	Course Code	:	1BAUA302C	Thermodynamics	Semester	:	III
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the principles of engineering thermodynamics to analyze energy interactions, evaluate the performance of thermal systems, and solve engineering problems involving heat and work. Use thermodynamic laws and property relations to assess the efficiency of energy conversion processes and support the design and improvement of sustainable engineering systems.

Course Outcomes:

After completion of the course, the student will be able to:

1: Realize the fundamental concepts of engineering thermodynamics, including work, and heat, and **apply** these concepts to analyze simple thermodynamic processes and solve basic engineering problems.

2:Apply the first and second laws of thermodynamics to analyze closed and open systems and determine the performance of heat engines, refrigerators, and heat pumps through problem-solving.

3:Apply the concept of entropy to analyze reversible and irreversible processes and evaluate entropy changes using thermodynamic relations.

4:Analyze air-standard gas power cycles by interpreting P–V and T–S diagrams, evaluating their performance parameters, and comparing cycle efficiencies.

UNIT-I	**11 Hrs**

Fundamental concepts and definitions: Thermodynamics; definition and scope. Microscopic and macroscopic approaches, some practical applications of engineering thermodynamic. Types of system, control volume and characteristics of system boundary and examples. Thermodynamic properties; Types of properties, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes; thermodynamic equilibrium; definition, mechanical equilibrium, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics.

Work and heat: Mechanics definition of work and its limitations. Thermo dynamic definition of work with examples and sign convention. Displacement work; expressions for displacement work in various processes through PV diagrams. Heat; definition, units and sign convention and numerical problems.

UNIT–II	**11 Hrs**

First law of thermodynamics: Joule's experiments, equivalence of heat and work. Statement of the first law of thermodynamics, extension of the first law to non – cyclic processes, energy, energy as a property, modes of energy, specific heat at constant volume, enthalpy, specific heat at constant pressure. Steady flow energy equation and numerical problems.

Second law of thermodynamics: Heat reservoir, heat source and sink, heat engines, heat pump, refrigerator and COP. Kelvin – Planck and Clausius statement of second law of thermodynamics; equivalence of the two statements and numerical problems. Reversible and irreversible processes; factors that make a process irreversible.

UNIT–III	**10Hrs**

Entropy: Entropy, Clausius inequality, statement, proof, application to a reversible cycle. Q S P as independent path. Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using T-ds relations and numerical problems.

UNIT–IV	**10Hrs**

Gas power cycles: Air-standard cycles; Carnot, Otto, Diesel, dual and Stirling cycles, P-v and T-S diagrams, definition, efficiencies and mean effective pressure. Comparison of Otto and Diesel cycle and numerical

problems.

Reference Books

Text books:

1.Nag P .K. (2012), Basic and Applied Thermodynamics, (Edi.- 5), Tata McGraw Hill

Reference Books:

1.Yunus A, Cenegal and Michael A. Boies, (2002), Thermodynamics an engineering a approach, Tata McGraw Hill

2.Van Wylenand G.J. Sontang R. E. (1994), Fundamental of Classical Thermodynamics,(4) John Wiley

Additional Learning Resources:

1. http://platform.sysmoltd.com/
2. http://sourceforge.net/projects/dwsim/
3. http://sourceforge.net/projects/dwsim/
4. http://platform.sysmoltd.com/
5. http://exergy.se
6. http://demonstrations.wolfram.com/CarnotCycleOnIdealGas/

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

	Course Code	:	1BAUA303C	PRODUCTION TECHNOLOGY	Semester	:	III
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:	
Students Develop the ability to understand, analyze, and apply conventional and advanced manufacturing processes for the efficient production of engineering components with the desired quality, accuracy, and productivity. The course enables students to select appropriate production techniques, machine tools, and manufacturing processes while considering technical, economic, and sustainability aspects in industrial practice.	
Course Outcomes:	
After completion of the course, the student will be able to: **1.Explain** the concepts of manufacturing processes, cutting tool materials, cutting fluids, to realize their role in machining operations. **2.Analyze** the constructional features, working principles, machining operations, and machining time of various conventional machine tools. **3.Compare** grinding, broaching, non-traditional machining processes, and additive manufacturing techniques for selecting suitable manufacturing methods for engineering applications. **4.Apply** the principles of pattern making, sand moulding, welding, soldering, and brazing processes to select appropriate manufacturing techniques for component fabrication.	
UNIT-I	**11 Hrs.**
Introduction: Concept of manufacturing process, its importance. Classification of manufacturing processes. Advantages and limitations. **Cutting tool materials:** Desired properties, types of cutting tool materials – HSS carbides coated carbides and ceramics, cutting fluids, types and selection. Machinability, factors affecting machinability. **Theory of metal cutting:** Single point cutting tool nomenclature, geometry, orthogonal and oblique cutting, mechanism of chip formation, types of chips.	
UNIT–II	**11 Hrs.**
Turning: Classification, constructional features of Turret and Capstan lathe, tool layout. Machining time. **Shaping and Plainingmachines**: Classification, constructional features, driving mechanisms, shaping and planning operations. Machining time. **Drilling and Milling machines**: Classification, constructional features, drilling and related operations, types of drilling tools, drill bit nomenclature. Milling Machines**:** classification, constructional features, milling cutters, nomenclature, milling operations, up milling and down milling, indexing: Simple and compound indexing.	
UNIT–III	**10 Hrs.**
Grinding machines: Types of abrasives, bonding process, grade and structure of grinding wheels and types. Classification, constructional features. Selection of grinding wheel. **Broaching process:** Types of broaching machines – constructional details, applications. **Non-traditional machining processes:** Need for non-traditional machining, operation and applications of Abrasive Jet Machining, Electric Discharge Machining, Electro Chemical Machining. Laser Beam Machining and Electron Beam Machining. **Additive manufacturing:**Introduction, Basic Principles. Need for Additive Manufacturing, Generic AM process,	

3dprinting, rapid proto typing, the benefits of AM, distinction between AM and CNC machining, other relatedtechnologies.

UNIT–IV	10 Hrs.

Patterns: Definition, functions, materials used for pattern, various pattern allowances. Classification of patterns.

Sand moulding: Types of base sand, requirement of base sand. Types of sand moulds, ingredients for different sand mixtures. Method used for sand moulding. Cores:Definition, need and types.

Welding process: Definition, classification, application, arc welding, gas welding, TIG and MIG.

Principles of soldering and brazing: Different types of soldering and brazing methods, plastic welding techniques.

Reference Books

Text Books:

1.Jain R. K. (2009), Production Technology, (17), Khanna Publication

Reference Books:

1.Boothroyd G.(2007), Fundamentals of metal machining and machine tools, McGraw-Hill Publication

2.HMT Hand book, McGraw-Hill, Edition 38, 2016

Additional Learning Resources:

1. https://vtu.ac.in/pdf/2022_3to8/2autosyll.pdf
2. https://www.youtube.com/results?search_query=lathe+machine+animation+video
3. https://www.youtube.com/shorts/RkGddZABd84
4. https://www.youtube.com/shorts/XlpXMwLtObQ

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

	Course Code	:	1BAUA304C	MECHANICS OF MATERIALS	Semester	:	III
	L:T:P	:	2 : 2 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	28Hrs		CIE Marks	:	50
	Tutorial	:	28Hrs		SEE Marks	:	50
	Learning (TW+SL)	:	28Hrs				
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the principles of engineering mechanics and physics to analyze forces, stress and deflection in machine elements.

Course Outcomes

After completion of the course student will be able to:

1. Compute simple stress, strain and deformation in bars of varied cross sections subjected to different types of axial forces and twisting moment
2. Draw SF and BMdiagrams for beams of different cross sections subjected to transverse loading and compute bending and shear stresses in beams.
3. To find the deflection in different types of beams subjected to bending and compute compound stresses on inclined planes subjected to different stress systems
4. Analyzethecylindersexposedtointernalandexternalpressures from the view point of stresses developedand analyze elastic stability of columns subjected to loadforvariousendconditions

UNIT-I	10 Hrs.

Simplestressand strain –Mechanicalpropertiesofmaterials, stress, strain, stress-strainrelation, extension/shortening of a bar, Poisson's ratio, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), elongation due to self weight, principle of superposition, thermal stresses, volumetricstrain, Elasticconstants, Relation between elastic constants

Torsion of circular shafts - Pure torsion, assumptions, derivation of tensional equations, polar modulus, torsional rigidity /stiffness of shafts, power transmitted by solid and hollow circular shafts

UNIT - II	10 Hrs.

Shear force and Bending Moment in beams– Introduction, typesofbeams,loadsandreactions, rateofloading,Shearforceandbendingmoment, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams fordifferent beams subjected to concentrated loads, uniform distributedload (UDL)andcouple

Bending and shear stresses in beams -Theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section, shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T- sections

UNIT - III	10 Hrs.

Deflection of beams - Deflection of beams, equation for deflection, slope and moments, double integration method for cantilever and simply supported beamsforpointload,UDL,UVLandcouple,Macaulay'smethod.

Compound stress - Introduction, plane stress system, sign convention, stresses on an inclined plane, Uniaxial and Biaxial stresses on an element, General 2-D stress system, Principal stresses and planes, Mohr's circle

UNIT - IV	**10 Hrs.**

Thick and thin cylinders - Stresses in thin cylinders, changes in dimensions of cylinder, thick cylinders subjected to internal and external pressures (Lame's equation).

Elastic stability of columns: Introductiontocolumns,Euler'stheoryforaxiallyloadedelasticlongcolumns,derivationofEuler'sloadforvariousendconditions, limitationsofEuler's theory and Rankine'sformula.

Reference Books

1. Bhavikatti S. S, (2022), Strength of Materials(5th edition), Vikas Publications House - Pvt. Ltd
2. Bansal R. K, (2024), A Textbook of Strength of Materials, Laxmi Publications
3. Ferdinand Beer, Jr. Johnston, E. Russell, John De Wolf, David Mazurek, (2017), Mechanits of Materials(7th edition), McGraw-Hill Education

Additional Learning Resources:

1. https://www.civil.iitb.ac.in/~naresh/teaching/ce221/L1_concept%20of%20stress_v1.pdf
2. https://ocw.mit.edu/courses/2-001-mechanics-materials-i-fall-2006/pages/lecture-notes/
3. https://www.arma.org.au/wp-content/uploads/2017/03/introduction-to-mechanics-of-materials-part-i.pdf
4. https://www.youtube.com/watch?v=Y8tXHk3irqEhttps://www.youtube.com/watch?v=Y8tXHk3irqE

Course Outcomes	**Programme Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	3	1								1	3		2
CO2	3	3	1								1	3		2
CO3	3	3	1								1	3		2
CO4	3	3	1								1	3		2

COs*	Programme Outcomes (POs) and WKs ***											PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK 4)	3 (WK1, WK2, WK3 andWK 4)	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	2 (WK5)	3 (WK8)	-	2 (WK1, WK5, WK7)	-	-	-	-	1	3	3	-
CO3	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	2 (WK2, WK6)	-	-	-	-	-	2	2	3	-
CO4	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	1 (WK2, WK6)	-	-	-	-	-	1	3	2	-

Course Code		:	1BAUA305C	AUTOMOTIVE CHASSIS	Semester	:	III
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply knowledge of Elements of Mechanical engineering to classify Automotive layouts and describe construction working of vehicular systems such as suspension, steering, brakes, and wheels.

Course Outcomes:

After completion of the course student will be able to:

1. Classify the different types ofautomotive layouts and differentiate them
2. Describe construction and working of different types of suspension systems
3. Classify brakes and explain construction and operation of various steering systems
4. Solve numerical problems onsteering and braking systems
5. Describe construction of wheels, front andrear axles

UNIT-I	10 Hrs.

LAYOUTS AND FRAMES: Introduction, classification of automobiles, Automobile layouts; front wheel drive, rear wheel drive, four wheel drive, rear engine layout. Types of frames, materials, Loads on frame, cross members, channel sections, sub frames, passenger car frames, x member type frame, truck frames, box section type frame, testing of frames, bending and torsion test, body construction and repairs, frame alignment and framedefects.

SUSPENSION: Objectives, basic considerations, types of suspension springs; construction, rigid axle suspension, operation, materials of leaf springs, coil springs, torsion bar, rubber springs, helper springs, air suspension, shock absorbers, independent suspension; front and rear, stabilizer bars, active suspension systems, suspension systems for commercial vehicles trouble shooting, Numerical problems

UNIT - II	10 Hrs.

STEERING SYSTEMS: Two wheeled steering system, four wheeled steering system, steering systems for multi axle vehicles and long wheeled chassis vehicles, steering mechanisms, correct steering angle, cornering force, self- righting torque, under steer and over steer, steering linkages, types of steering gear boxes: rack and pinion, recirculating ball type, etc. Steering ratio, turning radius, steering adjustment, steering columns, power steering; hydraulic and electronic, advanced steering systems, trouble shooting of steering systems. Numericalproblems.

UNIT - III	10 Hrs.

BRAKES: Function, stopping distance, brake efficiency, weight transfer, determination of braking torque, classification of brakes, types, construction, operation of braking systems; mechanical, hydraulic, disc, drum. Details of hydraulic systems: master and wheel cylinder, diagonal split systems, bleeding of brakes, factors affecting brake fluid, pressure differential valve, proportioning valve, metering valve, brake adjustment. Brake compensation, parking brakes, hill holders, servo brakes, power brakes. Vacuum servo brakes, air brakes, vacuum - boosted hydraulic brakes. Auxiliary braking systems; retarders, exhaust brake, jakebrakes.

UNIT - IV	**10 Hrs.**

WHEELS AND TYRES: Types of wheels, construction, wheel dimensions, structure and function, desirable tyre properties, types, materials, manufacture, designation, factors affecting tyre life, rotation and trouble shooting. Heat dissipation, wheel alignment and wheelbalancing.

FRONT AXLE: Types of front axle, stub axle, materials, loads and stresses, drive line, construction working of drive shaft, types of drive shaft.

REAR AXLE: Types of drive, torque reaction, driving thrust, construction of rear axle supporting; fully floating, semi floating, three quarter floating arrangements, trouble shooting. Numerical problems

Reference Books

4. Dr. Kirpal Singh, (2020), Automobile Engineering Vol. 1 (Chassis, Body), (14thEdition/Reprint), Standard publications, NewDelhi
5. William Crouse, Donald Anglin, (2017), Automotive Mechanics(10th edition),McGraw Hill
6. JornsenReimpell,HelmutStoll,JurgenBetzler, (2001), TheAutomotiveChassis:EngineeringPrinciples,(2nd edition), Butterworth-Heinemann,Elsevier
7. David C Barton, John D Fieldhouse, (2018), Automotive Chassis Engineering, (1st edition), Springer

Additional Learning Resources:

1. https://www.youtube.com/watch?v=_bPrnyGdFig
2. https://www.youtube.com/watch?v=aNxSigpIhxA
3. https://www.youtube.com/watch?v=ltufRS3xj30
4. https://www.youtube.com/watch?v=URqf-GyqUU4
5. https://www.youtube.com/watch?v=I08QRQYr-k8
6. https://www.youtube.com/watch?v=e7d1kOnHIdA
7. https://media.defense.gov/2014/Jun/20/2002655912/-1/-1/1/140620-N-ZZ182-6554.pdf
8. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAUA1403.pdf
9. https://people.iith.ac.in/ashok/VD/VD_L3_2015.pdf?form=MG0AV3
10. https://www.gcoeara.ac.in/learning_material/auto/Unit%202-AST.pdf
11. https://www.g-w.com/assets/files/pdf/sampchap/9781685844103_Ch24.pdf
12. https://law.resource.org/pub/in/bis/S13/is.15636.2012.pdf

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3										2	3	2	
CO2	3										2	3	2	
CO3	3	1	1								2	3	2	
CO4	3	3	1								2	3	2	
CO5	3										2	3	2	

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

	Course Code	:	1BAUA306C	MATERIAL SCIENCE & METALLURGY	Semester	:	III
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will develop the ability to analyze the structure, properties, processing, and performance of engineering materials for diverse applications. Apply principles of materials science and metallurgy to select appropriate materials, evaluate their behaviour under service conditions, and solve engineering problems involving metals, alloys, composites, and manufacturing processes.

Course Outcomes:

After completion of the course, the student will be able to:

1.Explain crystal structures, crystallographic parameters, crystal imperfections, and atomic diffusion mechanisms to analyze the behaviour of engineering materials.

2.Evaluate the mechanical behaviour of metals using standard mechanical testing methods and analyze failure mechanisms including fatigue, fracture, and creep.

3.Interpret solidification processes, phase diagrams, iron–carbon equilibrium diagram, and TTT curves to predict the microstructure and properties of engineering alloys.

4.Apply the principles of heat treatment, powder metallurgy, and composite materials to select suitable engineering materials for industrial applications

UNIT-I	**10 Hrs.**

Crystallography - Concept of UNIT cell, metallic crystal structures, calculation of atomic radius, coordination number and atomic packing factor for different cubic structures,

Crystal imperfections - Point, line, surface and volume defects,

Atomic diffusion -Phenomenon, Flick's 1stand 2nd law of diffusion, factors influencing diffusion, concept of slip and twinning.

UNIT–II	**10 Hrs.**

Mechanical properties of metals - Concepts of stress and strain, tension test - true stress and true strain, compression test, notch impact test - izod and charpy, hardness test - brinell, vickers and rockwell,

Fatigue - Fatigue test - fatigue loadings, S-N diagram and fatigue properties,

Failure - Failure of metals, fracture - fundamentals of fractures, types - ductile &brittle, mechanisms of ductile fracture, griffith's theory of brittlefracture,

Creep - Creep curve, mechanism of creep and creep resistant materials.

UNIT–III	**10 Hrs.**

Solidification- Mechanism of solidification, homogeneous and heterogeneous nucleation, crystal growth, cast metal structures, **Solid solution** - Types, Hume-Rothary rules governing the formation of solids solutions,

Phase diagrams - basic terms, Gibbs phase rule, construction of phase diagrams, lever rule, different types of invariant reactions,

Iron carbon equilibrium diagram - Salient features of iron and carbon, allotropic forms of iron, Fe-C equilibrium diagram, phases in the Fe-C system, Invariant and TTT curves.

UNIT–IV	**12 Hrs.**

Heat treatment - Basic concept of heat treatment, different types of heat treatment processes,
Ferrous and non-ferrous materials - Steel, cast irons, copper and its alloys, aluminium and its alloys, magnesium and its alloys,
Powder metallurgy - Concept of powder metallurgy, application and advantages, production of powder,
Composite material - Concept and classification of composites, matrix-polymer matrix composites (PMC), metal matrix composites (MMC), ceramic matrix composites (CMC), reinforcement-particle reinforced composites, fiber reinforced composites, reinforcement-matrix interface, applications of various types of composites - automobile, aircrafts, missiles, space hardware, electrical and electronics, marine, recreational and sports equipment.

Reference Books *

Text Books:
1.William D. Callister, 2006, Materials Science and Engineering - An introduction , 7th Edition Jr Wiley India Pvt. Ltd., New Delhi
2.George E. Dieter, Adapted by David Bacon, Mechanical Metallurgy (SI Metric Edition), McGraw-Hill Book Company
3.K. Srinivasan, Composites Materials - Production, Properties, Testing and Applications Narosa Publishing House, New Delhi.

Reference Books:
1.James F. Shackel Ford, 2006, Introduction to Material Science for Engineering, 6th Edition Pearson, Prentice Hall, New Jersey
2.V. Raghavan, 2007, Materials Science and Engineering 5thEdition, Prentice Hall, India,
3.O. P. Khanna, A Text Book on Material Science and Metallurgy, DhanpatRaiPublications (P) Ltd, New Delhi
4.Van Vlack, Elements of Material Science and Engineering 6th Edition, Addison Wesley Publishing Company
5.Smith, 1997, Foundation of Material Science and Engineering 3rd Edition McGraw Hill.

Additional Learning Resources:

1. https://nptel.ac.in/courses/113102080
2. https://nptel.ac.in/courses/113106032
3. https://www.digimat.in/nptel/courses/video/113102080/L01.html
4. https://www.youtube.com/watch?v=b4jvpYxxZco

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

1BAUA307L	Basic Automobile Engineering Lab	Credits: 01
L:T:P -0: 0: 2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

PART-A	10 Hrs.

1. Study of steering system.
2. Study of braking system
3. Study of differential rear axle
4. Study of gearbox
5. Study of propeller shaft
6. Study of front and rear axels
7. Study of pneumatic tooling system

PART-B	20 Hrs.

1. Study of IC engine assembly for single cylinder engines
2. Study of IC engine assembly for 4 cylinder engines
3. Study of IC engine assembly for 6 cylinder engines
4. Performance tests on I.C engines, calculations of IP, BP, FP, Thermal, volumetric and mec efficiency, SFC and heat balance sheet for diesel engine
5. Performance tests on I.C engines, calculations of IP, BP, FP, Thermal, volumetric and mec efficiency, SFC and heat balance sheet for petrol engine

SCHEME OF EXAMINATION

One question from part A	: 20 Marks
One question from part B	: 20 Marks
Viva-voice	: 10 Marks
Total marks	: 50 Marks

Course Outcomes

After completion of the course student will be able to:

1. Able to know, analyze and to perform experiments on various Automotive systems
2. Able to know, analyze and to perform experiments on various Automotive engines
3. Able to assemble and dissemble automotive engine components

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3(WK2, WK3)	1	1		1							3	2	1
CO2	3(WK2, WK3)	1	1		1							3	2	1
CO3	3(WK2, WK3))	1	1		1							3	2	1
CO4	3(WK2, WK3)	1	1		1							3	2	1

1BAUA308L	MACHINE SHOP & FOUNDRY PRACTICE LAB	Credits: 01
L:T:P -0: 0: 2		CIE Marks:50
Total Hours/Week: 02		SEE Marks:50

PART-A	10 Hrs.

Minimum four jobs using lathe of following machining operations:

1. Plain turning, taper turning, step turning, thread cutting, facing, knurling, eccentric turning.
2. Cutting of gear teeth using milling machine.
3. Cutting of V – groove / Dovetail / Rectangular groove using shaping machine

PART-B	20 Hrs.

Testing of molding sand and core sand:

Preparation of sand specimens and conduction of the following tests:

1. Compression, shear and tensile tests on universal sand testing machine.
2. Permeability test
3. Core hardness & mould hardness tests
4. Grain fineness number test (Sieve analysis test)
5. Clay content test
6. Moisture content test

Foundry practice:

1. Use of foundry tools and other equipments.
2. Preparation of moulds using molding boxes using patterns or without patterns.
3. Preparation of one casting (Aluminum or cast iron - Demonstration only)

SCHEME OF EXAMINATION

One question from part A	: 20 Marks
One question from part B	: 20 Marks
Viva-voice	: 10 Marks

Total marks : 50 Marks

Course Outcomes

After completion of the course student will be able to:

1. Develop skills to operate lathe for turning, facing, tapering, knurling, step turning, forming and threading operation and apply skills to develop jobs on shaper and milling machine.
2. Calculate machining time for different operations.
3. Ability to prepare different types of mold cavities and different sand testing methods
4. Aware of importance of manufacturing process in an industry and the applications

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3(WK2, WK3)	2(WK5)										3	2	1
CO2	3(WK3)	2(WK5)										3	2	1
CO3	3(WK4)	2(WK5)										3	2	1
CO4	3(WK4)	2(WK5)										3	2	1

Course Code		**:**	**1BBTA402C**	**BIOLOGY FOR ENGINEERS**	**Semester**	**:**	**04**
L:T:P*		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42Hrs.**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42Hrs.**		**SEE Marks**	**:**	**50**
	Exam	**:**	**6Hrs.**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90Hrs.**		**Credits**	**:**	**03**

Professional Competency:

Understanding fundamentals of biological processes and apply to solve engineering problems,
bridging the technical engineering with living systems.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the structure and functions of cells and biomolecules, properties and applications of special biomolecules in engineering and industrial contexts.

CO2: Interpret bio-inspired models and natural mechanisms and correlate them with engineering designs and technological innovations.

CO3: Analyze the functional architecture of human organ systems as models to design and evaluate engineering solutions**.**

CO4: Apply the concept of bioprinting, artificial intelligence, and microbial processes in the design and development of innovative solutions for healthcare, food science, and sustainable infrastructure.

UNIT-I	**10 Hrs.**

Introduction to Biology:

The cell: Structure, and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins and Lipids. Importance of special biomolecules: Enzymes, vitamins and hormones -properties and functions.

Biomolecules and their Applications:

Carbohydrates in bioplastics production, Proteins in food production, Lipids in biodiesel.

UNIT-II	**10 Hrs.**

Bio Inspiration Models Used in Engineering:

Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature. Bird flying (GPS and aircrafts), Lotus leaf effect (Super

hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.

Nature Bioinspired Mechanisms:
BioEcholocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs) .

UNIT-III	**12 Hrs.**

Human Organ Systems and Bio Designs

Brain as a CPU system -architecture, CNS and Peripheral Nervous System, signal transmission, EEG. Engineering solutions for Parkinson's disease.

Heart as a pump system -architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators.

Lungs as purification system gas exchange mechanisms, spirometry, Ventilators.

Eye as a Camera system, bionic eye. **Kidney** as a filtration system - dialysis systems.

UNIT-IV	**10 Hrs.**

Trends In Bioengineering

Bioprinting techniques and materials, 3D printing of ear, bone and skin, electrical tongue and electrical nose in food science, Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes), Biomining via microbial surface adsorption. Artificial Intelligence for disease diagnosis. Biochips & their applications. Biosensors & their applications.

Reference Books

1. Rajendra Singh C and RathnakarRao N, Rajendra Singh C and RathnakarRao, "Biology for Engineers" N Publishing, Bengaluru, 2023.
2. S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., *Biology for Engineers*, Tata McGraw-Hill, New Delhi, 2012.
3. Arthur T. Johnson, *Biology for Engineers*, 2nd Edition, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2019.
4. Sohini Singh and Tanu Allen, *Biology for Engineers*, Vayu Education of India, New Delhi, 2014.
5. Yoseph Bar-Cohen, *Biomimetics: Nature-Based Innovation*, 1st edition, CRC Press., 2012
6. Ibrahim Ozbolat, *3D Bioprinting: Fundamentals, Principles and Applications*, Academic Press (Elsevier), 2016.
7. Rodríguez Méndez, M. L. (Ed.), *Electronic Noses and Tongues in Food Science*, 1st Edition, Academic Press (Elsevier), Cambridge, MA, USA, 2016.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/121106008

- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**	**PSO3**
CO 1	3 (WK1, WK2, WK3, andWK4)	3 (WK1, WK2, WK3, andWK4)	3 (WK5)	2 (WK8)	2 (WK2,WK6)	2 (WK1,WK5,WK7)	2 (WK9)	2			3 (WK8)	3	2	2
CO 2	3 (WK1, WK2, WK3, andWK4)	3 (WK1, WK2, WK3, andWK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	2 (WK9)	2			3 (WK8)	3	2	2
CO 3	3 (WK1, WK2, WK3, andWK4)	3 (WK1, WK2, WK3, andWK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	3 (WK9)	2			3 (WK8)	3	2	2
CO 4	3 (WK1, WK2, WK3, andWK4)	3 (WK1, WK2, WK3, andWK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	3 (WK9)	2			3 (WK8)	3	2	2

	Course Code	:	1BAUA403C	Fluid Mechanics	Semester	:	IV
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:	
Students develop the ability to analyze the behaviour of fluids under static and dynamic conditions and apply the principles of fluid mechanics to solve engineering problems involving fluid flow, pressure measurement, and hydraulic systems. The course enables students to evaluate fluid engineering applications using analytical methods and engineering fundamentals for effective design and operation.	
Course Outcomes:	
After completion of the course, the student will be able to: **1.Explain** the properties of fluids and the principles of fluid statics to determine pressure distribution and measure fluid pressure using manometers. **2.Apply** the principles of hydrostatics and buoyancy to determine hydrostatic forces, center of pressure, and the stability of floating and submerged bodies. **3.Analyze** fluid flow using the principles of fluid kinematics, fluid dynamics, and flow measurement devices to evaluate flow characteristics in engineering applications. **4.Apply** the concepts of pipe flow and dimensional analysis to evaluate energy losses and develop dimensionally consistent models for fluid flow problems.	
UNIT-I	**11 Hrs.**
Properties of fluids: Introduction, properties of fluids, classification of fluids, thermodynamic properties of fluids. **Fluid statics - pressure and its measurement:** Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressure, simple manometers, differential manometers.	
UNIT–II	**11 Hrs.**
Fluid statics- hydrostatic forces on surfaces: Total pressure and center of pressure, vertical plane surface submerged in liquid, horizontal plane surface submerged in liquid, inclined plane surface submerged in liquid, curved surface submerged in liquid. **Buoyancy and floatation:** Buoyancy, center of buoyancy, Metacenter and Metacentric height, conditions of equilibrium of floating and submerged bodies.	
UNIT–III	**10 Hrs.**
Fluid kinematics: Types of fluid flow, flow net, continuity equation, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function for 2D flow and types of motion. **Fluid dynamics:** Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids**.** **Fluid flow measurements:** Introduction, venturimeter, orifice meter, Pitot tube.	
UNIT–IV	**10 Hrs.**
Flow through pipes: Frictional loss in pipe flow, major energy losses and minor energy losses in pipe flow, Darcy- equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, hydraulic gradient and total energy line. **Dimensional analysis:** Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's- π theorem, Raleigh's method, dimensionless numbers, similitude, types of	

similitude.

Reference Books:

TEXTBOOKS:

1. Dr.Bansal.R.K, **"Fluid Mechanics**" by Lakshmi Publications, 2010.

REFERENCE BOOKS:

1. Kumar.D.S, **"Fluid Mechanics and Fluid power Engineering**" Kataria and sons-2010

ADDITIONAL LEARNING RESOURCES:

Unit I https://www.rgpv.ac.in/campus/ME/Unit%201%20-%20Fluid%20Mechanics.pdf
https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/98d22b38-9609-4ec7-a2e4-1bc2f6df813f.pdf

Unit II https://www.rgpv.ac.in/campus/ME/Unit%201%20-%20Fluid%20Mechanics.pdf
https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/98d22b38-9609-4ec7-a2e4-1bc2f6df813f.pdf

Unit III https://mrcet.com/downloads/digital_notes/ME/II%20year/FMHM%20DIGITAL%20NOTES.pdf
https://aec.edu.in/aec/Instruction_Material/UNIT%202%20.pdf

Unit IV https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/98d22b38-9609-4ec7-a2e4-1bc2f6df813f.pdf

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

	Course Code	:	1BAUA404C	THEORY OF MACHINES	Semester	:	IV
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will develop the ability to analyze, evaluate, and apply the principles of kinematics and dynamics of machines for understanding the operation and performance of mechanical systems. The course enables students to design and assess mechanisms, balancing systems, governors, gyroscopic effects, gear trains, and cam systems for efficient and reliable machine operation.

Course Outcomes:

After completion of the course, the student will be able to:

1.Explain the concepts of kinematic links, pairs, chains, mechanisms, and analyze various mechanisms and their inversions used in machine applications.

2.Analyze the static forces and balancing conditions of mechanisms and rotating masses to determine equilibrium and improve machine performance.

3.Apply the principles of governors and gyroscopes to evaluate speed regulation, stability, and dynamic effects in mechanical systems.

4.Design and analyze gear trains and cam mechanisms to determine velocity ratios, motion characteristics, and their applications in machinery.

UNIT-I **10 Hrs.**

Introduction:

DEFINITIONS: Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion, Machine. kinematic chains and inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

MECHANISMS: Quick return motion mechanisms -Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms –Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms – Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

UNIT–II **10 Hrs.**

STATIC FORCE ANALYSIS: Introduction: Static Equilibrium. Equilibrium of Two and Three Force Members. Members with Two Forces and Torque, Free Body Diagrams, Principle of Virtual Work. Static Force Analysis of Four Bar Mechanism and Slider-Crank Mechanism with and without friction.

BALANCING OF ROTATING MASSES: Static and Dynamic Balancing, Balancing of Single Rotating Mass by Balancing Masses in Same plane and in Different planes. Balancing of Several Rotating Masses by Balancing Masses in Same plane and in Different planes.

UNIT–III **10 Hrs.**

GOVERNORS: Types ofGovernors: Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power .

GYROSCOPE: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aeroplane, Stability of Two Wheelers and Four Wheelers.

UNIT–IV **10 Hrs.**

GEAR TRAINS: Simple gear trains, Compound gear trains for large speed reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

CAMS: Types of cams, Types of followers, Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife -edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

Reference Books:

Text Book:

1.Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition - 2005.

Reference book:

1.Sadhu Singh, "Theory of Machines", Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2nd Edition 2006.

Additional Learning Resource:

UNIT I

1. https://www.shobhituniversity.ac.in/pdf/econtent/Monograph-on-Theory-of-Machine-Raman-Gahlaut.pdf
2. https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/384810bb-f8bc-411b-96a6-fbaf3ef7c0c4.pdf
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMEA1402.pdf

UNIT II

1. https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/384810bb-f8bc-411b-96a6-fbaf3ef7c0c4.pdf
2. https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/MMT-M4.pdf

UNIT III

1. https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/384810bb-f8bc-411b-96a6-fbaf3ef7c0c4.pdf
2. https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/MMT-M4.pdf

UNIT IV

3. https://static.pw.live/5eb393ee95fab7468a79d189/GLOBAL_CMS_BLOGS/384810bb-f8bc-411b-96a6-fbaf3ef7c0c4.pdf
4. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMEA1402.pdf

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

	Course Code	:	1BAUA405C	Design of Machine Elements - I	Semester	:	iV
	L:T:P	:	2 : 2 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	28 Hrs		CIE Marks	:	50
	Tutorial	:	28 Hrs		SEE Marks	:	50
	Learning (TW+SL)	:	28 Hrs				
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to design simple machine components by considering the forces and stresses acting on them using the knowledge of engineering mechanics, mechanics of materials and material science.

Course Outcomes

After completion of the course student will be able to:

1. Define key terms related to machine design and compute stresses induced in elementary machine parts subjected to static and dynamic loading
2. Design shafts used for power transmission subjected to various types of loads
3. Design and analyze mechanical joints such as keys, coupling, and knuckle joints for various load condition
4. Design and analyze threaded fasteners and welded and riveted joints as per the standards

UNIT-I	6Hrs. + 6 Hrs

INTRODUCTION: Classification of design, design procedure, standardization, preferred numbers. Selection of materials, manufacturing consideration in design**.**

STRESSES IN ELEMENTARY MACHINE PARTS: Definitions derived from stress; strain diagram, loads, stress, strain, stress strain diagrams. Factor of safety, combined stresses, eccentric loading, theories of failure stress concentration and stress concentration factor, variable stresses, endurance limit, fatigue stress concentration factor, notch sensitivity, impact loading, design criteria.

UNIT - II	6Hrs. + 6 Hrs

SHAFTS: Introduction, material used for shafting, stresses in shafts, design of shafts, shafts subjected to twisting moment, bending moment. Combined bending and twisting moment, axial load in addition to bending and torsion, fluctuating loads, Design of shaft on the basic of rigidity ASME and ISI codes for design of transmission shafting.

GEOMETRIC DIMENSIONING AND TOLERENCING (GD & T): Introduction to GD and T, Terms and definitions, Symbols and rules of GD and T, Datum and datum reference frame, Concept of bonus tolerance

UNIT - III	6Hrs. + 6 Hrs

THREADED FASTENERS AND POWER SCREWS: Uses of screw threads, design of screw threads, design of screw threads, threaded fasteners, effect of initial tension, effect of applied loads; bolt stress, bolt spacing, effect of dynamic loads, bolts subjected to shear and eccentric loading, bolts subjected to shear eccentric loading, power screws; efficiency of screw threads, differential screws stress in power screws.

UNIT - IV	6Hrs. + 6 Hrs

RIVETED JOINTS: Types of joints, design stresses, design of typical joints, boiler joint, tank and structural joints.

WELDED JOINTS: Types of joint deign stresses, design of typical joints, eccentrically loaded welded joints

Reference Books

1. Das J. B. K., P L Shrinivasa Murthy, (2018), Design of Machine Elements-1, Sapna Book House
2. Bhandari V. B,(2020) Design of Machine Elements,(5th edition) Tata McGraw Hill Publishing Company Ltd
3. ShigleyJ E and MischkeC R., (2014) Mechanical Engineering Design, (10th edition) McGraw Hill International

DATA HAND BOOKS:

1. LingaiahK, (2014), Design Data Hand Book, (2nd edition), McGraw Hill,.
2. Mahadevan K and Balaveera Reddy, (2024), DesignData Hand Book, (4th edition) CBS Publication

Additional Learning Resources:

1. https://www.me.iitb.ac.in/~ramesh/courses/ME423/Introduction1.pdf
2. https://www.me.iitb.ac.in/~ramesh/courses/ME423/shafts.pdf
3. https://tcdcinc.com/assets/NADCA_GDT.pdf
4. http://egyankosh.ac.in/bitstream/123456789/31603/1/Unit-5.pdf
5. https://vssut.ac.in/lecture_notes/lecture1423723085.pdf

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	2								1	3	1	2
CO2	3	2	2								1	3	1	2
CO3	3	3	3								1	3	1	2
CO4	3	3	3								1	3	1	2
CO5	3	3	3								1	3	1	2
CO6	3	1	2								1	3	1	2

COs *	Programme Outcomes (POs) and WKs ***											PSOs **		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK 4)	3 (WK1, WK2, WK3 andWK 4)	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	2 (WK5)	3 (WK8)	-	2 (WK1, WK5, WK7)	-	-	-	-	1	3	3	-
CO3	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	2 (WK2, WK6)	-	-	-	-	-	2	2	3	-
CO4	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	1 (WK2, WK6)	-	-	-	-	-	1	3	2	-

* **COs: Course Outcomes**

** **PSOs: Program Specific Outcomes**

*** **WKs: Washington Knowledge Profiles**

Course Code		:	1BAUA406C	AUTOMOTIVE ENGINES	Semester	:	V
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply knowledge of engineering chemistry and elements of mechanical engineering to describe working of SI and CI engines using hydrocarbons and alternate fuels.

Course Outcomes

After completion of the course student will be able to:

1. Classify different types of engines used in automobiles and illustrate working of air standard cycles
2. Describe the process of combustion in SI engines and related parameters
3. Describe the process of combustion in CI engines and associated parameters
4. Calculate engine performance parameters
5. Compare and analyze the suitable fuel for an automobile assessing fuel properties

UNIT-I	10 Hrs.

INTRODUCTION: Historical development of automotive power plants. Types of power plant, Classification of engines; V - engines, stratified charge engines, variable compression ratio engine. Principle of engine operation - SI and CI two stroke and four stroke engines. Scavenging systems**:** Theoretical processes, parameters, relative merits and demerits, valve and port timing diagrams.

AIR STANDARD CYCLES: Otto, Diesel and dual cycle - efficiency and mean effective pressure. Fuel air cycles: Introduction and mixture strength variations

UNIT - II	10 Hrs.

COMBUSTION IN S.I. ENGINES: Ignition limits, stages of combustion, ignition lag, effect of engine variables on ignition lag, flame propagation, effect of variables, abnormal combustion, detonation, theory of detonation, effect of engine variables on detonation, control of detonation, surface ignition. Knock rating of SI engine fuels. HUCR engine. Combustion chamber: requirements, types, advantages and limitations.

UNIT - III	10 Hrs.

COMBUSTION IN CI ENGINES: Stages of combustion, air fuel ratio in CI engines, delay period, variables affecting delay period, diesel knock, methods of controlling diesel knock. CI engine combustion chambers; open and divided. Swirl; induction, turbulent and combustion swirl chambers. M - Combustion chamber.

ENGINE PERFORMANCE: Performance parameters; BHP, FHP, IHP, specific fuel consumption, volumetric efficiency, thermal efficiency, specific weight, heat balance sheet and testing of engines

UNIT - IV	10 Hrs.

LIQUID FUELS: Properties: specific gravity, viscosity, flashes and fire points, calorific value, rating of fuels.

PETROL: Octane number, chemical energy of fuels, reaction equation, volatility properties of A/F mixture, combustion temperature.

DIESEL: Cetane number, vapor pressure, cloud and pour point, annealing point, diesel index, carbon residue. Chemical energy of fuels, reaction equation, properties of A/F mixture, combustion temperature, rating of fuels.

DUAL FUEL AND MULTI-FUEL ENGINES: Combustion in dual fuel engines, factors affecting combustion. Main types of gaseous fuels, super-charge knock control and performance of diesel fuel engines. Characteristics of multi fuel engines, modification of fuel system, suitability of various engines as multi fuel unit, performance of multi fuel engines

Reference Books

1. Mathur R P, Sharma M L,(2005),**Internal Combustion Engines**, DhanpatRai publications
2. Rajput R K, (2016), A Textbook of Internal Combustion Engines (3rd edition), Laxmi publications
3. Heywood John, (2018), Internal Combustion Engine Fundamentals, (2nd Edition), McGraw Hill
4. Ganesan V, (2017), Internal Combustion Engines, (4th edition), McGraw Hill

Additional Learning Resources:

1. https://www.engr.colostate.edu/~allan/engines.html
2. https://www.fs.isy.liu.se/Edu/Courses/TSFS03/OH_2010/02_cycles_handout.pdf
3. https://uomustansiriyah.edu.iq/media/lectures/5/5_2018_05_04!09_23_25_AM.pdf
4. https://davuniversity.org/images/files/study-material/Combustion%20stage%20in%20CI%20Engine%20(Part%201).pdf
5. https://www.philadelphia.edu.jo/academics/nbadarneh/uploads/ICE%20CH4%202018-2019.pdf
6. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/UNIT-IV_0.PDF

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	2	2	3
CO1	3	2	1								1	2	1	1
CO2	3	1	1								1	2	1	1
CO3	3	2	1								1	2	1	1
CO4	3	2	2								1	2	1	1
CO5	3	1	1								1	2	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

COs	Program Outcomes and (WKs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, and WK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

	Course Code	:	1BAUA407C	AUTOMOTIVE TRANSMISSION SYSTEMS	Semester	:	IV
	L:T:P	:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will develop the ability to understand, analyze, and apply the principles of automotive transmission systems, including clutches, torque converters, gear boxes, differentials, and advanced transmission technologies. The course enables students to diagnose, evaluate, and select suitable transmission systems for improving vehicle performance, efficiency, reliability, and drivability.

Course Outcomes:

After completion of the course, the student will be able to:

1.Explain the principles of vehicle propulsion, power requirements, and various clutch mechanisms to evaluate their performance and applications in automobiles.

2.Analyze the working principles and performance characteristics of fluid couplings, torque converters, drive line components, and differential systems used in automotive power transmission.

3.Apply the concepts of manual, automatic, epicyclic, and hydrostatic transmission systems to determine gear ratios, performance characteristics, and suitability for vehicle applications.

4.Evaluate the design, operation, and control mechanisms of automatic and electric transmission systems for improving vehicle efficiency and performance.

UNIT - II	**11Hrs.**

Fluid coupling and one way clutches: Necessity, constructional details, types, field of application, percentage slip, one way clutch, working fluid requirements, fluid coupling characteristics. **Hydrodynamic torque converters:** Introduction, comparison between fluid coupling and torque converter, performance characteristics, slip, principle of torque multiplication, 3 and 4 phase torque converter, typical hydrodynamic transmission.

Drive line: Front universal joint, CV joint-inner and outer, slip joint.

Final drive gears: Axle ratio**,** gear tooth nomenclature. Differential, limited slip differential. Transfer case; inter axle differential, locking differential, electronic control of transfer cases and drive trains, all wheel drive. Trouble shooting diagnosis of final drive

UNIT - III	**11 Hrs.**

Gear box: Functions of transmissions, necessity of gear box, gears, gear ratio and torque, types of transmission; manual and automatic transmission, sliding-mesh gear box, constant-mesh gear box, synchromesh gear box. Transfer box. Transaxle; construction and operation, dual range transaxle. Selector mechanism and its types and interlock devices, gearbox lubrication. Calculation of gear ratios for vehicles, performance characteristics in different gears. Switches and sensors - Transmission Controlled Spark (TCS), trouble shooting diagnosis and servicing and maintenance of manual transmission and transaxle. Trouble shooting diagnosis of gear box. Numerical problems.

Epicyclic transmission: Principle of operation, types of planetary transmission, calculation of gear ratio in different speeds, over drives, numerical problems.

Hydrostatic drives: Principle of hydrostatic drives, different systems of hydrostatic drives, types of pumps, advantages and limitations, typical hydrostatic drives.

UNIT - IV	**10 Hrs.**

Automatic transmission: Hydraulic system, automatic transmission fluid, transmission fluid coolers, basic hydraulic control circuits, accumulator, shift timing, governor pressure, throttle pressure, controlling shift

timing and quality, hydraulic valves and valve bodies, starting controls and shift interlocks, electronic shift control, shift solenoid, automatic shift counter shaft transmission. Principle, general description of Borg-Warner automatic transmission, Continuous Variable Transmission (CVT).

Electric transmission: General arrangement and description of electric transmission, their working principle and control mechanisms and limitations

Reference Books	**10 rs.**

Text Books:

1.Dr. Kirpal Singh, (2020), Automobile Engineering Vol. 1 (Chassis, Body), (14th Edition / Reprint), Standard publications, NewDelhi

2.William Crouse, Donald Anglin, (2017), Automotive Mechanics (10th edition), McGraw Hill

Reference Books:

1.Giri N. K, (2024), Automobile Mechanics, (12th edition), Khanna Publishers

2.Young Chen, (2021), Automotive Transmissions: Design, Theory and Applications, (1st edition), Springer

3.Yi Zhang, Chris Mi, Automotive Power Transmission Systems, (2018), John Wiley & Sons Ltd

Additional learning Resources:

1. https://www.engr.colostate.edu/~allan/fluids/page8/page8.html
2. https://www.gcoeara.ac.in/learning_material/auto/TE/Automotive%20Chassis%20and%20Transmission/Unit%204-Clutches%20_%20Gear%20Box%20.pdf
3. https://www.gcoeara.ac.in/learning_material/auto/TE/Automotive%20Chassis%20and%20Transmission/Unit%206-Automatic%20Transmission%20.pdf
4. https://www.youtube.com/watch?v=z5G2zQ_3xTc
5. https://www.youtube.com/watch?v=uEhLBKCSXO4
6. https://www.gcoeara.ac.in/learning_material/auto/TE/Automotive%20Chassis%20and%20Transmission/Unit%205-Drive%20Lines,%20Final%20Drive%20_%20Rear%20Axle%20.pdf
7. https://auto.howstuffworks.com/transmission.htm
8. https://dn790009.ca.archive.org/0/items/Harald_Naunheimer_Bernd_Bertsche_Joachim_Ryborz_Wolfgang_Novak_Automotive_Transm/Harald_Naunheimer_Bernd_Bertsche_Joachim_Ryborz_Wolfgang_Novak_Automotive_Transmissions.pdf

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1 (WK5)	-	-	-	-	-	-	-	1	2	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1 (WK5)	-	-	-	-	-	-	-	1	2	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1 (WK5)	-	-	-	-	-	-	-	1	2	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1 (WK5)	-	-	-	-	-	-	-	1	2	2	1

1BAUA408L	Computer Aided Machine Drawing	Credits: 01
L:T:P -0: 0: 2		CIE Marks:50
Total Hours/Week: 02		SEE Marks:50

	30 Hrs.

1. Review of graphic interface of the software

Review of basic sketching commands and navigational commands. Standard sheet templates, and creating new templates, different line types and their applications.

1. **Section of solids:** sections of square pyramids, hexagonal prism, cones and cylinders**.**

2. **Orthographic views:** Conventions used in machine drawings. Sectional planes, Conversion of pictorial views into orthographic projections of simple machine parts with or without section (Bureau of Indian Standards conventions are to be followed for the drawings). Dimensioning and annotations.

1. **Thread forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme, Sellers thread, American Standard thread.

2. Fasteners :

Hexagonal head bolt, nut and washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

3. Keys & Joints

Parallel key, taper key, feather key, Gib head key and Woodruff key joint (socket and spigot), knuckle joint (pin joint) for two rods.

4. Couplings

Split Muff coupling, protected type flanged coupling, pin (bush) .type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint).

Assembly Drawings (Part drawings should be given)

1) Screw jack (Bottle type)
2) I.C. Engine connecting rod.

SCHEME OF EXAMINATION

Laboratory Assessment:

1. This subject is to be evaluated for 100 marks (50 CIE and 50 SEE)
2. Allocation of 50 marks for CIE

- Performance and preparation of drawings :
  10 sheets manually drawn shall be submitted and each sheet shall be evaluated for 3 marks.
- One practical test for 20 marks. (5 mark for conversion from isometric to orthographic, 15 marks assembly and printing).

3. The SEE practical is conducted for 50 marks of three hours duration. The distribution of marks as 30% from orthographic view, 70 % for part modeling, assembling and creating 2 D views from assembly using CAD Software. No viva voce.
4. Question paper shall have two parts, questions for first part shall be asked from conversion of isometric to orthographic views and second part shall be asked from assembly.
5. Student should answer two questions choosing one question from each part. At least one question shall be asked from first 3 assemblies

Course Outcomes

After completion of the course student will be able to:

1. Able to utilize CAD software to generate 2D and 3D models.
2. Utilize CAD software commands and develop sections of solids.
3. Able to convert orthographic views to isometric views using CAD software.
4. Utilize advanced commands to generate assembly drawings from part drawings.

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)			3 (WK1, WK2, WK3 andWK4)						1	3	2	2
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)			3 (WK1, WK2, WK3 andWK4)						1	3	2	2
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)			3 (WK1, WK2, WK3 andWK4)						1	3	2	2
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)			3 (WK1, WK2, WK3 andWK4)						1	3	2	2

Course Code		:	1BAUA501C	Design of Powertrain and Suspension Systems	Semester	:	V
L:T:P		:	2 : 2 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	28 Hrs		CIE Marks	:	50
	Tutorial	:	28 Hrs		SEE Marks	:	50
	Learning (TW+SL)	:	28 Hrs				
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the principles of design of machine elements and mechanics of materials to analyze and solve design problems in Automotive Powertrain and suspension systems.

Course Outcomes:

After completion of the course, the student will be able to:

1) Analyse the concept of engineering system design and formulate design aspects of automotive clutc
2) Design gear box and components for automotive applications
3) Analyse the gear mechanisms and its applications to two and three wheelers.
4) Design propeller shaft for power transmission
5) Design rear axle and final drive components

UNIT-I — 10 Hrs.

CRITERIA FOR VEHICULAR SYSTEM DESIGN: Power and torque required for propulsion, Vehicle load, Road, Wind and Gradient Resistance, Expectancy curves and Performance curves. Driving Power and torque, Output Power and torque of the Propeller shaft, Output power and torque at fly wheels, Graphical representations of expectancy curves, Starting torque, Load-speed characteristics and performance curves

DESIGN AND DEVELPOMENT OF CLUTCH ASSEMBLY:-Design and Development of clutch assembly using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of clutches: - single plate, multi plate and cone clutches, selection criteria for the clutches. Analyses of various stresses, forces acting on clutch assembly and components

Clutch assembly: clutch plates, pressure plates, springs, input and output shafts, rivets nuts and bolts, clutch plates, frictional materials and their selection criteria, materials used for various components.

UNIT - II — 10 Hrs.

DESIGN AND DEVELPOMENT OF GEAR TRAINS AND GEAR BOXES:-Design and Development of gear trains using the vehicular design data, calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of gear boxes, gear trains and gears, selection criteria, transmission efficiency, criteria for selection of different gear ratios in gear

boxes, calculations of gear train dimensions, gear ratios, diameter of the gear shafts and gears etc

LUBRICATION AND BEARINGS: Lubricants and their properties, mechanisms of lubrication bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, heat dissipated, bearing materials, design of journal bearing and thrust bearing (No derivation only problems).

TYPES OF BRAKES: Single block and simple band brakes.

UNIT - III	**10 Hrs.**

DESIGN AND DEVELPOMENT OF CONVENTIONAL TRANSMISSION SYSTEMS TWO AND THREE WHEELERS:-Design and Development of gear trains using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, types of conventional transmission systems:-belts ropes and chains, force and stress analyses, calculations of dimensions for wire ropes. Belts:- types, Flat belts: length and cross section, selection of v-belts,wire ropes and chains for automotive and other applications (No derivation only problems).

DESIGN AND DEVELPOMENT OF PROPELLER SHAFTS:-Design and Development of propeller shaft using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, Types of propeller shaft, selection criteria, types of joints

UNIT - IV	**10 Hrs.**

SPRINGS: Types of springs, stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, leaf Springs: stresses in leaf springs. Equalized stresses, energy stored in springs, torsion, Belleville and rubber springs.

DESIGN AND DEVELPOMENT OF REAR AXEL GEAR TRAINS:-Design and Development of rear axle gear trains using the vehicular design data calculation methods for the different types of vehicles, Calculations of required torque and BHP to be transmitted, Types of gear trains, axle shaft design, gear train selection criteria, rear axle gear ratio calculations and selection criteria

Reference Books

1) Mechanical Engineering Design - Joseph E Shigley and Charles R.Mischke. McGraw Hill iternational edition.
2) Introduction engineering system design method – V. Gupta and P. Murthy
3) Automotive Mechanics – N. K. Giri
4) Machine Design – Trika

Additional Learning Resources:
1. https://www.youtube.com/watch?v=4BOryrhs9iA 2. https://www.iqytechnicalcollege.com/AE%20104%20Brake%20&%20Steering%20System-Vehicle%20Power%20train%20system.pdf 3. https://www.irjet.net/archives/V9/i5/IRJET-V9I5172.pdf 4. https://www.cedengineering.com/userfiles/M06-031%20-%20Basic%20Fundamentals%20of%20Gear%20Drives%20-%20US.pdf 5. https://www.youtube.com/watch?v=9I_tgpxBpwo&t=14s 6. https://www.youtube.com/watch?v=sueEHwDajD0
Course Outcomes
1. Analyze the concept of engineering system design and formulate design aspects of automotive clutch
2. Design gear box and components for automotive applications
3. Analyze the gear mechanisms and its applications to two and three wheelers.
4. Design propeller shaft for power transmission
5. Design rear axle and final drive components

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2									3	1	1
CO2	3	3	1									3	1	1
CO3	3	3	1									3	1	1
CO4	3	3	1									3	1	1
CO5	3	3	1									3	1	1

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	3 (WK1, WK2, WK3 andWK4)	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	3 (WK8)	-	2 (WK1, WK5, WK7)	-	-	-	-	1	3	3	-
CO3	1 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	3 (WK5)	3 (WK8)	2 (WK2, WK6)	-	-	-	-	-	2	2	3	-
CO4	1 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	3 (WK5)	3 (WK8)	1 (WK2, WK6)	-	-	-	-	-	1	3	2	-

Course Code		:	1BAUA502C	HEAT TRANSFER	Semester	:	V
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the principles of conduction, convection, and radiation to analyze and solve engineering problems involving thermal energy transfer in mechanical, chemical, and industrial systems. Evaluate and design heat transfer equipment and thermal management solutions using engineering fundamentals, mathematical modeling, and relevant standards to improve efficiency, safety, and sustainability..

Course Outcomes:

After completion of the course, the student will be able to:

1.Understand the fundamental principles of heat transfer, and apply the governing equations of one-dimensional steady-state conduction to solve engineering heat transfer problems.

2.Analyze steady-state heat transfer through extended surfaces (fins) and evaluate transient heat conduction in solids using lumped system analysis and Heisler charts for engineering thermal applications.

3.Develop the ability to analyze boundary layer phenomena and convective heat transfer processes, and apply empirical correlations to evaluate forced and free convection heat transfer problems.

4.Understand the principles of heat exchanger operation and thermal radiation, and apply heat transfer analysis methods, radiation laws, and performance evaluation techniques to solve engineering problems involving heat exchange and radiative energy transfer.

UNIT-I — 11 Hrs.

INTRODUCTORY CONCEPTS AND DEFINITIONS: Modes of heat transfer; basic laws governing conduction, convection, and radiation heat transfer; thermal conductivity; convective heat transfer coefficient; radiation heat transfer coefficient; combined heat transfer mechanism.

CONDUCTION: Basic equations, general form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates. Boundary conditions of first, second and third kinds; illustrative problems on mathematical formulation of conduction problems.

ONE-DIMENSIONAL STEADY STATE CONDUCTION : Steady state conduction in a slab, in a cylinder and in a sphere without heat generation; overall heat transfer coefficient for a composite medium; thermal contact resistance; critical thickness of insulation.

UNIT - II — 11 Hrs.

FINS: Steady state conduction in fins of uniform cross section long fin, fin with insulated tip and fin with convection at the tip; fin efficiency; conduction in solids with variable thermal conductivity.

ONE-DIMENSIONAL TRANSIENT CONDUCTION: Conduction in solids with negligible internal temperature gradients (lumped system analysis); use of transient temperature charts (Heisler 's charts) for transient conduction in slab, long cylinder and sphere.

UNIT - III — 10 Hrs.

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS: Flow over a body - velocity boundary layer; laminar and turbulent layers, critical Reynolds number; general expressions for drag coefficient and drag force, thermal boundary layer.

FORCED AND FREE CONVECTION: Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydrodynamically and thermally developed flows; use of correlations for flow over a flat plate, over a cylinder and numericals. Application of dimensional analysis for free convection-physical significance of Grashoff number.

UNIT - IV	**10 Hrs.**

HEAT EXCHANGERS: Classification ofheat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD and NTU methods of analysis of heat exchangers.

RADIATION HEAT TRANSFER: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan - Boltzman law, Kirchoff's law, Planck's Law and Wein's displacement law, Lambert's Law; radiation heat exchange between two parallel infinite black surfaces.

Reference Books:

TEXTBOOKS:

I)**Heat Transfer** by P.K. Nag Tata McGraw Hill 2002

2)**Heat Transfer**- A Basic approach by M NecatsOsisikMcGraw Hill International ed 1988

REFERENCE BOOKS:

1) **Heat transfer** a practical approaches by Yunus A Cengel Tata McGraw Hill 2002.

2) **Principles ofHeat Transfer** by Kreith Thomas learning 200 1.

3)**Fundamentalsof Heat and Mass Transfer** by Frank. P. Incropera and David. P. Dewitt John Wiley and Sons 4th ed 1995.

4) **Heat transfer:**JojoJaico Book house 2003

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

Course Code		:	1BAUA503C	AUTO ELECTRICAL SYSTEM	Semester	:	V
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to **diagnose, test, service, and maintain automotive electrical and electronic systems**, including batteries, charging systems, starting systems, ignition systems, dashboard instruments, lighting systems, vehicle safety devices, and HVAC systems. They will develop the ability to apply electrical and electronic principles, use diagnostic tools, interpret fault codes, and troubleshoot system malfunctions to ensure reliable and efficient vehicle operation.

Course Outcomes:

After completion of the course, the student will be able to:

1. Understand, test, maintain, and troubleshoot automotive batteries, electrical networks, vehicle safety systems, and dashboard instrumentation used in modern automobiles.
2. To enable students to understand the construction, operation, testing, servicing, and troubleshooting of automotive charging and starting systems, including generators, alternators, and starter motors.
3. realise the construction, operation, testing, servicing, and troubleshooting of automotive charging and starting systems, including generators, alternators, and starter motors.
4. familiarize with automotive lighting, electrical accessories, and HVAC systems, enabling them to understand their operation, maintenance, and troubleshooting in modern vehicles.

UNIT-I — **11 Hrs.**

STORAGE BATTERY: Introduction, principle of lead acid cells, construction and elements, electrolyte and their preparation, specific gravity, capacity and efficiency, battery tests, battery ratings, chemical action in cell, direction of current flow, recharging batteries, temperature effect on battery characteristics, methods of charging. Working principles of Alkaline, Nickel - Cadmium, silver - zinc battery, Lithium batteries. Battery trouble shooting. Networks and multiplexing. Other electric and electronic devices. Vehicle security systems: seat belts, air bags.

INDICATING AND WARNING DEVICES AND DASH BOARD INSTRUMENTS: Fuel gauge, oil-pressure gauge; balancing coil, thermostatic, electronic and digital gauges, water temperature gauge, speedometers; mechanical, electrical, digital. Warning lights; oil pressure, water temperature, horn, windscreen-wipers, signaling devices. Trouble shooting.

UNIT - II — **11 Hrs.**

GENERATOR / ALTERNATOR: Principle of generation of direct current, generator constructional details; commentators, principle of commutation, armature, field magnets, windings, brushes, wiring circuit of generators, types of generators, generator drives, cutout relay, ammeter. Construction of alternator, rectification, voltage regulation, testing of alternator. Alternator terminals, cooling, instrument panel. Charge indicators, charging system test, charging system service and fault diagnosis.

STARTER MOTOR AND DRIVES: Introduction**,** starting motor principle, torque and power requirements, starting motors and its characteristics. Starting motor drives. Starting system tests. Servicing starting motors. Starting motor trouble shooting.

UNIT - III	10 Hrs.

IGNITION SYSTEM: Ignition fundamentals, types of ignition systems and related components. Spark plugs; general considerations, characteristics, materials. Ignition timing; advance mechanism; centrifugal and vacuum. Ignition system tests, oscilloscope pattern. Setting ignition timing; types.

ELECTRONIC IGNITION: Pickup coil voltage pulse, high energy ignition system, electronic spark advance, optical photo diode distributor, distributors less ignition system, multiple coil ignitions, direct capacitor charge ignition. Distributor less ignition system, C.D.I, systems. Artificial intelligence.

UNIT - IV	10 Hrs.

LIGHTING AND ELECTRICAL ACCESSORIES: Introduction, principle of automobile illumination, lightings, control of head light beam, head light dazzle, fog lamps, side and taillight, brake warning light, instrument and indicator lights, ignition warning light, direction indicators, parking light, fluorescent lighting. Automatic head lamp controls, fiber optic lighting, computer control lighting, distributed lighting, head lamp aiming. Lighting system trouble shooting and recent developments; L.E.D.

VENTILATION, HEATING AND AIR CONDITIONING: Passenger compartment heater, heater controls, heated air distribution, basic refrigeration cycle: refrigerant flow control valves, refrigerants, refrigerant oil. Types of air conditioner: manually controlled, automatically controlled and electronic automatic temperature control.

Reference Books:

TEXT BOOKS:

1. Automobile Engineering, Kirpal Singh, 14th Edition,2021.

2. Automobile Mechanics , William H Crouse, 10th Edition, 2017.

3. Automotive Electrical equipments, P.L.Kohli , 1st Edition, 2017.

4. Understanding Automotive Electronics, William B. Ribbens, 8th Edition, 2017.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

Course Code		:	1BAUA003E	Automotive Emissions and Control	Semester	:	V
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply knowledge of Automotive engines and engineering chemistry to measure and control emissions in Petrol, Diesel and other alternate fuel engines..

Course Outcomes

After completion of the course, the student will be able to:

1) Analyze, interpret and compare the sources, formation and effects of various emissions in automotive engines.
2) Discuss and differentiate the influence of fuel properties on emissions.
3) Carry out the emission control measures for SI engines.
4) Evaluate the formation and controlling of emissions in CI engines.
5) Analyze and interpret the instrumentation utilized in measurement of emissions.

UNIT-I	10 Hrs.

INTRODUCTION: Historical background, Euro norms, air quality standards. Effect of air pollution: effect on humans, animals and plants. Smog formation and its effects.

GENESIS AND FORMATION OF POLLUTANTS: Vehicle emissions; sources- evaporative, blow-by and exhaust pipe. Unburnt hydrocarbons, carbon monoxide, oxides of nitrogen, particulate emission of both SI and CI engines. Diesel smoke; types and reasons of smoke, mechanism of smoke formation. Thermodynamics state of burned gases, flame quenching combustion chamber deposits, soot and particulate formation, characteristics and composition of particulates. Effect of engine design and operating variables. Emission test procedures and standards: test cycles for light and medium duty vehicles, USEPA emission test cycles, European emission test procedure, types of emission driving cycle, motor cycle emission standards.

UNIT - II	10 Hrs.

INFLUENCE OF GASOLINE AND DIESEL PROPERTIES ON EMISSION: Properties like density, olefin and aromatic content, volatility, octane number, additives, viscosity, distillation interval, cetane number, sulphur content on emissions. Emission control methods: Evaporative emission control; charcoal canister. Positive Crankcase Ventilation (PCV).

EXHAUST EMISSION CONTROL: Design modifications: lean burn strategies, compression ratio, cylinder size and combustion chamber shape, variable valve timing and lift, variable swept volume, downsizing and pressure charging, faster warm-up, heated air systems. Exhaust Gas Recirculation(EGR); control and related systems

UNIT - III	10 Hrs.

ADD-ON SYSTEMS FOR TREATMENT OF EMISSION WITHIN ENGINE: Air injection, thermal reactor, catalytic converter. Catalytic converter: catalysts, substrate, converter housing, oxidation and reduction catalyst, two and three way converter. Catalyst technology for control of cold start, catalyst and poisoning. Gasoline direct injection stratified charge engines; air motion and mixture formation in the cylinder, fuel injection and air fuel ratio control, emissions of gasoline direct injection engines. OBD systems.

UNIT - IV	10 Hrs.

INSTRUMENTATION FOR POLLUTION MEASUREMENT: NDIR analyzers, gas chromatograph, Orsat apparatus, flame ionization detectors, chemilumiscence, smoke measurement; principle, Hartridge and Bosch smoke meter.

CI ENGINE EMISSION CONTROL TECHNOLOGY: Fuel injection variables, high injection pressures, high pressure distributor pumps, electronic unit injectors, common rail fuel injection systems, EGR, turbo charging, catalytic treatment, Diesel Particulate Filters (DPF); material, substrates, diesel exhaust after treatment with metal substrates.

Reference Books

1) Theory of IC engines: Mathur and Sharma.
2) Automotive Mechanics: William H Crouse.
3) Engine Emissions: P.B.Pundir

Additional Learning Resources:

1) https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAU1306.pdf
2) https://www.youtube.com/watch?v=V83pI7WbSpM&t=23
3) https://www.acea.auto/files/WWFC_19_gasoline_diesel.pdf
4) https://dieselnet.com/tech/engine_emission-control.php
5) https://www.youtube.com/watch?v=BsJEBRdjGZw
6) https://shaktifoundation.in/wp-content/uploads/2022/08/Remote-Sensing.pdf

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3											3	1	1
CO2	3	1										3	1	1
CO3	3		1									3	1	1
CO4	3	1										3	1	1
CO5	3	1		1								3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

	Program Outcomes and (WKs)											PSOs		
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	**3 (WK1, WK2, WK3, andWK4)**	**2(WK1, WK2, WK3, and WK4)**	**2 (WK5)**					**1**			**1 (WK8)**	**2**	**3**	
CO2	**3 (WK1, WK2, WK3, andWK4)**	**2 (WK1, WK2, WK3, and WK4)**	**3(WK5)**		**3 (WK6)**	**1 (WK1, and WK7)**	**1(WK9)**	**1**	**1**		**1 (WK8)**	**2**	**3**	
CO3	**--**	**2 (WK1, WK2, WK3, and WK4)**	**3 (WK5)**		**3(WK 6)**	**1 (WK1, and WK7)**		**1**	**1**		**1(WK8)**	**2**	**2**	
CO4	**3 (WK1, WK2, WK3, andWK4)**	**2 (WK1, WK2, WK3, and WK4)**	**2 (WK5)**			**-**		**1**	**1**		**1 (WK8)**	**3**	**3**	

	Course Code	:	1BAUA504P	MINI PROJECT	Semester	:	V
	L: T:P	:	0:0 :2		Course Type	:	Mini Project
Hours/Sem.	Teaching(Contact Hours)	:	56Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	00Hrs.		SEE Marks	:	50
	Exam	:	04Hrs.		Total Marks	:	100
	Total Hrs.	:	60 Hrs.		Credits	:	02

Professional Competency:

Develop the ability to identify, analyze, design, implement, and evaluate engineering solutions to real-world Engineering problems in automobile domain through project-based learning while demonstrating teamwork, project management, communication, and professional ethics.

Course Outcomes:

After completion of the course student will be able to:

CO1. **Apply** engineering principles, modern engineering tools, and appropriate methodologies to identify and formulate a real-life problem.

CO2. **Analyze** alternative engineering solutions using appropriate analytical, computational, experimental, to develop a feasible solution.

CO3. **Evaluate** the effectiveness, feasibility, sustainability, and practical implications of the developed solution considering technical, economic, environmental, and societal aspects.

CO4. **Demonstrate** effective project planning, teamwork, technical documentation, presentation, and communication skills while executing and presenting the mini project.

	56 Hrs.

Number of students per batch: Maximum2

CIE Evaluation

Evaluation : 15 Marks

Review : 15 Marks

Guide : 20 Marks

Evaluations will be done by a department committee consisting of

- HOD or his Nominee
- Guide
- Project Coordinator

SEE Evaluation

Students have to submit project diary.

The evaluation of the SEE will be based on write-up (10marks) +Demo (15marks) +Presentation (15marks) and Viva- Voce(10marks)

Evaluation Committee

- HOD or his nominee
- External Examiner
- Project Coordinator

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Course Outcomes (Cos)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3(WK2, WK3)	3(WK2, WK3)	–	2(WK4)	3(WK6)	–	–	–	–	–	2(WK6)	3	3	–
CO2	2(WK3)	3(WK3, WK4)	2(WK4)	3(WK4, WK6)	2(WK6)	–	–	–	–	–	2(WK6)	3	3	–
CO3	2(WK4)	3(WK4, WK5)	3(WK5)	3(WK5)	2(WK6)	2(WK7)	2(WK7)	2(WK8)	–	–	3(WK5, WK6)	3	3	–
CO4	2(WK4)	2(WK4)	2(WK5)	2(WK5)	2(WK6)	–	–	2(WK8)	3(WK8)	3(WK8)	3(WK5, WK8)	3	3	–

Scheme of evaluation for Mini-Project,

Rubrics for Project V Semester

SEMESTER V

Rubrics for	Phase	Period (Duration)	Rubric #	Marks	Evaluation by
	Evaluation-I	**Before first one and**	**R1**	**15**	**Committee consisting of**

CIE		**half month in V semester of BE Program**			**HOD/Nominee + Project Coordinator/Nominee of Project Coordinator + Guide(s)**
	Evaluation-II	**Before 15 days from the last working day of V semester of BE Program**	**R2**	**15**	
	Evaluation by guide	**In the last week of working days of V semester**	**R3**	**20**	**Guide(s)**
SEE	**Semester End Examination**	**During SEE of V semester of BE Program**	**R4**	**50**	**Committee consisting of HOD/Nominee + External Examiner**

The evaluation criteria may vary *marginally* (maximum of 5%) from the perspective of different disciplines but the structure/stages of evaluation and allotted marks for each stage of evaluation in 7th or 8th semesters must be same for all the branches across the institute.

R1. Synopsis presentation (Before the end of the first one and half months in the V semester of the BE Program): Total Marks of 15

Evaluation Criteria	Score/Marks			Total Marks	Evaluation By
	Poor (Needs Improvement) (1)	Average (Acceptable) (2)	Very good (Proficient) (3)		
Motivation And Rationale behind the project	• Less motivated and has less desire to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish a work towards expectations in a challenging and interesting area is not good	• Moderately motivated and has some interest to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish work towards expectations in a challenging and interesting area is okay and acceptable	• Highly motivated and desirous to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish work towards expectations in a challenging and interesting area is good	15	Committee consisting of HOD/Nominee +Project Coordinator + Guide(s) Each will be evaluated for 15 marks and the average of all three is the marks awarded
Literature review	• Less than 3 technical papers are reviewed and less relevant	• Three to five technical papers are reviewed and moderately relevant	• More than 5 technical papers from reputed journals are made and reviews are quite relevant to the project work		

Objectives, Project plan	• Only some objectives of the proposed work are well defined and ill-defined project plan	• Incomplete justification to the objectives proposed and moderately defined project plan	• Good justification to the objectives and well-defined project plan		
Proposed methodology	• Division of project work into modules but improper selection of design approaches and design methodology and not properly justified	• Division of project work into modules with proper selection of design approaches and design methodology but not properly justified	• Division of project work into modules and good selection of design approaches, appropriate design methodology with proper justification		
Presentation	• Contents of presentations are not appropriate and not well arranged • Very less eye contact and unclear voice	• Contents of presentations are appropriate but not well arranged • Eye contact with few people and unclear voice	• Contents of presentations are appropriate and well arranged • Satisfactory demonstration, clear voice with good spoken language and good non-verbal communication		

R2. Project Complete presentation (Before 15 days of the endof the Last month in the V semester of the BE Program): Total Marks of 15

Evaluation Criteria	Score/Marks			Total Marks	Evaluation By
	Poor (Needs Improvement) (1)	**Average (Acceptable) (2)**	**Very good (Proficient) (3)**		
Involvement in the work and ability to work in a team	• Less involved in the work	• Would have involved still more	• Sincerely involved in the work and very hard working and has good interest	15	Committee consisting of HOD/Nominee +Project Coordinator + Guide(s) Each will be evaluated for 15 marks and the average of all three is the
Incorporation of Suggestions made in the	• Some changes are made as per	• All major changes are made as per modifications suggested	• Changes are made as per modification		

previous review	modifications suggested during previous evaluation	during previous evaluation	s suggested during previous evaluation and good justification		marks awarded
Results and Discussion	• Results are not presented properly, Project work is not summarized and concluded • Future extensions in the project are not specified	• Results presented are not much satisfactory, Project work summary and conclusion not very appropriate • Future extensions in the project are not specified	• Results are presented in good manner, Project work summary and conclusion not very appropriate • Future extensions in the project are specified		
Demonstration / Conclusion	• Modules are not in proper working form that further leads to failure of integrated system, Contents of presentations are not appropriate and not well delivered	• Modules are working well in isolation and properly demonstrated, Modules of project are not properly integrated, Contents of presentations are appropriate but not well delivered	• Each module working well and properly demonstrated, Integration of all modules done and system working is very satisfactory		
Presentation	• Contents of presentations are not appropriate and not well arranged • Very less eye contact and unclear voice	• Contents of presentations are appropriate but not well arranged • Eye contact with few people and unclear voice	• Contents of presentations are appropriate and well arranged • Satisfactory demonstration, clear voice with good spoken language and good eye contact		

R3: Evaluation by the guide (In the last week of working days of VII semester): Total Marks of 20

Evaluation Criteria	Score/Marks				Total Marks	Evaluated by
	Needs improvemen	Acceptable (Average)	Satisfactory (Good)	Proficient (Excellent)		

	t (Poor) (2)	(3)	(4)	(5)		
Technical Knowledge gained through project work	• Poor knowledge and no awareness related to project	• Lacks sufficient knowledge and Awareness	• Fair knowledge and awareness related to the project	• Extensive knowledge and awareness related to the project	**20**	**Guide(s)**
Regularity and Attendance	• Irregular and inconsistent in work	• Reports to the guide but lacks Consistency	• Reports to the guide very often but not very consistent	• Reports to the guide regularly and consistent in work		
Incorporation of Suggestions made periodically	• Major changes are not made as per modifications suggested	• Few changes are made as per modifications suggested	• Changes are made as per modifications suggested	• Changes are made as per modifications suggested and innovations are added		
Organization and structure of Project Report	• Project report not prepared according to the specified format, References and citations are not appropriate	• Project report is according to the specified format but some mistakes, Insufficient references and citations	• Project report is according to the specified format, References and citations are appropriate but not mentioned well	• Project report is according to the specified format, References and citations are appropriate and well mentioned		

R4: SEE Evaluation for Project Phase(During SEE of V semester of BE Program): Total Marks of 50

Evaluation Criteria	Score				Total Marks	Evaluation By
	Needs improvement (Poor) (4)	Acceptable (Average) (6)	Satisfactory (Good) (8)	Proficient (Excellent) (10)		
Presentation	• Contents of presentations are not appropriate and not well delivered, Poor eye contact with audience and unclear voice	• Contents of presentations are appropriate but not well delivered, Eye contact with only few people and unclear voice	• Contents of presentations are appropriate and well delivered, Clear voice with good spoken language but less eye contact with audience	• Contents of presentations are appropriate and well delivered, Proper eye contact with audience and clear voice with good spoken language	50	Internal Examiner + External Examiner Each will evaluate for 50 marks and average of two will be taken
Designs and implementation	• Proper design	• Proper design	• Proper design	• Proper design		

	methodology is not followed resulting into poor design ,No modern tools are used to implement , Work contributes very less to the world	methodology is followed, Design lacks, very less modern tools are used to implement , the work contributes to the world in little way	methodology is followed, Design is done but not perfect, few modern tools are used to implement , the work contributes to the world in some way	methodology is followed, Design is perfect, Modern tools are used to implement , the work contributes to the world in greater way		
Results and Demonstration	• Some of the defined objectives are achieved • Modules are not in proper working form that further leads to failure of integrated system	• All defined objectives are achieved • Modules are working well in isolation and properly demonstrated • Modules of project are not properly integrated	• All defined objectives are achieved and working well and demonstrated • Integration of all modules done and system working is not very satisfactory	• All defined objectives are achieved and evident from the results • Each module working well and properly demonstrated • All modules of project are well integrated and system working is accurate		
Project report	• Project report not prepared according to the specified format • References and citations are not appropriate	• Project report is according to the specified format with mistakes • In-sufficient references and citations	• Project report is according to the specified format • References and citations not mentioned well	• Project report is according to the specified format • References and citations are appropriate and well mentioned		
Viva - Voce	• Answered	• Answered	• Answered	• Answered		

	25% of questions related to design, implementation and applications of project work	50% of questions related to design, implementation and applications of project work	75% of the questions related to design, implementation and applications of project work	more than 90% of the questions related to design, implementation and applications of project work		

Course Code		:	1BAUA601C	**Automotive Engine Component Design**	Semester	:	V
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the principles of design of machine elements and mechanics of materials to analyze and solve design problems in Automotive engine and its components.

UNIT-I **10 Hrs.**

ENGINE SELECTION CRITERIA: Road, wind and gradient resistance, starting torque, load-speed characteristics, expectancy curves and performance curves.

CARBURETION: Air-fuel ratio, throat diameter, air and fuel flow rate, change in air-fuel ratio at altitude, velocity of air at venture throat, pressure drop, mass flow of fuel.

INJECTION: Injection in CI engines; volume of fuel injected, velocity and duration of injection, orifice area of injector, pressure difference.

DESIGN OF CYLINDER BLOCK, CRANK CASE AND CYLINDER HEADS: Cylinder heads, gaskets, cylinder wear, water jacket, cylinder liners, crank case, oil sumps and cooling features.

Engine mountings, front and rear mountings, type of engine blocks, manifolds; types, inlet and exhaust manifolds, dual manifolds, design of manifolds, mufflers; types, design.

UNIT - II **10 Hrs.**

DESIGN OF CYLINDER BLOCK, CRANK CASE AND CYLINDER HEADS: Cylinder heads, gaskets, cylinder wear, water jacket, cylinder liners, valve seats. Crank case - general form of crank case, oil sumps and cooling features, flywheel mountings, engine mountings, front and rear mountings. Production of engine blocks, manifolds and mufflers - inlet and exhaust manifolds, mixture distribution, heating by exhaust gas, dual manifolds, general design of manifolds, effect of firing order, mufflers, general design.

DESIGN OF PISTON, PISTON RINGS, PISTON PIN: Piston temperatures, piston slap, compensation of thermal expansion in pistons. Piston rings, forms of gap, stresses in piston rings, ring collapse, heat treatment, piston ring selection, shape. Piston pin, locking of piston pins, length of piston

UNIT - III **10 Hrs.**

DESIGN OF CONNECTING ROD: Length of rod, cross section, buckling, drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials, lubrication.

DESIGN OF CRANK SHAFT: Balance weights, local balance, crankshaft proportions, oil holes drilled in crank shafts, balancing and torsional vibration analysis, vibration dampers, firing order, bearings, lubrication

UNIT - IV **10 Hrs.**

DESIGN OF FLYWHEEL: Necessity, capacity, mounting of flywheels, coefficient of fluctuation of speed, fluctuation of energy, maximum fluctuation of energy, energy stored in a flywheel, stresses, construction.

DESIGN OF VALVE AND VALVE MECHANISM: Angle of seat, operating conditions, operating

temperatures, valve cooling, sodium cooled valves, valve rotators, valve seats, valve guides, valve springs, valve clearance, valve timing, OHV, OHC, dual valves, types of valve operating mechanisms. Valve train component details, camshaft, drives of cams, cam types, tappets, automatic zero clearance tappets, push rods, rocker arms and rocker shaft
Reference Books
1. High Speed Engines - P.M.Heldt, Oxford & IBH, 1965 2. Auto Design – R.B Gupta, SatyaPrakashan, New Delhi 2002 3. Automotive mechanics- N.K. Giri
Additional Learning Resources:
Course Outcomes **After completion of the course, the student will be able to:**
1) Estimate and analyze the expectancy curves and compare with performance curves.
2) Design a cylinder head, block and valves with live time approach
3) Select a suitable piston, connecting rod, crank shaft and flywheel with live time approach.
4) Recommend a suitable crank shaft and flywheel for given applications
5) Develop valve configurations for various applications

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1									3	1	1
CO2	3	3	1									3	1	1
CO3	3	3	1									3	1	1
CO4	3	3	1									3	1	1
CO5	3	2	1									3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK 4)	3 (WK1, WK2, WK3 andWK 4)	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	2 (WK5)	3 (WK8)	-	2 (WK1, WK5, WK7)	-	-	-	-	1	3	3	-
CO3	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	2 (WK2, WK6)	-	-	-	-	-	2	2	3	-
CO4	1 (WK1, WK2, WK3 andWK 4)	2 (WK1, WK2, WK3 andWK 4)	3 (WK5)	3 (WK8)	1 (WK2, WK6)	-	-	-	-	-	1	3	2	-

Course Code		:	1BAUA602C	Autotronics	Semester	:	V
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply the knowhow of vehicular systems and electronics engineering to analyze and electronic control systems used in Automotive chassis and engines.

Course Outcomes

After completion of the course, the student will be able to:

1) Justify the need of Autotronic systems and explain the construction of various electronically controlled chassis and vehicle safety systems.
2) analyse the working of electronic control systems used in modern automobiles
3) apply the knowledge of working of various sensors in the control of vehicular systems
4) compare the working of programmed control systems with conventional vehicular control systems
5) prepare block diagrams of autotronic systems used in automotive comfort, safety and security systems

UNIT-I	10 Hrs.

INTRODUCTION: Need for electronics in automotive control systems, structure of vehicle electronics systems, common features of vehicle systems, measurement system, sensors and actuators.

INTRODUCTION TO ELECTRONICS: Electronic components, diodes, transistors, electronic circuits, analog circuits, digital circuits, integrated circuits, microprocessor systems, systems approach to control and instrumentation.

UNIT - II	10 Hrs.

ELECTRONIC IGNITION SYSTEMS: Types of ignition systems, conventional ignition system, CDI, programmed ignition system, distributor-less ignition system, direct ignition.

ELECTRONIC FUEL CONTROL: Electronic control of carburetion, petrol injection system, single and multi-point injection system, components, flow diagram, diesel fuel injection

UNIT - III	10 Hrs.

ENGINE MANAGEMENT SYSTEM: Combined ignition and fuel management system, exhaust emission control, digital control techniques, complete vehicle control systems, artificial intelligence and engine management.

CHASSIS ELECTRICAL SYSTEMS: Anti-lock brakes, active suspension, traction control, electronic control of automatic transmission

UNIT - IV	10 Hrs.

ELECTRONICS FOR COMFORT, SAFETY AND SECURITY: Electric seats, mirrors and sun-roof operation, central looking and electric windows, cruise control, In Car Entertainment (ICE) and

communications, adaptive noise control, airbags and seatbelt tensioners, obstacle avoidance radar, security systems - engine immobilizer, ICAT

Reference Books

1. Automotive electrical and electronic systems: Tom Denton, 3rd edition, SAE International
2. Automotive electronics: Eric Chowanietz, Newnes, 1995.
3. Understanding automotive electronics, William B Ribbens, Butterworth-Heinemann.
4. Automotive Electrics Automotive Electronics, Robert Bosch.

Additional Learning Resources:

2. https://dev.anvthub.jo/wp-content/uploads/2024/11/Bosch-Automotive-Electrics-and-Automotive-Electronics_-Systems-and-Components-Networking-and-Hybrid-Drive-PDFDrive.com-.pdf
3. https://nibmehub.com/opac-service/pdf/read/Automobile%20Electrical%20and%20Electronic%20Systems-%203rd%20edition.pdf
4. https://www.acma.in/uploads/publication/annual-report/Automotive-Electronics-Study.pdf
5. https://www.researchgate.net/publication/339795701_Introduction_to_Automotive_Electrical_and_Electronic_Systems
6. https://www.ueen.fekt.vut.cz/sites/default/files/inline-files/20221121_introduction_to_automotive_electronics_brno_university_hirz_0.pdf

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3		1			1						3	1	1
CO2	3		1			1						3	1	1
CO3	3		1			1						3	1	1
CO4	3		1			1						3	1	1
CO5	3		1			1						3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, and WK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

Course Code		:	1BAUA603C	Hybrid and Electric Vehicles	Semester	:	VI
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will develop the ability to analyze, design, and evaluate electric and hybrid electric vehicle systems by applying principles of electrical engineering, electric drives, battery technologies, and vehicle dynamics. Acquire the competence to select appropriate EV components, assess vehicle performance and safety, and contribute effectively to the development and deployment of sustainable transportation technologies.

Course Outcomes:

After completion of the course, the student will be able to:

1) **Explain** the fundamentals of electric vehicles, their classification and compare different battery technologies used for EVs.
2) **Analyze** the operation, characteristics, and control of electric traction motors and **compare** their suitability for EV applications.
3) **Evaluate** different hybrid electric vehicle power train architectures, operating modes, and hybrid drive structures, and **compare** the performance with ICE vehicles.
4) **Apply** vehicle design principles and vehicle dynamics concepts to **estimate** tractive effort, vehicle performance, and identify battery requirements for different class of electric vehicle.

1) UNIT-I	11 Hrs.

Electric Vehicles History, Basics of Electric Vehicles ,Components of Electric Vehicle, General Layout of EV, EV classification : Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs), Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EVs, National Policy for adoption of EVs

Batteries: Lead Acid, Nickel-Cadmium and Lithium Ion batteries, working, merits and demerits. Comparison of different batteries, battery parameters and their significance.

UNIT - II	11 Hrs.

Drives and controls: Drive classification: Principle and working of PMDC motor, BLDC motor. Characteristics (Speed torque characteristics) and control features of PMDC motor,

PMSM motors, working and applications. Comparison and advantages. Converters Principle and logic: AC-DC, DC-AC, DC-DC and AC-AC. Four quadrant operation. Induction motors, working principle, advantages as traction motors.

UNIT - III	10 Hrs.

HYBRID DRIVE STRUCTURES: Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive(electrical coupling), parallel hybrid electrical drive train(mechanical coupling),

Parallel hybrid drive train with torque coupling, power split hybrid drive, speed coupling, hybrid drive train with torque and speed coupling. Control of hybrid vehicles.

UNIT - IV	10 Hrs.

Energy Management Strategies Hybrid and Electric Vehicles: Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy strategies. Plug-in electric vehicles, Vehicle to grid (V2G) and G2V fundamentals.

VEHICLE DESIGN AND SAFETY: Effect of battery weight and volume, designing for minimum weight, safety of batteries, safety of alternative energy generating and storage systems, safety of other electrical systems, general design and safety issues, heating and air conditioning, auxiliary power subsystem, braking, suspension and wheel systems

Reference Books:

TEXT BOOKS:

1. Electric and Hybrid vehicles – Pistoia, Elsevier, 1st Edition, 2016.

REFERENCE BOOKS:

1. Electric and Hybrid vehicles – IqbalHussain, CRC Press, Special Indian Edition, 2023.
2. Electric and Hybrid vehicles – James D Halderman, Pearson,Inadian Edition, 2023.
3. Electric and Hybrid Vehicles, Tom Denton, Routledge,2016.

Additional Learning Resource:

1.https://mrcet.com/downloads/digital_notes/EEE/Electrical%20&%20Hybrid%20Vehicles%20Digital%20Notes.pdf
2.https://annamacharyauniversity.edu.in/wp-content/uploads/2025/10/9.-Hybrid-Electric-Vehicle.pdf
3.https://mace.ac.in/wp-content/uploads/2025/07/ELECTRIC-HYBRID-VEHICLES.pdf

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

Course Code		:	1BAUA604C	CAD/CAM	Semester	:	VI
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Student can demonstrate competency in applying CAD/CAM principles, computer graphics, robotics, and CNC technologies to modern design and manufacturing systems. Possesses the ability to develop and interpret CAD models, CNC programs, and finite element analysis solutions while integrating computer-aided tools for efficient product design, manufacturing, and automation. Capable of utilizing industry-standard hardware, software, and data exchange standards to enhance productivity, accuracy, and quality in engineering applications.

Course Outcomes:

After completion of the course, the student will be able to:

1. Understand the role of computers in modern design and manufacturing systems and familiarize students with CAD/CAM concepts and associated hardware components.
2. Develop knowledge of computer graphics, geometric modeling techniques, CAD/CAM data exchange standards, and the fundamentals of industrial robotics.
3. Introduce the NC, CNC, and DNC technologies, CNC tooling systems, and CAM-based machining processes used in advanced manufacturing.
4. Develop CNC part programs and understand the fundamental concepts and applications of Finite Element Analysis in engineering design.

UNIT-I — 11 Hrs.

INTRODUCTION: Role of computers in design and manufacturing. Influence of computers in manufacturing environment. Product cycle in conventional and computerized manufacturing environment. Introduction to CAD, Introduction to CAM. Advantages and disadvantages of CAD and CAM.

HARDWARE FOR CAD: Basic hardware structure, working principles, usage and types of hardware for CAD - Input devices, output devices, memory, CPU, hardcopy and storage devices.

UNIT - II — 11 Hrs.

COMPUTER GRAPHICS: Software configuration of a graphic system, function of graphics package, construction of geometry, wire frame and solid modeling, geometry transformation - two dimensional and three dimensional transformation, translation, scaling, reflection, rotation, CAD/CAM integration. Desirable modeling facilities. Introduction to exchange of modeling data - basic features of IGES, STEP, DXF, DMIS.

INTRODUCTION TO ROBOTICS: Introduction, robot configuration, robot motion, programming of robots, end effectors work cell, control and interlock, robot sensor, robot applications.

UNIT - III — 10 Hrs.

NC, CNC, DNC TECHNOLOGIES: NC, CNC, DNC, modes, NC elements, advantages and limitations of NC, CNC. Functions of computer in DNC.

CNC TOOLING: Turning tool geometry, milling tooling system, tool presetting, ATC, work holding.

CAM PROGRAMMING: Overview of different CNC machining centers, CNC turning centers, high speed machine tools.

UNIT - IV	10 Hrs.

CNC PROGRAMMING: Part program fundamentals, steps involved in development of a part program. Manual part programming, milling, turning, turning center programming.

INTRODUCTION TO FINITE ELEMENT ANALYSIS: Introduction, basic concepts, discretization, element types, nodes and degrees of freedom mesh generation, constraints, loads, preprocessing, application to static analysis.

Reference Books:

TEXT BOOKS:

1. CAD/CAM Principles and Application - by P.N. Rao, Tata McGraw Hill.

2. CAD/CAM - by Groover, Tata McGraw Hill.

REFERENCE BOOKS:

1. Introduction to the Design and Analysis of Algorithms– S.E. Goodman, S.T. Headetmiemi, McGraw Hill Book Company – 1988.
2. Principles of Interactive Computer Graphics - by Newman and Sproull, Tata McGraw Hill, 1995.

3. NCMachine Programming and Software Design – Chno- Hwachang, Michel. A. Melkanoff, Prentice Hall, 1989.

4. Numetical Control and CAM - Pressman RS and Williams JE, Johnwiley.

5. Computer Graphics by Steven Harrington, McGraw Hill Book Co.

6. CAD-CAM - by Chris McMahon & Jimmie Browne – Pearson education Asia 2001.

7. CAD/CAM – Ibrahim Zeid, Tat McGraw Hill, 1999.

8. Computer Aided Manufacturing - by P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 1999.

9. Introduction to FEM - T Chandra patta Ashok D Bebgundu.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

Course Code		:	1BAUA022E	Hydraulics and Pneumatics	Semester	:	VI
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:	
Students will apply the fundamentals of fluid mechanics electrical & electronics engineering to analyze and design hydraulic, pneumatic operated by mechanical and electrical control systems.	
Course Outcomes	
1. To draw block diagram and explain working principles of fluid power systems	
2. To analyze given hydraulic and pneumatic circuits	
3. To compute dimensions of various hydraulic and pneumatic components using analytical equations	
4. To design basic hydraulic and pneumatic circuits for a given application	
5. To design electro-hydraulic and electro-pneumatic circuits for a given application	
UNIT-I	**10 Hrs.**
INTRODUCTION TO HYDRAULIC POWER:Pascal's law and problems on Pascal's law, continuity equations, introduction to conversion of units. Structure of hydraulic control system. **SOURCE OF HYDRAULIC POWER**: Pumps; pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. **HYDRAULIC ACTUATORS AND MOTORS**: Linear hydraulic actuators [cylinders], mechanics of hydraulic cylinder loading, hydraulic rotary actuators, gear motors, vane motors, piston motors, hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.	
UNIT - II	**10 Hrs.**
CONTROL COMPONENTS IN HYDRAULIC SYSTEMS:Directionalcontrol valves - symbolic representation, constructional features, pressure control valves - direct and pilot operated types, flow control valves. **HYDRAULIC CIRCUIT DESIGN AND ANALYSIS**:Control of single and double - acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counter balance valve application, hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.	
UNIT - III	**10 Hrs.**
MAINTENANCE OF HYDRAULIC SYSTEMS: Hydraulic oils -desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.	

INTRODUCTION TO PNEUMATIC CONTROL: Choice of working medium, characteristics of compressed air. Structure of pneumatic control system.

PNEUMATIC ACTUATORS: Linear cylinders-types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod - less cylinders - types, working advantages. Rotary cylinder types construction and application. Design parameters - selection.

UNIT - IV	**10 Hrs.**

DIRECTIONAL CONTROL VALVES:Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve.Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Signal processing elements: Use of logic gates - OR and AND gates pneumatic applications. Practical examples involving the use of logic gates.

MULTI-CYLINDER APPLICATIONS:Coordinated and sequential motion control. Motion and control diagrams-signal elimination methods. Electro-pneumatic control:principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Compressed air:production of compressed air compressors, preparation of compressed air driers, filters, regulators, lubricators, distribution of compressed air piping layout.

Reference Books

1) Fluid Power with applications: Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2) Pneumatics and Hydraulics: Andrew Parr. Jaico Publishing Co. 2000.
3) Oil Hydraulic Systems – Principles and Maintenance: S.R. 2002 Majumdar, Tata McGraw Hill publishing company Ltd. 2001.

Additional Learning Resources:

1. https://media.defense.gov/2014/Jun/20/2002655903/-1/-1/1/140620-N-ZZ182-6549.pdf
2. https://staff.tiiame.uz/storage/users/4/books/c58rEgNUMCwDoa7brXWUFiOpwoBiumzlqS2FqXsY.pdf
3. https://digitalmedia.sheffield.ac.uk/media/Introduction+to+Hydraulics++Pneumatics/1_0u9onk9h/95899281
4. https://www.youtube.com/watch?v=Nq5d6qHlLOE
5. http://amrita.digimat.in/nptel/courses/video/112105047/L15.html

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2		1									3	1	1
CO2	2	2	1	2								3	1	1
CO3	3	3	2	2								3	1	1
CO4	2	2	2	1								3	1	1
CO5	1	2	2									3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, and WK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

1BAUA605L	COMPUTER AIDED ENGINEERING LAB	Credits: 01
L:T:P -0: 0: 2		CIE Marks:50
Total Hours/Week: 02		SEE Marks:50

PART-A	20 Hrs.

1. Modeling – Introduction. Development of 2D and 3D geometric modeling using anyone parametric software. Exercises on automotive components - 3D modeling (1 – 4 components) using CATIA Software

   10 Hrs

2. Analysis – FEA (Preprocessor, solver, post processor)
   a) Exercise involving simple structures.
   b) Validation of result with analytical solution.

   10 Hrs

PART-B	10 Hrs.

3. Introduction to CNC programming (G codes & M codes) a) Turning b) Milling Simple Exercises (2 – 4 Nos.) using CNC Simulator.

   10 Hrs

SCHEME OF EXAMINATION

Laboratory Assessment:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)

2. Allocation of 50 marks for CIE

Performance and journal write-up :

Marks for each experiment = 30 marks / No. of proposed experiments.

One Lab CIE for 20 marks. (5 marks write-up + 10 marks conduction + 5 marks viva-voce).

3. Allocation of 50 marks for SEE (20 marks Write-up + 20 marks conduction + 10 marks Viva Voce) (The write up shall include two questions, One from Part A and and Another from Part B) (Conduction includes question from 1)

Write Up	: 20 Marks
Conduction	: 20 Marks
Viva-voice	: 10 Marks

Total marks : 50 Marks

Course Outcomes

After completion of the course student will be able to:

1.Develop 2D sketches and 3D parametric models of engineering and automotive components using CATIA or equivalent CAD software.

2.Apply Finite Element Analysis (FEA) procedures, including preprocessing, solving, and post-processing, to analyze simple engineering structures and validate numerical results with analytical solutions.

3.Generate and simulate basic CNC part programs using G-codes and M-codes for turning and milling operations using a CNC simulator.

4.Integrate CAD, CAE, and CNC concepts to model, analyze, and manufacture simple engineering components using modern engineering software tools

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1									3	1	2
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1									3	1	2
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1									3	1	2
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	1									3	1	2

Course Code		**:**	**1BHSA701C**	**Entrepreneurship and Management**	**Semester**	**:**	**VII**
L:T:P		**:**	**3: 0 :0**		**Course Type**	**:**	**Theory (HSMC)**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:	
Students will be able to apply fundamental management principles and functions, including planning, organizing, staffing, directing, and controlling, to support effective decision-making and organizational performance. They will develop entrepreneurial and project management competencies by identifying business opportunities, evaluating project feasibility, preparing project reports, and utilizing institutional support mechanisms for enterprise development and small-scale industry growth.	
Course Outcomes:	
After completion of the course, the student will be able to: 1. Understand the fundamental concepts, principles and functions of management, and significance of the planning process and decision-making in effective organizational management. 2.Realize organizational structure, staffing processes, leadership, motivation, communication, coordination, and control mechanisms, which enables to manage organizational activities to achieve business objectives. 3. Provide students with a comprehensive understanding of entrepreneurship and small-scale industries, including policies and support systems, and the role of SSI in promoting industrial growth and employment. 4. Develop students' understanding of institutional support systems for entrepreneurs and small industries, and skills required for assessing project feasibility for entrepreneurial success.	
UNIT-I	**11 Hrs.**
MANAGEMENT: Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of management - Management as an art or science, art or profession Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches. **PLANNING:** Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning only) - Decision making – Importance of planning - steps in planning & planning premises - Hierarchy of plans.	
UNIT - II	**11 Hrs.**
ORGANISING AND STAFFING: Nature and purpose of organization -Principles of organization - Types of organization - Departmentation -Committees – Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of Staffing - Process of Selection & Recruitment (in brief). **DIRECTING & CONTROLLING**: Meaning and nature of directing - Leadership styles, Motivation Theories, Communication - Meaning and importance – Coordination, meaning and importance and	

Techniques of Co - ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief)

UNIT - III	10 Hrs.

ENTREPRENEUR: Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur – an emerging Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Barriers to entrepreneurship.

SMALL SCALE INDUSTRY: Definition; Characteristics; Need and rationale: Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI – Government policy towards SSI; Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT, Supporting Agencies of Government for S.S.I., Meaning; Nature of Support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only)

UNIT - IV	10 Hrs.

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency: SISI; NSIC; SIDBI; KSFC.

PREPARATION OF PROJECT: Meaning of Project**;** Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

Reference Books:

TEXT BOOKS:

1. **Principles of Management** - P.C. Tripathi, P.N. Reddy; Tata McGraw Hill,2021

2**. Dynamics of Entrepreneurial Development & Management** - Vasant Desai ,Himalaya Publishing House 2025

3. **Small Business Enterprises** - Poornima M Charantimath – Pearson Education - 2022

REFERENCE BOOKS:

1**. Management Fundamentals** - Concepts, Application, Skill Development Robert Lusier - Thomson

2**. Entrepreneurship Development** - S S Khanka - S Chand & Co

3. **Management** - Stephen Robbins - Pearson Education /PHI -17th Edition, 2003

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, andWK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, andWK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

	Course Code	:	1BAUA702C	Vehicle Body Engineering	Semester	:	VII
	L:T:P	:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply principles and design such as aesthetics, ergonomics and structural design to analyze the forces acting on vehicle body and design vehicles with safety and comfort in mind.

Course Outcomes

1) To analyse classification, vehicle body construction, design and development of various types of vehicles and their layouts body design nomenclatures.
2) To analyse fixed and free control systems, aerodynamic styling, trimming, materials and paintings used in vehicle body design and development of various vehicles.
3) Analyse the forces and couples acting on vehicle during various running conditions.
4) Develop templates / prototypes and analyze the various aerodynamic forces and couples acting on the vehicle, pressure distribution analysis and flow visualization techniques while testing in wind tunnel.
5) To analyse and develop SFD and BMD for load distribution and stress analysis in vehicle body design.

UNIT-I **10 Hrs.**

INTRODUCTION: Classification of coachwork type: styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, commercial vehicle types, vans and pick-ups. Terms used in body building construction, angle of approach, angle of departure, ground clearance, cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, roof stick, roof longitude, rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

VEHICLE BODY MATERIALS: Properties, manufacturing methods and suitability for vehicle body constructionAluminum alloys, steel, alloy steels, plastics and composite materials, semi rigid PUR foams and sandwich panel construction. Paints and adhesives.

UNIT - II **10 Hrs.**

AERODYNAMICS: Basics,various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, study of wind tunnels, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

LOAD DISTRIBUTION: Type of body structures, vehicle body stress analysis, vehicle weight distribution, calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

UNIT - III **10 Hrs.**

INTERIOR ERGONOMICS: Introduction, seating dimensions, interior ergonomics, seat comfort, driver seat design, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, driver's visibility, methods of improving visibility, window winding mechanisms.

VEHICLE STABILITY: Introduction, longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

UNIT - IV	**10 Hrs.**

NOISE AND VIBRATION: Noise characteristics, sources of noise, noise level measurement techniques, body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

SAFETY: Impact protection basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety.

Reference Books

1) *Donald E. Malen*, "Fundamentals of Automobile Body Structure Design", 2nd edition, SAE International, 2020
2) John Fenton, "Handbook of Automotive Body and Systems Design", Wiley India Pvt Ltd, 2013
3) *A.K. Babu, "*Vehicle Body Engineering", Khanna Publishers, New Delhi, First Edition, 2021

Additional Learning Resources:

1. https://media.defense.gov/2014/Jun/20/2002655912/-1/-1/1/140620-N-ZZ182-6554.pdf
2. https://wjarr.com/sites/default/files/fulltext_pdf/WJARR-2020-0010.pdf
3. https://apps.dtic.mil/sti/tr/pdf/AD0873103.pdf
4. https://booksite.elsevier.com/samplechapters/9780750667531/9780750667531.pdf
5. https://www.youtube.com/watch?v=490_5JpAC3w

Course Outcomes	**Programme Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	3	3	1							3	1	1
CO2	3	2	3	3	2							3	1	1
CO3	3	2	3	3	2							3	1	1
CO4	3	2	3	3	2							3	1	1
CO5	3	2	3	3	2							3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, andWK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, andWK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

Course Code		:	1BAUA703C	VEHICLE DYNAMICS	Semester	:	VII
L:T:P		:	3: 0 :0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will develop the competency to analyze, evaluate, and control vibrations in vehicle systems to improve ride comfort, durability, safety, and performance. It involves applying principles of vibration theory, modeling of vehicular systems and extend the knowledge to testing, and simulation, identify vibration sources and develop effective mitigation solutions in automotive components and structures.

Course Outcomes:

After completion of the course, the student will be able to:

1. **Understand the free vibration response of single-degree-of-freedom systems under undamped and damped conditions and determine their natural frequencies and damping characteristics.**
2. **Evaluate the forced vibration behavior of single and two-degree-of-freedom systems and apply vibration isolation and modal analysis concepts to engineering applications**
3. **Apply numerical approaches to determine natural frequencies and mode shapes of multi-degree-of-freedom vibrating systems.**
4. **Analyze vehicular vibration phenomena and assess vehicle handling and steering characteristics using tyre mechanics and suspension system concepts**

UNIT-I	11 Hrs.

UNDAMPED FREE VIBRATION: Introduction, sinusoidal motion, single degree of freedom system, Newton's method, energy method and De'Alembert's principle, undamped free vibration - natural frequency of free vibration, problems.

DAMPED FREE VIBRATION: Single degree of freedom systems, different types of damping, concept of critical damping and its importance, response study of viscous damped systems for cases of under damping and over damping, logarithmic decrement, problems.

UNIT - II	11 Hrs.

FORCED VIBRATION: Single degree of freedom systems, steady state solution with viscous damping due to harmonic force solution by complex algebra, vibration isolation - transmissibility ratio, energy dissipated by damping equivalent viscous damping, structural damping, sharpness of resonance, base excitation, problems.

SYSTEMS WITH TWO DEGREE OF FREEDOM: Introduction, principle modes and normal modes, co-ordinate coupling, generalised and principle co-ordinate, free vibrations in terms of initial conditions, Lagrange's equation, semi-definite systems, applications: Vehicle suspension, dynamic vibration absorber, dynamics of reciprocating engines, problems.

UNIT - III	10 Hrs.

NUMERICAL METHODS FOR MULTI DEGREE OF FREEDOM SYSTEMS: Introduction, influence coefficients, Maxwell's reciprocal theorem, Dunkerley's method, orthogonality principle, method of matrix iteration-method of determination of all the natural frequencies using sweeping matrix and orthogonality principle,

Holzer's method for systems with free, fixed free and fixed ends, Stodola method, Rayleigh Ritz method for beam vibration.

UNIT - IV	10 Hrs.

VEHICULAR VIBRATION: Vibration due to road roughness, vibration due to engine unbalance, reciprocating and rotating unbalance, transmissibility of engine mounting vibration with two degree of freedom, compensated suspension systems forced vibration.

TYRE MECHANICS: Vehicle control - low speed cornering and static steering, steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), roll steer, compliance steer, ride steer, slip angle steer, steady state handling - lateral acceleration gain, characteristic speed, yaw velocity gain, critical speeds.

Reference Books:

TEXT BOOKS:

1. Mechanical Vibration - G.K.Grover, Nemchand& Brothers,1989
2. Mechanical Vibration – V.P.Singh, DhanpatRai& Company Pvt. Ltd., 3rd Edition, 2006.

REFERENCE BOOKS:

1. Vibration Theory Mechanical Vibrations- S.S.Rao, Pearson Edu.Inc., 4th Edition, 2003
2. Theory & Problems of Mechanical Vibration - William W. Seto, McGrawHill (schaum's outline series)
3. Problems in Automobile Mechanics - N.K.Giri, Khanna Pub.2004
4. Mechanics of Pneumatic Tyre - S.K.Clark, Prentice Hall

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAU1304.pdf
https://www.academia.edu/10008016/Vehicle_Dynamics
https://www.academia.edu/30239545/Automobile_Vibration_and_their_Control
https://www.springerprofessional.de/en/vehicle-vibrations/26615694

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO2	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO3	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1
CO4	3 (WK1, WK2, WK3 andWK4)	2 (WK1, WK2, WK3 andWK4)	2 (WK5)	-	-	-	-	-	-	-	1	3	2	1

Course Code		:	1BAUA035E	Earth Moving Equipment	Semester	:	VII
L:T:P		:	3 : 0 : 0		Course Type	:	Theory (PC)
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Students will be able to apply knowledge of Automotive chassis, powertrain and Hydraulics to analyze and design earthmover systems used in construction industry.

Course Outcomes

After completion of the course, the student will be able to:

1) List various types of earthmovers and explain their working principles and applications
2) Describe and differentiate the systems used in earth movers with conventional vehicles
3) Prepare maintenance schedules for earthmovers and tractors
4) Identify the hydraulic components and analyze hydraulic circuits used in earthmovers
5) Apply analytical methods to calculate productivity of earthmovers.

UNIT-I — **10 Hrs.**

EQUIPMENTS AND OPERATION:Different types of earth moving equipments and their applications.Dozers, loaders, shovels, excavators, scrapers, motor graders, rollers, compactors, tractors and attachments. Types of soil.

UNIT - II — **10 Hrs.**

UNDER CARRIAGE AND SUSPENSION: Tyre and tracked vehicles, advantages and disadvantages, under carriage components like tracks, roller frames, drive sprockets, track rollers, track chains and track shoes.

ENSION: Rubber spring suspension and air spring suspension.

TRANSMISSIONS AND FINAL DRIVES: Basic types of transmissions, auxiliary transmission, compound transmission, planetary transmission, constructional and working principles,hydroshift automatic transmission and retarders. Final drives; types of reductions like, single reduction, double reduction final drives and planetary final drives, PTO shaft

UNIT - III — **10 Hrs.**

HYDRAULICS: Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth anddraft control systems.

STEERING AND BRAKES: Power steering types like, linkage type power steering, semi integral power steering and integral power steering. Steering of tracked vehicles: articulated steering, clutch /brake steering system. Brakes: types of brakes like, disc brake, engine brakes etc

UNIT - IV — **10 Hrs.**

METHODS OF SELECTION OF EQUIPMENTS: Selectionof machines,basic rules of equipments including the nature of operation, selection based on typeof soil, selection based on haul distance,selection based on weather condition.

CALCULATION OF OPERATING CAPACITY: Methods of calculating operating capacity, calculation of

productivity of EMEs

Reference Books

1) Diesel equipment: volume I and II by Erich J.schulz, McGraw Hill, 1981
2) Construction equipment and its management , 1st edition, S.C. SharmaKhanna Book Publishing Company, 2019
3) Moving the Earth: Excavation Equipment, Methods, Safety, and Cost, 7th Edition,, McGraw Hill, 2018

Additional Learning Resources:

1. https://rdso.indianrailways.gov.in/works/uploads/File/WKS-R-1.pdf
2. https://vulcanhammer.net/wp-content/uploads/2017/01/fm5_434.pdf
3. https://law.resource.org/pub/in/bis/S08/is.12209.1993.pdf
4. https://dgt.gov.in/sites/default/files/2024-02/MEMM.pdf
5. https://www.liebherr.com/en-int/earthmoving/information-sales/downloads-5376846

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3											3	1	1
CO2	3	2										3	1	1
CO3	3	2	2	1								3	1	1
CO4	3	2										3	1	1
CO5	3	3	3	1								3	1	1

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, andWK4)	2(WK1, WK2, WK3, andWK4)	2 (WK5)					1			1 (WK8)	2	3	
CO2	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, and WK4)	3(WK5)		3 (WK6)	1 (WK1, and WK7)	1(WK9)	1	1		1 (WK8)	2	3	
CO3	--	2 (WK1, WK2, WK3, and WK4)	3 (WK5)		3(WK6)	1 (WK1, and WK7)		1	1		1(WK8)	2	2	
CO4	3 (WK1, WK2, WK3, andWK4)	2 (WK1, WK2, WK3, andWK4)	2 (WK5)			-		1	1		1 (WK8)	3	3	

Course Code		:	1BAUA705P	PROJECT	Semester	:	VII
L: T:P		:	0:0 :9		Course Type	:	Project
Hours/Sem.	Teaching (Contact hours)	:	0Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	294Hrs.		SEE Marks	:	50
	Exam	:	6 Hrs.		Total Marks	:	100
	Total Hrs.	:	300Hrs.		Credits	:	09

Professional Competency:

Develop the ability to identify, investigate, design, implement, validate, and communicate innovative solutions to complex Engineering problems in automobile domain by integrating engineering knowledge, modern tools, research methodologies, sustainability principles, teamwork, and project management practices.

Course Outcomes:

After completion of the course, the student will be able to:

CO1. Apply engineering principles, research methodologies, and modern engineering tools to identify, formulate, and plan the solution of a complex Industrial and Production Engineering problem.

CO2. Analyze, model, design, and implement an engineering solution using appropriate analytical, computational, experimental, and optimization techniques.

CO3. Evaluate and validate the developed solution considering technical performance, economic feasibility, sustainability, societal impact, environmental aspects, and ethical responsibilities.

CO4. Demonstrate professional competence through effective project management, teamwork, technical documentation, presentation, communication, and lifelong learning during project execution.

	252 Hrs.

Number of students per batch: Maximum4

Evaluation

Evaluation : 15 Marks
Review : 15 Marks
Guide : 20 Marks

Evaluations will be done by a department committee consisting of

- HOD or his Nominee
- Guide
- Project Coordinator

SEE:

Students have to submit project diary.

The evaluation of the SEE will be based on write-up (10marks) +Demo (15marks) +Presentation (15marks) and Viva- Voce(10marks)

Evaluation Committee

- HOD or his nominee
- External Examiner
- Project Coordinator

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3(WK2, WK3)	3(WK3, WK4)	2(WK4)	2(WK4)	3(WK6)	–	–	–	–	1	2(WK6)	3	3	2
CO2	2(WK3)	3(WK4)	3(WK4, WK5)	3(WK4, WK5)	3(WK6)	1	1	–	1	1	2(WK6)	3	3	3
CO3	2(WK4)	2(WK5)	2(WK5)	3(WK5)	2(WK6)	3(WK7)	3(WK7)	2(WK8)	1	2	3(WK5, WK6)	3	3	3
CO4	1	1	1	1	2(WK6)	1	1	2(WK8)	3(WK8)	3(WK8)	3(WK8)	3	3	2

Scheme of evaluation for Project

RUBRICS FOR PROJECT VII/VIII SEMESTER

SEMESTER VII/VIII

Rubrics for	Phase	Period (Duration)	Rubric #	Marks	Evaluation by
CIE	Evaluation-I	Before first one and half month in VII/VIII semester of BE Program	R1	15	Committee consisting of HOD/Nominee + Project Coordinator/Nominee of Project Coordinator + Guide(s)
	Evaluation-II	Before 15 days from the last working day of VII/VIII semester of BE Program	R2	15	
	Evaluation by guide	In the last week of working days of VII/VIII semester	R3	20	Guide(s)
SEE	Semester End Examination	During SEE of VII/VIII semester of BE Program	R4	50	Committee consisting of HOD/Nominee + External Examiner

The evaluation criteria may vary *marginally* (maximum of 5%) from the perspective of different disciplines but the structure/stages of evaluation and allotted marks for each stage of evaluation in 7th or 8th semesters must be same for all the branches across the institute.

R1. Synopsis presentation (Before the end of the first one and half months in the VII/VIII semester of the BE Program): Total Marks of 15

Evaluation Criteria	Score/Marks			Total Marks	Evaluation By
	Poor (Needs Improvement) (1)	**Average (Acceptable) (2)**	**Very good (Proficient) (3)**		
Motivation And Rationale behind the project	• Less motivated and has less desire to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish a work towards expectations in a challenging and interesting area is not good	• Moderately motivated and has some interest to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish work towards expectations in a challenging and interesting area is okay and acceptable	• Highly motivated and desirous to achieve a goal, accomplish a task, or work • Need for the process /product that offers viable solutions to accomplish work towards expectations in a challenging and interesting area is good	15	Committee consisting of HOD/Nominee +Project Coordinator + Guide(s) Each will be evaluated for 15 marks and the average of all three is the marks awarded
Literature review	• Less than 3 technical papers are reviewed and less relevant	• Three to five technical papers are reviewed and moderately relevant	• More than 5 technical papers from reputed journals are made and reviews are quite relevant to the project work		
Objectives, Project plan	• Only some objectives of the proposed work are well defined and ill-defined project plan	• Incomplete justification to the objectives proposed and moderately defined project plan	• Good justification to the objectives and well-defined project plan		

Proposed methodology	• Division of project work into modules but improper selection of design approaches and design methodology and not properly justified	• Division of project work into modules with proper selection of design approaches and design methodology but not properly justified	• Division of project work into modules and good selection of design approaches, appropriate design methodology with proper justification		
Presentation	• Contents of presentations are not appropriate and not well arranged • Very less eye contact and unclear voice	• Contents of presentations are appropriate but not well arranged • Eye contact with few people and unclear voice	• Contents of presentations are appropriate and well arranged • Satisfactory demonstration, clear voice with good spoken language and good non-verbal communication		

R2. Project Complete presentation (Before 15 days of the end of the Last month in the VII/VIII semester of the BE Program): Total Marks of 15

Evaluation Criteria	Score/Marks			Total Marks	Evaluation By
	Poor (Needs Improvement) (1)	**Average (Acceptable) (2)**	**Very good (Proficient) (3)**		
Involvement in the work and ability to work in a team	• Less involved in the work	• Would have involved still more	• Sincerely involved in the work and very hard working and has good interest	15	Committee consisting of HOD/Nominee +Project Coordinator + Guide(s) Each will be evaluated for 15 marks and the average
Incorporation of Suggestions	• Some changes are	• All major changes are made as per	• Changes are made as per		

made in the previous review	made as per modifications suggested during previous evaluation	modifications suggested during previous evaluation	modifications suggested during previous evaluation and good justification		of all three is the marks awarded
Results and Discussion	• Results are not presented properly, Project work is not summarized and concluded • Future extensions in the project are not specified	• Results presented are not much satisfactory, Project work summary and conclusion not very appropriate • Future extensions in the project are not specified	• Results are presented in good manner, Project work summary and conclusion not very appropriate • Future extensions in the project are specified		
Demonstration / Conclusion	• Modules are not in proper working form that further leads to failure of integrated system, Contents of presentations are not appropriate and not well delivered	• Modules are working well in isolation and properly demonstrated, Modules of project are not properly integrated, Contents of presentations are appropriate but not well delivered	• Each module working well and properly demonstrated, Integration of all modules done and system working is very satisfactory		
Presentation	• Contents of presentations are not appropriate and not well arranged • Very less eye contact and unclear voice	• Contents of presentations are appropriate but not well arranged • Eye contact with few people and unclear voice	• Contents of presentations are appropriate and well arranged • Satisfactory demonstration, clear voice with good spoken		

			language and good eye contact		

R3: Evaluation by the guide (In the last week of working days of VII semester): Total Marks of 20

Evaluation Criteria	Score/Marks				Total Marks	Evaluated by
	Needs improvement (Poor) (2)	Acceptable (Average) (3)	Satisfactory (Good) (4)	Proficient (Excellent) (5)		
Technical Knowledge gained through project work	• Poor knowledge and no awareness related to project	• Lacks sufficient knowledge and Awareness	• Fair knowledge and awareness related to the project	• Extensive knowledge and awareness related to the project	**20**	**Guide(s)**
Regularity and Attendance	• Irregular and inconsistent in work	• Reports to the guide but lacks Consistency	• Reports to the guide very often but not very consistent	• Reports to the guide regularly and consistent in work		
Incorporation of Suggestions made periodically	• Major changes are not made as per modifications suggested	• Few changes are made as per modifications suggested	• Changes are made as per modifications suggested	• Changes are made as per modifications suggested and innovations are added		
Organization and structure of Project Report	• Project report not prepared according to the specified format, References and citations are not appropriate	• Project report is according to the specified format but some mistakes, Insufficient references and citations	• Project report is according to the specified format, References and citations are appropriate but not mentioned well	• Project report is according to the specified format, References and citations are appropriate and well mentioned		

R4: SEE Evaluation for Project Phase (During SEE of VII/VIII semester of BE Program): Total Marks of 50

Evaluation Criteria	Score				Total Marks	Evaluation By
	Needs improvement (Poor) (4)	Acceptable (Average) (6)	Satisfactory (Good) (8)	Proficient (Excellent) (10)		
Presentation	• Contents of presentations are not appropriate and not well delivered, Poor eye contact with audience and unclear voice	• Contents of presentations are appropriate but not well delivered, Eye contact with only few people and unclear voice	• Contents of presentations are appropriate and well delivered, Clear voice with good spoken language but less eye contact with audience	• Contents of presentations are appropriate and well delivered, Proper eye contact with audience and clear voice with good spoken language	50	Internal Examiner + External Examiner Each will evaluate for 50 marks and average of two will be taken
Designs and implementation	• Proper design methodology is not followed resulting into poor design , No modern tools are used to implement, Work contributes very less to the world	• Proper design methodology is followed, Design lacks, very less modern tools are used to implement, the work contributes to the world in little way	• Proper design methodology is followed, Design is done but not perfect, few modern tools are used to implement, the work contributes to the world in some way	• Proper design methodology is followed, Design is perfect, Modern tools are used to implement, the work contributes to the world in greater way		
Results and Demonstration	• Some of the defined objectives are achieved • Modules	• All defined objectives are achieved • Modules are	• All defined objectives are achieved and working	• All defined objectives are achieved and evident		

	are not in proper working form that further leads to failure of integrated system	working well in isolation and properly demonstrated • Modules of project are not properly integrated	well and demonstrated • Integration of all modules done and system working is not very satisfactory	from the results • Each module working well and properly demonstrated • All modules of project are well integrated and system working is accurate		
Project report	• Project report not prepared according to the specified format • References and citations are not appropriate	• Project report is according to the specified format with mistakes • In-sufficient references and citations	• Project report is according to the specified format • References and citations not mentioned well	• Project report is according to the specified format • References and citations are appropriate and well mentioned		
Viva - Voce	• Answered 25% of questions related to design, implementation and applications of project work	• Answered 50% of questions related to design, implementation and applications of project work	• Answered 75% of the questions related to design, implementation and applications of project work	• Answered more than 90% of the questions related to design, implementation and applications of project work		