturing Processes, 4. E. P. DeGarmo, J.T. Black and R. Kohser, Materials & Processes in Manufacturing, 5. S. Kalpakjian, Manufacturing Engineering and Technology, 6. E.P. DeGarmo: Materials and Processes in Manufacturing, Macmillan. 7. J.S. Campbell: Principles of Manufacturing Materials and Process, McGraw Hill. 8. J.S. Schey: Introduction of Manufacturing Processes, McGraw Hill International. 9. M.L. Begeman & B.H. Amstead: Manufacturing Process, John Wiley. 10. H.W. Pollack: Manufacturing and Machine Tool Operations, Prentice-Hall. 11. R.A. Lindberg: Process and Materials for Manufacturing, Prentice-Hall. 12. L.E. Doyle: Manufacturing Processes & Materials for Engineers, Prentice-Hall.
Guide lines for ICA:
Lab file should be from above said syllabus and to be drawn in lab.
Guidelines for ESE:
Oral will be based on the Practical Performed in the examination and the sheets included in the Journal.

MACHINE DRAWING LAB

LAB COURSE OUTLINE

Course Title:	**Machine Drawing Lab**	**Short Title:**	**MDL**	**Course Code:**	

Course description:

This course is essential for understanding of working drawings in order to manufacture the parts with specified tolerances and accuracy. The emphasis is given on understanding and preparing the assembly and detailed drawings of the machine units.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	14	28	01

End Semester Exam (ESE) Pattern: ***Practical (PR) / Oral (OR)***

Prerequisite course(s):

Engineering Graphics; Workshop Practice

Course objectives:

The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

i. to define terms used to explain abbreviations
ii. to list / name / sketch different types of machine parts, assemblies and their conventions
iii. to read and interpret the given details of production drawing of machine components
iv. to imagine shapes and sizes of components and visualize / draw their views in different directions
v. to imagine and assemble the given set of components to form a workable machine assembly

LAB COURSE CONTENT

Machine Drawing Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

1. Assignment on Conventional representation of machine components, conventional signs used for welding as per BIS, standard abbreviations in droughting

2. Detail and assembly drawing of the following with complete dimensioning, tolerances, material and surface finish specifications. (Any one of the following manually and with CAD)
(i) Foot Step Bearing (ii) Stuffing Box (iii) Cross Head of IC engine (iv) Eccentric (v) Petrol Engine Connecting rod (vi) Piston assembly (vii) Screw jacks (viii) Machine Vice (ix) Plummer Block (x) Tailstock of lathe (xi) Steam Stop Valve (xii) Spring loaded Safety Valve (xiii) Feed Check Valve (xiv) Box type Jig (xv) Marine Engine Connecting rod (xvi) Steam Engine Connecting rod (xvii) Radial Engine Sub Assembly (xviii) Rotary Gear Pump (xix) Air Valve

(xx) Fuel Injector (xxi) Single Plate Clutch (xxii) Square Tool Post (xxiii) Shaper tool head slide (xxiii) Milling Machine Tail stock (xxiv) Revolving Centre (xxv) Floating reamer holder (xxvi) Swivel Machine vice (xxvii) Indexing Drill Jig (xxviii) Self centering chuck (xxix) Four Jaw Chuck (xxx) Gate Valve (xxxi) Non return valve (xxxii) Blow off valve (xxxiii) Pressure Relief Valve (xxxiv) Lever Safety Valve (xxxv) Ramsbottom Safety Valve (xxxvi) Swivel Bearing (xxxvii) Crane hook (xxxviii) Pipe Vice (xxxix) Speed Reducer 3. Prepare single line and double line diagrams of piping layouts & Draw the assembly drawing and sectioned views of pipe joint. 4. Practice the Preparation of working drawing of welded fabrications.
Text Books:
1. “Machine Drawing”, Third Edition, New Age International Publishers, K. L. Narayana, P. Kannaiah, K. Venkata Reddy. 2. “Machine Drawing”, R K Dhawan, S Chand.
Reference Books:
1. T.S.M & S.S.M in respect of Technical Drawing by TTTI, Madras 2. Machine Drawing by A.C. Parkinson. 3. Machine Drawing by Jones & Jones. 4. Machine Drawing by N.D. Bhat. 5. A text book for Technical Schools Engg. Drawing by N.C.E.R.T 6. Machine Drawing by R.B. Gupta. 7. Indian Standard Scheme of symbol for Welding by SP-46-1988. 8. Machine Drawing by Bhattacharyya (Oxford Publishers). 9. Machine Drawing by Ajeeth Singh (MGH Publishers) 10. Machine Drawing by N. Siddeswar, Kannaih, Sastri. (MGH Publishers)
Guide lines for ICA:
Lab file should be from above said syllabus and to be drawn in lab.
Guidelines for ESE:
Oral will be based on the Practical Performed in the examination and the sheets included in the Journal.

Minor Project (Stage – I)

LAB COURSE OUTLINE

Course Title:	**Minor Project (Stage – I)**	**Short Title:**	**MPROJ-SI**	**Course Code:**	

Course description:

Minor project represent the culmination of study towards the Bachelor of Engineering degree. The minor project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	6	**14**	**84**	**3**

End Semester Exam (ESE) Pattern:	**----**

Prerequisite course(s):

Course objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Minor Project (Stage – I)		**Semester:**	**V**
Teaching Scheme:		**Examination scheme:**	
Practical:	**6 hours/week**	**Internal Continuous Assessment (ICA):**	**50 marks**

At third year, the students shall carry out a minor project in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – V the students shall complete the partial work, and by the end of Semester – VI the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of minor projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – IV. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study/Survey/Design.

Minor Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – V. Each student group should submit partial project report in the form of spiral bound at the end of Semester –V.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract

Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objectives
- Selection of Life cycle Model for Development
- Organization of Report
- Summary

Chapter 2. Project Planning and Management

- Feasibility Study
- Risk Analysis
- Project Scheduling
- Effort Allocation
- Cost Estimation
- Summary

Chapter 3. Literature Survey

- Sources of information
- List of important literature
- Literature review
- Summary

Chapter 4. Future Work Plan

- Summary

Chapter 5. Conclusion & Future Work

Bibliography

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project (stage – I) in Semester – V shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Constitution of India

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

Kavayatri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering (Mechanical Engineering)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

Syllabus Structure & Contents of Third Year of Engineering

Semester-VI

w.e.f. 2020 – 2021

KINEMATICS AND THEORY OF MACHINES					
COURSE OUTLINE					
Course Title:	**Kinematics and Theory of Machines**	**Short Title:**	**KTM**	**Course Code:**	
Course description:					
This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms. It discusses the dynamic force analysis, Cams, Governor, Gyroscope and Balancing methods. The course will demonstrate various concepts by working out problems relevant to real life applications of mechanisms. The course is expected to help students in their basic understanding and use of kinematic analysis.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):

Engineering Mechanic, Strength of Materials

Course objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion
4. To understand the kinematics of gear trains

Course outcomes:

After successful completion of this course the student will be able to:

Design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning.

COURSE CONTENT

Kinematics and Theory of Machines		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

MECHANISMS & MACHINES: Introduction, Constrained motion, Link, Kinematic pair, Types of Joints, Degree of Freedom, Classification of Kinematic pairs, Kinematic chain, Mechanism and structures, Equivalent Mechanisms, Simple mechanism, Compound mechanism, Planer mechanism, Spatial mechanism, Four Bar Mechanism, Mechanical Advantage, Transmission angle, Slider Crank Mechanism, Double Slider Crank Mechanism. Pantograph, Toggle Mechanism, Geneva Mechanism, Automobile steering Mechanism – Davis Steering Gear, Ackermann Gear, Hooks Joint, Double Hook Joint.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
VELOCITY AND ACCELERATION ANALYSIS: Absolute and Relative Motions, motion of a link, Instantaneous centre, Kennedy's Theorem, Locating I-Centers of Four Bar Mechanism and Slider Crank mechanism, Space and Body Centrode, Relative Velocity of Four Bar Mechanism and Slider Crank mechanism, Rubbing Velocity, Acceleration, Radial and Tangential acceleration, Relative acceleration of Four Bar Mechanism and Slider Crank mechanism, Coriolis Acceleration, Klein's Construction.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
DYNAMIC FORCE ANALYSIS: D' Alembert's Principle, Inertia Force, Dynamic analysis of Four Bar Mechanism and Slider Crank mechanism, Engine force analysis, Simple and Compound Pendulum, Dynamically Equivalent System, Inertia of Connecting Rod,		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
CAMS: Types of Cams and Followers, Terminology, Motions of the Follower, Layout of Cam profiles, Specified Contour Cams, Circular and Tangent Cams, Pressure angle and Undercutting, Sizing of Cams. **BALANCING:** Need of Balancing, Static and Dynamic Balancing, Balancing of several masses in different planes, Balancing of reciprocating masses.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
GOVERNORS: Introduction, Types of Governors, Watt Governor, Proell Governor, Wilson Hartnell Governor, Inertia Governor, Controlling Force, Sensitiveness, Hunting, Isochronism, Stability, Effort, Power of Governor. **GYROSCOPE:** Gyroscopic Principle, Gyroscopic Effect, Gyroscopic Effects on Aeroplanes, Naval ships, Stability of an Automobile, Stability of two wheels Vehicle.		
Text Books:		
1. Cleghorn W. L., Mechanisms of Machines, Oxford University Press, 2005. 2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009. 3. Ratan S. S., Theory of Machines, 4th edition, Tata McGraw Hill, 2014. 4. Khurmi R. S, Theory of Machines, 14th edition, S. Chand & Co. Ltd., 2005. 5. Singh V. P., Theory of Machines, Dhanpat Rai & Co. 6. Bansal R. K., Theory of Machines, Laxmi Publications. 7. Singh Sadhu, Theory of Machines, Pearson Publication.		
Reference Books: 1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005. 2. Ghosh A. and Mallick A. K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988. 3. Lal Jagdish, Theory of Mechanisms & Machines, Metropoliton Book Co. 4. Shingley J. E. and Uicker J. J., Theory of Machines and Mechanisms, McGraw45 Hill International Book Co. 5. Ballaney P. L., Theory of Machine, Khanna Publication.		

MANUFACTURING TECHNOLOGY

COURSE OUTLINE

Course Title:	Manufacturing Technology	Short Title:	MT	Course Code:	PCC-ME 307

Course description:

This course is designed to help student understand advanced machining process, rapid prototyping and automation of manufacturing process. This course will also help students to estimate different forces and their relationship during metal cutting. They will be familiarized with computer aided manufacturing and computer integrated manufacturing.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	14	42	3

Prerequisite course(s):

Manufacturing process, Workshop Technology.

Course objectives:

(i)To provide knowledge on machines and related tools for manufacturing various components.
(ii) To understand the relationship between process and system in manufacturing domain.
(iii) To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course outcomes:

After successful completion of this course the student will be able to understand:
1. geometry & use of single point cutting tool, forces of machining & different types of tool wear.
2. working principle of various machining processes their applications.
3. rapid prototyping, its types and role of automation in manufacturing industry.
4. different advanced manufacturing process.
5. aspects product design and manufacturing.

COURSE CONTENT

Manufacturing Technology		Semester:	VI
Teaching Scheme:		Examination scheme	
Lectures:	3 hours/week	End semester exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Theory of Metal Cutting : Introduction, The mechanics of chip formation, single point cutting tool, methods of machining, Types of chips, Determination of shear angle, Force relations, energy considerations in metal cutting, Tool wear and tool life, Economics of metal cutting.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Advanced Machining Processes: Introduction, Chemical Machining, Electrochemical Machining, Electro Chemical Grinding, Electrical Discharge Machining, Laser Beam Machining, Electron Beam Machining, Water Jet Machining, Abrasive Jet Machining, Hybrid Machining System, Economics of Advanced Machining Processes.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Rapid Prototyping and Automation of manufacturing processes: Rapid Prototyping; Introduction, Subtractive processes, Additive processes, Virtual prototyping, Self-replicating machine, Direct manufacturing and rapid tooling. Automation; Introduction, Automation, Numerical control, Adaptive control, material handling and movement, Industrial robots, sensor technology, flexible fixturing, assembly systems, Design consideration for fixturing, assembly, disassembly and servicing, Economic consideration.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12

Advanced Manufacturing: Computer aided manufacturing; Introduction, Manufacturing System, Computer Aided Design and Engineering, Computer Aided Process Planning, Computer Simulation of Manufacturing Processes, Group Technology. Computer Integrated Manufacturing; Introduction, Cellular Manufacturing, Flexible Manufacturing system, Holonic Manufacturing, Just in Time Production, Lean Manufacturing, Communication Networks in Manufacturing

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Product Design and Manufacturing: Introduction, Product Design, Product Quality, Life-Cycle Assessment and sustainable manufacturing, Energy Consumption in Manufacturing, Material Selection for Products, Material Substitution, Manufacturing Process Capabilities, Process Selection, Manufacturing Costs and Cost Reduction.

Text Books:

1. Hajara Chaudhary and Bose, Element of Workshop Technology Volume I and II - S.K.,Asia Publishing House.
2. P. N. Rao, Production Technology Volume I and II –Tata McGraw Hill Publication.
3. R. K. Jain, Production Technology- Khanna Publications.
4. P. C. Sharma, Production Technology-, Khanna Publication.
5. Chapman W.A.J., Workshop Technology- ELBS Publication.
6. HMT, Production Technology- Tata McGraw Hill Publication.

Reference Books:

1. Kalpak Jain and Schmid, Manufacturing processes for engineering materials (7^{th} Edition)-Pearson India, 2014.
2. Taha H. A., Operations Research, 6^{th}Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
4. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, andSystems
5. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

6. Materials and processes in manufacturing, J T Black, Ronald A. Kosher, DeGarmos, Wiley student edition
7. Roy A Lindberg, Process and Material of Manufacturing, Prentice Hall of India Pvt Ltd.
8. S. K. Garg, Manufacturing Technology –- Fire wall media ltd.

AUTOMOBILE SERVICE & REPAIRS

COURSE OUTLINE

Course Title:	Automobile Service & Repairs	Short Title:	ASR	Course Code:	

Course description:

This subject includes various system operations and their operations along with their probable cause and remedies.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Internal Combustion Engine, Automobile System

Course objectives:

To study vehicle maintenance schedules and procedures

Course outcomes:

After successful completion of this course the student will be able to distinguish
Tuning procedures, engine overhauls brakes operation and maintenance. Determine the functioning of engines and its trouble shooting. Identify the Chassis and suspension maintenance.

COURSE CONTENT

Automobile Service & Repairs		Semester:	ASR
Teaching Scheme:		Examination scheme	
Lectures:	3 hours/week	End semester exam (ESE):	60 marks
		Duration of ESE:	03 hours
		Internal Sessional Exams (ISE):	40 marks

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Engine Repair & Maintenance

Introduction, Engine removal, Engine head, Removing cylinder head, Cleaning & Inspection. Refitting the cylinder head. Valve & valve mechanism, Piston connecting rod assembly, Cylinder block, Reinstalling the assembly in the cylinder, Crank shaft & main bearing, Engine reassembly, Precautions

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Tuning

Tuning procedure, Crankshaft thumping, Connecting rod noise, Piston noise, Piston pin noise, Valve & tappet noise, Abnormal oil consumption, Ignition timing, Servicing of propeller shaft & differential assembly. Assembling & dissembling of steering assembly.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Chassis Drive Line Components Service

Introduction, Suspension systems & springs of rigid & independent types; Dissembling of leaf spring, coil spring & its service.

Dissembling of clutch system (mechanical & hydraulic types) repair, maintenance & trouble shooting, Removal of gear-box assembly, Procedure of gearbox dismantling, troubleshooting & refitting.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Brakes & It's Types Adjustment, Relining Wheel Brake, Reconditioning Master & Wheel Cylinder Fast Brake Testing, Brake Service, Bleeding Of Brakes, Brake Pedal Adjustment, Brake Braking By Means Of Accelerated Speed Servicing Of Parking Brake, Wheel & Tyre Servicing Causes Of Tyre Wear & Its Remedies, Tyre Maintenance, Wheel Balance, Static Balancing Of Front Wheel, Dynamic Balancing Of Front & Rear Wheel, Trouble Shooting.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Servicing of Motor Vehicle Servicing & Its Necessity, Types Of Servicing, Cleaning Of Motor Vehicle & Its Part, Steam Cleaning, Engine De-Coking, Precaution To Minimize Carbon, Method of De-Carburizing, Greasing Of Motor Vehicle. Garage & Fleet Management, Introduction, Specimen Of Job Card, Work Charge, Procedure & Records, Garage, Tools & Equipment's.		
Text Books:		
1. Crouse & Anglin, Automotive Mechanics, Tata McGraw Hill Publications. 2. Dr.Kirpal Singh, Automobile Engineering (VOL–I & II), Standard Publishers Distributors		
Reference Books:		
1. Dr. V. M. Domkundwar, Automobile Engineering, Dhanpat Rai & Company, Reprint 2014. 2. G.B.S Narang, Automobile Engineering, Khanna Publishers.		

AUTOMOTIVE ERGONOMICS & STYLING						
COURSE OUTLINE						
Course Title:	**Automotive Ergonomics & Styling**		**Short Title:**	**AES**	**Course Code:**	
Course description:						
This subject includes automobile ergonomics and styling						
Lecture	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	3	14	42		3	
Prerequisite course(s):						
Automobile System, Automobile aerodynamics.						
Course objectives:						
To impart knowledge about the concept of automotive safety and comfort in an automobile.						
Course outcomes:						
Understand the basics of vehicle collision and its effects. Understand the various safety concepts used in passenger cars. Gain knowledge about various safety and its equipment. Understand the concepts of vehicle ergonomics. Gain knowledge about various automotive comforts features						
COURSE CONTENT						
Automotive Ergonomics & Styling			**Semester:**	AES		
Teaching Scheme:			**Examination scheme**			
Lectures:	**3 hours/week**		**End semester exam (ESE):**		**60 marks**	
			Duration of ESE:		**03 hours**	
			Internal Sessional Exams (ISE):		**40 marks**	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**			
Introduction - Design of The Body for Safety, Energy Equations, Engine Location. Effects of Deceleration Inside Passenger Compartment. Deceleration On Impact with Stationary and Movable Obstacle. Concept of Crumble Zone and Safety Sandwich Construction. Active and Passive Safety. Characteristics of Vehicle Structures. Optimization of Vehicle Structures for Crash Worthiness. Types of Crash / Roll Over Tests, Regulatory Requirements for Crash Testing. Instrumentation, High Speed Photography, Image Analysis						
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**			
Vehicle Ergonomics - Introduction to Human Body - Anthropometrics and Its Application to Vehicle Ergonomics. Cockpit Design. Driver Comfort – Seating, Visibility. Man-Machine System- Psychological Factors – Stress, Attention. Passenger Comfort - Ingress and Egress, Spaciousness. Ventilation, Temperature Control. Dust and Fume Prevention and Vibration, Interior Features and Conveniences. Use Of Modern Technology For The Same						

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Comfort and Convenience System. Cabin Comfort - In-Car Air Conditioning – Overall Energy Efficiency. Air Management, Central and Unitary Systems, Air Flow Circuits, Air Cleaning, Ventilation, Air Space Diffusion. Compact Heat Exchanger Design, Controls and Instrumentation. Steering and Mirror Adjustment, Central Locking System. Garage Door Opening System, Tire Pressure Control System, Rain Sensor System, Environment Information System, Automotive Lamps, Types, Design, Construction, Performance. Light Signaling Devices- Stop Lamp, Rear Position Lamp, Direction Indicator. Reverse Lamp, Reflex Reflector, Position Lamp, Gas Discharge Lamp, LED. Adoptive Front Lighting System (AFLS) And Daylight Running Lamps (DRL).		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Introduction to Styling - Car Design, Fundamental of Perspective drawing, Automotive Sketching, Styling Process, Car Proportions, Crashworthiness and its influence on body design, Designing of interiors.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Form Studies – Form Studies, Speed Forms, Clay Modeling, 2D System, 3D System		
Text Books:		
1. Prasad, Priya and Belwafa Jamel, "Vehicles Crashworthiness and Occupant Protection", American Iron and Steel Institute, USA. 2. Jullian Happian-Smith "An Introduction to Modern Vehicle Design" SAE, 2002 3. Vivek D Bhise, Ergonomics in the Automotive Design Process 2013		
Reference Books:		
1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000. 2. "Recent development in Automotive Safety Technology", SAE International Publication. Editor: Daniel J Helt,2013. 3. Keitz H.A.E. "Light Calculations and Measurements", Macmillan 1971. 4. Fenton John Handbook of Automotive body and System design, Wiley-Blackwell 1998		

AUTOMOTIVE AERODYNAMICS

COURSE OUTLINE

Course Title:	Automotive Aerodynamics	Short Title:	AA	Course Code:	

Course description:

Introduction of automotive aerodynamics, aerodynamic drag of cabs, shape optimization of cabs, vehicle handling, wind tunnels for automotive aerodynamics systems concentration will be taught to the students.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Automobile Design, Automobile System, Automobile styling

Course objectives:

To adequate the fundamentals of fluid mechanics related to vehicles and concepts of the aerodynamics drag of cars also familiarize with the basic principles of wind tunnel technology.

Course outcomes:

Demonstrate various flow phenomenon related to vehicles and analyze different types of drag forces, Optimization of various shape configurations in automobiles and the principle of wind tunnel technology also demonstrate various techniques used for drag reduction.

COURSE CONTENT

Automotive Aerodynamics		Semester:	AA
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Introduction - Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

DRAG and LIFT OF CARS - Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Shape Optimization of vehicles - Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Handling Characteristics -The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Wind Tunnels - Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.		
Text Books:		
1. Product Design and Development by AK Chitale and Gupta 2. Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworth's Co., Ltd., 1997. 3. A. Pope - "Wind Tunnel Testing"- John Wiley & Sons - 2nd Edition, New York - 1974		
Reference Books:		
1. Automotive Aerodynamic: Update SP-706 - SAE - 1987 4. 2. Vehicle Aerodynamics - SP-1145 - SAE – 1996.		

AUTOMOBILE FUELS & EMISSIONS					
COURSE OUTLINE					
Course Title:	**Automobile Fuels & Emissions**	**Short Title:**	AFE	**Course Code:**	
Course description:					
This subject includes various engine performances, system performance and their operations along with their working conditions.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Automobile Engines, Internal Combustion engine

Course objectives:

This course introduces undergraduate students to imparting knowledge of automobile engines and their combustion and emission.

Course outcomes:

Understand need of alternative Fuels with their Sources with advantages and disadvantages, illustrate various emission norms and regulations also sources and factors affecting the emissions from the SI and CI engines. Understand Emission Measurement, Test procedures and regulations.

COURSE CONTENT

Automobile Fuels & Emissions		**Semester:**	**AFE**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Sources of fuels – Bio fuels , Edible & non edible vegetable oils, hydrogen, LPG, CNG, Bio gas, Methanol & Ethanol, Engine modification required to use alternative fuels, Dual fuel engine, Fuel efficiency, fuel requirement, rating of fuels, Hybrid drives. Production methods and availability of alternative fuels, Economics, Engine performance and Emission Characteristics with alternative fuels, Limitations.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Hydrogen and Fuel cells: Properties of hydrogen with respect to its utilization as renewable forms of energy, sources of hydrogen, production, transportation, storage, application & economics of hydrogen. Principle of fuel cell, Types, Full cell for Automotive, PEM fuel cell stacks construction, performance.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Engine Emissions - Automobile emission scenario, Sources of emission from vehicle, Formation of pollutants, CO, NOx, UBHC, Soot & Particulate formation, health effect of emission.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
SI and CI engine Emission - Emissions from SI engine, Compression ratio, equivalence ratio, Ignition timing, Mixture preparation, Residual gas dilution, engine speed, coolant temperature, fuel injection and in cylinder liquid fuel during warm up. CI engine emissions: Emissions from CI engine, Compression ratio, combustion chamber dead volumes, in cylinder air swirl, multi valves, fuel injection variables, engine load, and engine speed.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Measurement techniques - Test procedures and regulations: Test cycles for light & medium duty vehicles, test procedure for evaporative emissions, Emission standards for light and heavy duty vehicles & motor cycle emission standard. NDIR analyzers, FID, NOx analyzer, oxygen analyzer, smoke measurement, constant volume sampling, particulate emission measurement, Orsat apparatus.		
Text Books:		
1. G.B.S. Narang, Automobile Engineering, CBS Publishers & Distributors, Delhi. 2. Gupta B. R., Electronics & Instrumentation Handbook, Wheeler Publishing. 3. F. Schafar & R van Basshuysen, Reduced emission and fuel consumption in automobile engine, Springer-Verlag Wien New York. 4. John k Pearson," Improving air quality". 5. Richard L.Bechtold , "Alternative Fuels Guidebook" 6. S.S.Thipse, "Alternative fuels"		
Reference Books:		
1. E.F. Oberts, "Internal Combustion Engine and Air Pollution", Harper & Row Publisher, NY. 2. J.G. Giles, "Vehicle Operation & Testing" (Automotive Vehicle Technology Vol. 7) 3. C.H. Fisher, "Carburetion", Vol. 4. 4. A.W. Judge, "Carburetion and Fuel Injection System", Motor Manual, Vol. 2, The Caxton Pub. Co. Ltd., London. 5. H.H. Willard and Others, "Instrumental Method of Analysis", CBS Publishers & Distributors, Delhi		

INSTRUMENTATION AND CONTROL					
COURSE OUTLINE					
Course Title:	**Instrumentation and Control**	**Short Title:**	**IC**	**Course Code:**	

Course description:

This course is designed to provide a knowledge base in the area of industrial sensors and transducers used to measure temperature, pressure, flow & level. Topics will include: operating theory of principal industrial process sensors; instrument calibration and installation practices with industrial applications as working examples in a modern automated control system.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Electrical drives and Controls, Physics,

Course objectives:

1. To provide basic knowledge about measurement systems and their components.
2. To learn about various sensors, use for measurement of mechanical quantities.
3. To learn about systems stability and control.
4. To integrate the measurement systems with the process for process monitoring and control.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the measurement of various quantities using instruments, their accuracy and range, and the techniques for controlling devices automatically.
2. Describe a given instruments basic theory of operation and its inherent capabilities and limitations.
3. Select an instrument based on his knowledge of basic applications.
4. Interpret measurement data properly, supported by his developed appreciation for a given instruments accuracy, precision and operating limits.
5. Define certain terms used in the calibration of instrumentation

COURSE CONTENT

Instrumentation and Control		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Measurement Systems : Introduction, Monitoring and control of processes and operations, Experimental engineering analysis, Functional elements of an instrument, active and passive transducers, analog and digital modes of operations, Null and deflection methods, input-output configurations, methods of correction

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Performance Characteristics of Measurement systems: systems, Instrumentation systems, Sensors, signal processors, data presentation, accuracy and error, hysteresis error, non-linearity error, insertion error, Range, Precision, Repeatability, reproducibility, Sensitivity, Stability, Dynamic characteristics, response, rise and setting time, Reliability, Calibration		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sensors for common Engineering measurements: Displacement sensors – Potentiometers, Strain gauges, Capacitive elements, LVDT, Optical encoders, Proximity sensors Speed Sensors – Tachogenerators, Diaphragm sensors, Piezoelectric sensors, Fluid Flow Sensors - Orifice plate, Rotameter, Turbine meter, Liquid level Sensors - Ultrasonic liquid gauge, Lad cell Temperature sensors – Bimetallic strips, Resistance temperature detectors, Thermisters, Thermocouples, Pyrometers,		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Control system: Introduction, history of automatic control, basic elements, open and closed loop systems, use of feedback in Control system , – Transfer function: Block diagram, control method, selection of control method, P, PI, PID, tuning of controllers		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Control system design & Applications: Control system design process, Design Examples such as Turntable Speed Control, Insulin Delivery Control System, Disk Drive Read System, Examples of modern control systems, Automatic assembly and Robots, Mechatronic systems, The Future Evolution of Control Systems		
Text Books:		
1. Ernest O. Doeblin (2004), Measurement Systems: Application and Design, 5th Edition, Tata McGraw- Hill. 2. Katsuhiko Ogata (2010), Modern Control Engineering, 5th Edition, Prentice Hall of India Pvt. Ltd. 3. D S Kumar, Mechanical Measurements and Control Engineering, Metropolitan Book Company Pvt. Limited 4. Patranabis D, Instrumentation and Control, PHI learning. 5. Arun K Ghosh, Introduction to control systems, PHI learning. 6. R K Rajput, Mechanical Measurements & Instrumentation, S. K. Kataria & Sons.		
Reference Books:		
1. R. Munasinghe, Classical Control Systems: Design and Implementation, Alpha Science 2. J.P. Holman (2004), Experimental Methods for Engineers, Tata McGraw-Hill. 3. Williams Bolton (2004), Instrumentation and control, Elsevier Ltd. 4. Kevin James (2000), PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes Publishers.		

MECHANICAL ESTIMATION & COSTING					
COURSE OUTLINE					
Course Title:	**Mechanical Estimation & Costing**	**Short Title:**	**MEC**	**Course Code:**	
Course description:					
This course is designed to develop the ability in the students to evaluate materials, consumables and process costs in the monetary units. Hence, it will help to increase the productivity of the organization and conservation of valuable resources. This course will also help in developing the skills required in the process of decision making and to plan, use, monitor and control resources optimally and economically. This will also be helpful in budgeting. The realm of this course is enlarged to estimate the process costs for fluid and thermal applications also.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	3

Prerequisite course(s):

Manufacturing Processes, Manufacturing Technology

Course objectives:

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:
1. Plan, use and control resources optimally and economically.
2. Estimate production/operation cost for budgeting and analysis.

Course outcomes:

After successful completion of this course the student will be able to:

i. Calculate material cost of given component/product.
ii. Identify and estimate elements of cost in various processes.
iii. Perform break even analysis to calculate break even quantity.
iv. Investigate the problem of cost and suggest their solution using cost reduction techniques.
v. Interpret given model of balance sheet and profit loss account.

COURSE CONTENT

Mechanical Estimation & Costing		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Estimating: Importance and aim, objectives, functions, organization of Estimating department, Estimating Procedure, Constituents of Estimation,
Costing: Definition, aims, procedure for Costing, types of costs, Costing controls, Difference between Estimating and Costing, Control of Costs, Elements of PPC and Time & Motion Studies, Allowance, Overheads, Profit and Pricing Policy.

Elements of Costs, Costing methodology for raw materials, Products and Services, Nature of Costs, Direct, Traceable and Non traceable, Wastage. Determining of Cost of raw materials, manufactured products, labor, indirect expenses and methods of overhead allocation.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Labour Costing: Introduction, factors influencing wage rate, methods of wage payments for direct and indirect labour time wage system, piece rate system, Wage incentives: different plans.
Depreciation: Introduction, purpose, methods for calculating depreciation-straight line method, Diminishing balance method, sum of year digit method, machine hour basis method.
Break even analysis: Introduction, assumptions in break-even analysis, important terms and definitions, calculation of breakeven point, advantages and limitations.

Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**

Estimating:
Definition, Different types, Methods adopted for estimation, Use of Standard data, parameter estimating, statistical estimating, feedback systems, importance, purpose and functions of estimating, Mensuration.
Estimation in Machine Shop & Foundry Shop:
Calculation of volume of machined component operation time calculation for turning, knurling, facing, drilling, boring, reaming, threading, milling, tapping, shaping, cutting, various grinding operations, planning etc.
Pattern cost estimation: material, labor, overheads, estimation of foundry costs material, labor other costs.

Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**

Estimation in Forging, Welding & Sheet Metal Work:
Forging process: and types, forging operations, Estimation procedure, estimating losses and time.
Welding: Type of welding processes, types of joints. Preparation cost, Actual welding cost; material, labour, finishing on cost, power cost, factors affecting welding cost. Gas cutting cost, material, labour finishing on cost.
Sheet Metal Work: Operations in sheet metal work, joints, blank layout and size, estimation of time, capacity and types of processes.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Budget: Objectives, classification of budgeting, Budgetary control, securing flexibilities of budgeting, limitation of budget. Operational and capital budgets, Cash flow schedules, estimating cost, Preparing an annual budget for the Engg. Department.
Engineering Contracts: Introduction, Types of contracts and similarities. Terms of payments, firm price contracts, cost reimbursable contracts, Target of cost contracts, schedule of rate contracts, bill of quantities contracts, compound contracts, contract policy, legal rights and commercial interests.

Text Books:

1. Sinha. B. P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co.
2. T. R. Banga and S. C. Sharma, Estimations and Costing, Khanna Publishers.

3. R. Kesava, C. Elanchezhian and B. Vijaya Ramnath, Process, Planning and Cost Estimation by 2nd ed. New Age International 2018.
4. Panneerselvam R., Process Planning and Cost Estimation by Prentice-Hall of India Pvt. Ltd.

Reference Books:

1. Process Planning & Cost Estimation by R. Kesoram & others, New Age International Pub., N. Delhi.
2. Dennis Lock, Handbook of Engineering Management, Butterwork & Heinemanky Ltd.
3. Learning package in ECC, NITTTR, Bhopal.
4. Shrimali and Jain, Mechanical estimating and costing, Khanna Publishers.
5. Singh and Khan, Mechanical costing and estimation, Khanna Publishers.

INTRODUCTION TO MICRO-ELECTRO MECHANICAL SYSTEMS

COURSE OUTLINE

Course Title:	**Introduction to Micro-electro Mechanical Systems**	**Short Title:**	**MEMS**	**Course Code:**	

Course description:

The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and to introduce the student's various opportunities in the emerging field of MEMS. Students will acquire an in-depth understanding of MEMS technologies and the Sensors, Actuation, Materials and Applications associated with them. Course includes basic technology features of MEMS devices.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	14	42	3

Prerequisite course(s):

Introduction to Electronics Engg, Introduction to Elect. Engg., Basic Electrical Drives & Control

Course objectives:

1. To study MEMS technology
2. To Introduce Various Sensors And Actuators
3. To Introduce Different Materials Used For MEMS
4. To Educate On The Applications Of MEMS To Disciplines Beyond Electrical And Mechanical Engineering.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the scope, importance and application of miniaturized products
2. Analyse and Demonstrate design skills of MEMS devices and products
3. Understand the design process
4. Select an appropriate micro sensor and micro actuator in a given application.
5. Recommend a suitable material for a MEMS product.

COURSE CONTENT

Introduction to Micro-electro Mechanical Systems		**Semester:**	***VI***
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

MEMS: Introduction, What is MEMS?, Definitions and Classifications, History, Intrinsic characteristics of MEMS - Miniaturization, Microelectronics Integration, Parallel fabrication with precision, Future trends, Miniaturization Issues, Scaling, MEMs Materials, Characteristics of MEMS Materials, Performance Characteristic and Cost of MEMS Products

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
MEMS Sensing and Actuation – I : MEMS Sensors and actuators considerations, Electrostatic Sensors – Parallel Plate Capacitors – Applications – Interdigitated Finger Capacitor – Comb Drive Devices – Micro Grippers – Micro Motors – Thermal Sensing And Actuation – Thermal Expansion – Thermal Couples – Thermal Resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micro magnetic Components – Case Studies Of MEMS In Magnetic Actuators- Actuation Using Shape Memory Alloys.		
Unit–III:	**No. of Lectures: 08 Hours**	**Marks: 12**
MEMS Sensing and Actuation – II: Piezoresistive Sensors – Piezoresistive Sensor Materials – Stress Analysis Of Mechanical Elements – Applications To Inertia, Pressure, Tactile And Flow Sensors – Piezoelectric Sensors And Actuators – Piezoelectric Effects – Piezoelectric Materials – Applications To Inertia , Acoustic, Tactile And Flow Sensors.		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
MEMS Materials: Overview of Smart Materials, Structures and Products Technologies, Smart Materials (Physical Properties), Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magneto electric Materials, Magneto rheological Fluids Electro Rheological Fluids, Super-plastic materials **Design considerations** – process design – mechanical design		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Applications of MEMS: In Automotive, Electronics, Medical, Communication and Deference sector, Automotive airbag sensor, Medical pressure sensor, Inkjet printer head, Overhead projection display, Bio-MEMS, MOEMS, RF-MEMS, MEMS Market, Blood Pressure Sensors, Microphone, Acceleration Sensors, Gyros,		
Text Books:		
1. Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002. 2. Mark Madou, "Fundamentals of Microfabrication", CRC Press, New York, 1997. 3. Julian W Gardner, "Micro sensors: Principles and Applications", John Wiley and Sons, New York, 2001. 4. Sze S M, "Semiconductor Sensors", McGraw Hill, New York, 1994. 5. Chang C Y and Sze S M, "VLSI Technology", McGraw Hill, New York, 2000. 6. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012. 7. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.		
Reference Books:		
1. https://nptel.ac.in/courses/117105082/ 2. MEMS & Microsystems: Design & Manufacture, Tai Ran Hsu, Tata McGraw Hill, 2002. 3. Smart Materials and Structures, M.V. Gandhi and B.S. Thompson, Chapman & Hall, London. 4. Nadim Maluf, "An Introduction To Micro Electro Mechanical System Design", Artech House, 2000. 5. Mohamed Gad-El-Hak, Editor, "The MEMS Handbook", CRC Press Baco Raton, 2001.		

6. Julian W. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS And Smart Devices, John Wiley & Son LTD, 2002.
7. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
8. Thomas M.Adams And Richard A.Layton, "Introduction MEMS, Fabrication And Application," Springer, 2010.

KINEMATICS AND THEORY OF MACHINES LAB

LAB COURSE OUTLINE

Course Title:	**Kinematics and Theory of Machines Lab**	**Short Title:**	**KTM Lab**	**Course Code:**	

Course description:

Mechanisms form the basis of any machine and it is an assemblage of rigid bodies so that they move upon each other with definite relative motion. Demonstration exercises are provided with wide varieties of transmission element models to understand machine kinematics. Various experiments with governors, gyroscopes and balancing machines and universal vibration facilities are available to understand machine dynamics.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	01

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):

Engineering Mechanic, Strength of Materials

Course objectives:

Objectives of this lab are to impart practical knowledge on design and analysis of mechanisms for the specified type of motion in a machine. With the study of rigid bodies motions and forces for the transmission systems, machine kinematics and dynamics can be well understood.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Distinguish kinematic and kinetic motion.
2. Identify the basic relations between velocity, and acceleration.
3. Use graphical and analytic methods to study the motion of a planar mechanism
4. design linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship.
5. analyze the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.

LAB COURSE CONTENT

Kinematics and Theory of Machines		**Semester:**	***VI***
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

ASSIGNMENTS:

1) Study of Kinematics of Four Bar, Slider Crank, Crank Rocker and Oscillating Cylinder Mechanism.
2) Study of Different Mechanisms.

DRAWING SHEETS:

1) ICR and Relative Velocity.
2) Relative Acceleration and Coriolis Acceleration.

3) Cam and Follower Motions.
4) Balancing of Rotating and Reciprocating Masses.

EXPERIMENTS:

1. To determine the characteristics of Centrifugal Governor and Find its Sensitivity and Stability.
2. To verify the principle of working of gyroscope
3. To determine mass moment of inertia of compound pendulum.
4. To determine mass moment of inertia of Rigid body by using Bifilar suspension or Trifilar suspension method.

Text Books:

1. Cleghorn W. L., Mechanisms of Machines, Oxford University Press, 2005.
2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
3. Ratan S. S., Theory of Machines, 4th edition, Tata McGraw Hill, 2014.
4. Khurmi R. S, Theory of Machines, 14th edition, S. Chand & Co. Ltd., 2005.
5. Singh V. P., Theory of Machines, Dhanpat Rai & Co.
6. Phakatkar H. G., Theory of Machines – I
7. Phakatkar H. G., Theory of Machines – II
8. Bansal R. K., Theory of Machines, Laxmi Publications.
9. Singh Sadhu, Theory of Machines, Pearson Publication.

Reference Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Ghosh A. and Mallick A. K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.
3. Lal Jagdish, Theory of Mechanisms & Machines, Metropoliton Book Co.
4. Shingley J. E. And Uicker J. J., Theory of Machines and Mechanisms, McGraw45 Hill International Book Co.
5. Ballaney P. L., Theory of Machine, Khanna Publication.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignments.

Guidelines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal.

MANUFACTURING TECHNOLOGY LAB

LAB COURSE OUTLINE

Course Title:	Manufacturing Technology Lab	Short Title:	MT	Course Code:	

Course description:

This course provides student comprehensive study of advanced technology of manufacturing. The will provide practical knowledge of different CNC machine, CNC milling machine and part programming using on these machines. The course will also enlighten students with different concepts like lean manufacturing, 3D manufacturing and its uses, tool life, tool wear, material handling devices etc.

Laboratory	Hours/week	No. of weeks	Total hours	Semester credits
	02	14	28	01

End Semester Exam (ESE) Pattern:	*Oral (OR)*

Prerequisite course(s):

Manufacturing processes, Workshop

Course objectives:

To help students understand student different advanced manufacturing processes used in industry to convert raw material into finished product. To impart practical knowledge of manufacturing processes like 3D manufacturing, CNC machine, CNC milling, concept of lean manufacturing, tool life and factors influencing it.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

Students will be to understand the different advanced production technologies. They will be able to perform and understand different machining operation using CNC machine, CNC milling machine. The students will understand concept of tool life, tool wear, lean manufacturing and different material handling devices used in industry.

LAB COURSE CONTENT

Manufacturing Technology		Semester:	VI
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**

1) Design and fabrication of milling fixture
2) Demonstration of CNC machine
3) Job programming and manufacturing on CNC milling or CNC Lathe machine.
4) Demonstration of advanced manufacturing process
5) Demonstration of 3D manufacturing process
6) Introduction and demonstration of lean manufacturing process in manufacturing technology
7) Demonstration of various material handling devices used in manufacturing industry.
8) Demonstration of different tool wear and factor affecting tool life.

Text Books:

1. Element of Workshop Technology Volume I and II -Hajara Chaudhary and Bose S.K.,Asia Publishing House.
2. Production Technology Volume I and II –P.N.Rao, Tata McGraw Hill Publication.
3. Production Technology- R. K. Jain, Khanna Publications.
4. Production Technology- P. C. Sharma, Khanna Publication.
5. Workshop Technology-Chapman W.A.J., ELBS Publication.
6. Production Technology- HMT, Tata McGraw Hill Publication.

Reference Books:

1. Kalpak Jain and Schmid, Manufacturing processes for engineering materials (7^{th} Edition)-Pearson India, 2014.
2. Taha H. A., Operations Research, 6^{th} Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.
4. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
5. Degarmo, Black &Kohser, Materials and Processes in Manufacturing
6. Materials and processes in manufacturing , J T Black, Ronald A. Kosher, De Garmos, , Wiley student edition

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical/assignment should be well documented. Faculty in charge will assess the practical/assignments continuously and grade or mark each practical/assignment on completion date declared for each assignments.

Guidelines for ESE:

The End Semester Examination (ESE) (Oral Exam) will be based on the above mentioned assignment/practical and theory topics mentioned in syllabus of manufacturing processes. Evaluation will be based on paper work.

AUTOMOBILE SERVICE & REPAIRS LAB

LAB COURSE OUTLINE

Course Title:	**Automobile Service & Repairs**	**Short Title:**	**ASR**	**Course Code:**	

Course description:

This subject includes various system operations and their operations along with their probable cause and remedies.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	14	28	1

End Semester Exam (ESE) Pattern: ***Practical (PR) / Oral (OR)***

Prerequisite course(s):

Internal Combustion Engine, Automobile System

Course objectives:

To study vehicle maintenance schedules and procedures

Course outcomes:

Upon successful completion of lab Course, student will be able to:

After successful completion of this course the student will be able to distinguish
Tuning procedures, engine overhauls brakes operation and maintenance. Determine the functioning of engines and its trouble shooting. Identify the Chassis and suspension maintenance.

LAB COURSE CONTENT

Automobile Service & Repairs		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

1. Dismantle and assemble a four stroke multi cylinder engine.
2. Dismantle and assemble a two stroke petrol engine.
3. Ackerman steering geometry verification
4. Brake system trouble shooting (Hydraulic brake, air brake and disc brake).
5. Study of servicing procedures of different types of rear axle assembly
(Light duty and heavy duty vehicles)
6. Servicing of clutches (single plate, multi plate).
7. Servicing of constant mesh, sliding mesh and synchromesh gear boxes.
8. Observe and sketch figures of various garage tools used in automobile

Text Books:

1. Crouse & Anglin “Automotive Mechanics”, Tata McGraw Hill Publications.
2. Dr. Kirpal Singh “Automobile Engineering”(VOL –I & II) , Standard Publishers Distributors

Reference Books:
1. Dr.V. M. Domkundwar "Automobile Engineering", Dhanpat Rai & Company, Reprint 2014. 2. G.B.S Narang, "Automobile Engineering", Khanna Publishers.
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.
Guidelines for ESE:
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Minor Project					
LAB COURSE OUTLINE					
Course Title:	**Minor Project**	**Short Title:**	**MPROJ**	**Course Code:**	
Course description:					
Minor project represents the culmination of study towards the Bachelor of Engineering degree. The minor project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.					
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	6	**14**	**84**	**3**	
End Semester Exam (ESE) Pattern:		**Oral (OR)**			
Prerequisite course(s):					
Course objectives:					
1. To understand the basic concepts & broad principles of projects. 2. To understand the value of achieving perfection in project implementation & completion. 3. To apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach. 4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.					
Course outcomes:					
Upon successful completion of lab Course, student will be able to:					
1. Demonstrate a sound technical knowledge of their selected project topic. 2. Undertake problem identification, formulation and solution. 3. Design engineering solutions to complex problems utilizing a systems approach. 4. Conduct an engineering project 5. Demonstrate the knowledge, skills and attitudes of a professional engineer.					
LAB COURSE CONTENT					
Minor Project			**Semester:**	**VI**	
Teaching Scheme:			**Examination scheme:**		
Practical:	**6 hours/week**		**End semester exam (ESE): (OR)**	**25 marks**	
			Internal Continuous Assessment (ICA):	**50 marks**	
In continuation with Minor Project (Stage – I) at Semester – V, by the end of Semester – VI, the student should complete implementation of ideas as formulated in Minor Project (Stage – I). It may involve coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project					

report at the end of Semester-VI in the form of Hard bound. Assessment for the project shall also include presentation by the students.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the complete project report is as follows.

Abstract
Chapter 1. Introduction

- Background
- Motivation
- Problem Definition
- Scope
- Objective
- Organization of Report
- Summary

Chapter 2. Literature Review

Chapter 3. Design & development / Experimentation & observation / Survey & Data collection

Chapter 4. Testing, Analysis & Validation / Results & discussions / Data interpretation

Chapter 5. Conclusion & Future Work

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Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Minor Project in Semester – VI shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide				Assessment by Departmental Committee			
Sr. No.	Name of the Student	Attendance / Participation	Implementation	Results	Report	Depth of Understanding	Presentation	Demonstration	Total
	Marks	5	5	5	5	10	10	10	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Internship

Internship is a mandatory and non-credit course. It is mandatory for all admitted students to undergo Internship during the degree course. The course shall be of THREE weeks duration during summer vacation after Semester - VI. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.

Students shall choose to undergo Internship / Innovation / Entrepreneurship related activities for Internship. Students shall choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations / Micro / Small / Medium enterprises / academic institutions / research institutions. In case student want to pursue their family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the Department Head / TPO.

During the last year of FOUR-year Bachelor of Engineering course the student should take project work, as specified in the curriculum, based on the knowledge acquired by the student during the degree course and during Internship. The project work provides an opportunity to build a system based on area where the student likes to acquire specialized skills. The work may also be on specified task or project assigned to the student during Internship.

The internship activities and list of sub-activities for Internship are as under.

- Innovation / Entrepreneurship:
    - Participation in innovation related Competitions for eg. Hackathons Robocon, Baha, IIT TechFest, Chemcon, Dipex etc
    - Development of new product/ Business Plan/ registration of start-up
    - Participation in Entrepreneurship Program of THREE weeks' duration
    - Online certification courses by SWAYAM, NPTEL, QEEE etc.
    - Working for consultancy/ research project within the institutes
    - Training on Software (As per the need of respective branch);
    - Field Survey / Case Study
    - Work experience at family business
- Internship:
    - Internship with Industry/Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ academic institutions / research institutions
    - Online Internship
- Rural Internship
    - Any Long Term Goals may be carried out by students in teams:
        - Prepare and implement plan to create local job opportunities.

- Prepare and implement plan to improve education quality in village.
- Prepare an actionable DPR for doubling the village Income.
- Developing Sustainable Water Management system.
- Prepare and Improve a plan to improve health parameters of villagers.
- Developing and implementing of Low Cost Sanitation facilities.
- Prepare and implement plan to promote Local Tourism through Innovative Approaches.
- Implement/Develop Technology solutions which will improve quality of life.
- Prepare and implement solution for energy conservation.
- Prepare and implement plan to Skill village youth and provide employment.
- Develop localized techniques for Reduction in construction Cost.
- Prepare and implement plan of sustainable growth of village.
- Setting of Information imparting club for women leading to contribution in social and economic issues.
- Developing and managing efficient garbage disposable system.
- Contribution to any national level initiative of Government of India. For eg. Digital India/ Skill India/ Swachh Bharat Internship etc.

Faculty Mentor/Supervisors have to play active roles during the internship and minimum 20 students are to be supervised by each faculty mentor or as per the departmental strength. Mentor shall be responsible for selection of Internship activities by the student under his/her supervision and shall avoid repetition of activities by the student. The college / Institute shall facilitate internship for the students.

Every student is required to prepare a file for Internship containing documentary proofs (daily training diary, comprehensive report and completion certificate) of the activities done by him/her. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should include Date, Time of Arrival, Time of Departure, Main points of the day. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working.

After completion of Internship, the student should prepare a comprehensive report to indicate what he / she has observed and learnt in the training period. The report should include Internship Objectives (in measurable terms), Internship Activities, and Internship Outcome.

The completion certificate should be signed by the supervisor / in charge of the section where the student has been working with performance remark as Satisfactory / Good / Excellent.

The evaluation of Internship shall be in Semester – VII. The evaluation shall be done by expert committee constituted by the concerned department including Department Head/ TPO/ faculty mentor or guide. It should be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.

- Adequacy & quality of information recorded.
- Originality.
- Adequacy and purposeful write-up.
- Practical applications, relationships with basic theory and concepts taught in the course.
- Skill / knowledge acquired

Hence the satisfactory completion of Internship shall be submitted to the university at the end of Semester - VIII of FOUR-year Bachelor of Engineering course. Only after successfully completion of Internship, Internship should be printed in the final year mark sheet as COMPLETED.