B.V.V.S.

BASAVESHWAR ENGINEERIGN COLLEGE (Autonomous)
BAGALKOT-587103
An Autonomous Institution under Visvesvaraya Technological University
Belgaum – 590014, Karnataka. India

Syllabus III & IV Semester
2018-19 (175 credits) Admitted Batch

DEPARTMENT OF AUTOMOBILE ENGINEERING

Institution Vision and Mission

Vision

To be recognized as a premier technical institute committed to developing exemplary professionals, offering research based innovative solutions and inspiring inventions for holistic socio economic development.

Mission

- To pursue excellence through student centric dynamic teaching-learning processes, encouraging freedom of inquiry and openness to change
- To carry out innovative cutting edge research and transfer technology for industrial and societal needs
- To imbibe moral and ethical values and develop compassionate, humane professionals

Department Vision and Mission

VISION

To nurture academic excellence in the field of automobile engineering with innovative and challenging attitudes to social needs.

MISSION

1. To disseminate the knowledge to build the outstanding professionals in automobile engineering through teaching learning process.

2. To develop platform for higher learning, research and industry institute interaction to face global challenges inculcated with human and social values.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	To prepare the students with knowledge in basic science and engineering to meet global challenges
PEO2	To develop the students in automotive engineering, thermal, design, manufacturing, autotronics in line with present technology
PEO3	To develop the students as entrepreneurs and encourage to pursue higher education and research

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Apply engineering basic knowledge with modern computing tools in solving problems of design, production and servicing domains
PSO2	Mould and develop engineers to serve in industries as professionals or entrepreneur
PSO3	Prepare engineers to undertake research and higher learning

PROGRAMME OUTCOMES (POs)

Sl. No	Programme Outcomes	
PO 1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/development of solutions**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SCHEME OF TEACHING AND EXAMINATION FOR THE STUDENTS ADMITTED TO SECOND YEAR IN 2019-20

III SEMESTER

Sl. No	Subject Code	Subject	Credits	Hours/ Week			Examination Marks		
				Lecture	Tutorial	Practical	CIE	SEE	Total
1	UMA333C	Computational methods for mechanical science	3	3	0	0	50	50	100
2	UAU312C	Thermodynamics	4	3	2	0	50	50	100
3	UAU313C	Production technology	3	3	0	0	50	50	100
4	UAU314C	Mechanics of materials	4	3	2	0	50	50	100
5	UAU325C	Automotive chassis	3	3	0	0	50	50	100
6	UAU306C	Material science and metallurgy	3	3	0	0	50	50	100
7	UAU317L	Computer aided machine drawing	1	0	0	2	50	50	100
8	UAU328L	Machine shop practice	1	0	0	2	50	50	100
9	UMA330M*	Bridge course Mathematics - I	--	3	0	0	50	50	100*
		Total	**22**	**18**	**4**	**4**	**400**	**400**	**800**

***Bridge course Mathematics – I is mandatory subject only for lateral entry Diploma students admitted to 3rd Semester during academic year 2019-20. Passing this subject is compulsory, however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for passing/not passing the subject.**

QUESTION PAPER PATTERN:

1. Total of **8** Questions with **2** from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than **4** sub divisions.
3. Any **Five** Full questions are to be answered choosing at least **one** from each unit.

Branches: Mechanical Engineering, Industrial Production & Automobile Engineering.

UMA333C: Computational methods for mechanical science

3 Credits (3-0-0)

Course Objectives:

- To enable the students to apply the knowledge of Mathematics in various engineering fields by making them
- To understand the numerical method of solving algebraic and transcendental equations.
- To determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
- To solve the first order first degree ordinary differential equations numerically.
- To obtain numerical solution of partial differential equation.
- Able to extremes the functional using integration technique

Course outcomes:

On completion of this course, students are able

CO1: To know how root finding techniques can be used to solve practical engineering problems.

CO2: To apply the concept of finding approximate value of the derivative & definite integral for a given data using numerical techniques.

CO3: To apply numerical techniques to solve the first order first degree ordinary differential equations.

CO4: To apply partial differential techniques to solve the physical engineering problems.

CO5: To implement integration technique to determine the extreme values of a functional.

Unit-I

Numerical analysis - I: **10 Hours**

Introduction to find root finding problems, Newton-Raphson method. Finite differences, forward and backward difference operators (no derivations on relations between operators) Newton-Gregory forward and backward interpolation formulae (without proof).Lagrange's and Newton's divided difference interpolation formulae (without proof) Numerical differentiation using Newton's forward and backward formulae-problems.

Unit-II

Numerical analysis-II: **10 Hours**

Numerical Integration: Simpson's one third rule, Simpson's three eighth rule (no derivation of any formulae)-problems. Numerical solution of ODE and PDE: Euler's and Modified Euler's method, Runge-Kutta 4th order method, Numerical solutions of one-dimensional heat and wave equations by explicit method, Laplace equation by using five point formula.

Unit-III

Fourier series: **10 Hours**

Periodic functions, Conditions for Fourier series expansions, Fourier series expansion of continuous and functions having finite number of discontinuities, even and odd functions. Half-range series, practical harmonic analysis.

Unit-IV

Fourier transforms: **10 Hours**

Infinite Fourier transforms and inverse Fourier transforms- simple properties, Fourier sine and Fourier cosine transforms.

Calculus of Variations:

Variation of a function and a functional, external of a functional, variational problems, Euler's equation, standard variational problems including geodesics, minimal surface of revolution, hanging chain and Brachistochrone problems.

Total: 40 Hours

Resources:

1. **Numerical Methods for Engineers** by Steven C Chapra & Raymond P Canale.
2. **Higher Engineering Mathematics** by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. **Advanced Engineering Mathematics** By H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. **Advanced Engineering Mathematics** by E Kreyszig (John Wiley & Sons)

Question paper pattern for SEE:

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than four subdivisions.
3. Any five full questions are to be answered choosing at least one from each unit.

Assignment Test for 5 Marks: Ten objective type questions can be prepared from entire syllabus.

Sl.No.	Title of the Subject : **Thermodynamics**	Sem:3			Code: UAU302C			Credits: 4				
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to define, state, classifications, and concepts of fundamentals of thermodynamic nomenclatures.	3	1	1	2								1
2	Able to understand and apply the knowledge to analyze and derive the thermodynamics equations.	3	3	1	3					1			1
3	Able to state, analyze and apply laws of thermodynamics and to solve the problems.	3	3	2	1		2						1
4	Apply thermodynamic knowledge to analyze the various thermodynamics gas cycles and to solve the problems	3	3	2	3					2			1
5	Apply thermodynamic knowledge to analyze the various thermodynamics vapour cycles and to solve the problems	3	2	1	2					2			1
6	Builds the foundation for preparing students to work in the area of thermal systems	3	3	1	2	1	2	2		2	2	1	1

UAU312C: THERMODYNAMICS
4 Credits (L-T-P: 3-2-0)

UNIT - I **10L +4T HOURS**

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, dithermic wall, Zeroth's law of thermodynamics, temperature; concepts, scales, measurement.

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. Shaft work; electrical work. Other types of work. Heat; definition, units and sign convention and numericals.

UNIT - II **10L +8T HOURS**

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 with numericals.

SECOND LAW OF THERMODYNAMICS: Heat reservoir, heat source and sink, heat engines, heat pump, refrigerator and COP. Kelvin - Planck and Clausius's statement of second law of thermodynamics; equivalence of the two statements and numericals. PMM - I and PMM - II. Reversible and irreversible processes; factors that make a process irreversible and Carnot cycle.

UNIT - III **10L +8T HOURS**

ENTROPY: Entropy - Clasius's inequality, statement, proof, application to a reversible cycle. QR/T as independent path. Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations.

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.

UNIT - IV **10L +6T HOURS**

VAPOR POWER CYCLES: Carnot vapor power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T - S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapor power cycles. Basic air conditioning system; air conditioning principles, air-conditioning types, temperature and pressure fundamentals, types of compressors and refrigerants.

TOTAL: 40L+26T HOURS

Text books

1."**Basic and Applied Thermodynamics**" by P .K. Nag, Tata McGraw Hill, 5th Edi. 2012

2."**Thermodynamics an engineering approach**", by Yunus A. Cenegal

Reference Books:

1. Spalding and Cole, Engineering Thermodynamics, ELBS Edition Longmans,1997.

2. Engineering Thermodynamics by J.B. Jones and G.A.Hawkins, John Wiley and Sons.

3. Arora C.P. Thermodynamics, TMH, 1998.

4. Gordan J. Van Wylen and Richard E.Sountag, Fundamentals of Classical Thermodynamics, 4th Edition, Wiley, 1994.

Sl. No.	**Title of the Subject : Production technology**	Sem:3		Code: UAU313C			Credits : 3					
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Ability to describe and compare different manufacturing methods, cutting tools and fluids.	3	1										1
2	Understand the constructional, operational features and applications of various machine tools.	3	2	2		2				2			3
3	Understand the operating principle, control parameters and applications in special machining processes	3	2	2		3							2
4	Solve numerical related to various machining operations	3	2	2		3							2
5	Ability to select different patterns and identify appropriate moulds and select different special casting process for types of product	3	1	3		2		1		2			1
6	Ability to identify and classify different welding processes and analyze the structure of the welds.	3	2	2		2		1					3

UAU313C: PRODUCTION TECHNOLOGY
3 Credits (L-T-P: 3 - 0 - 0)

UNIT - I **10 HOURS**

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.

TURNING: Classification, constructional features of Turret and Capstan lathe, tool layout. Machining time.

UNIT - II **10 HOURS**

SHAPING AND PLANNING MACHINES: 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. Machining time.

UNIT - III **10 HOURS**

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.

UNIT - IV **10 HOURS**

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.

TOTAL: 40 HOURS

Text Books:

1. **HMT Hand book,** McGraw-Hill, Edition 38, 2016
2. **Production Technology,** R. K. Jain, Khanna Publication, New Delhi, 17 Edition – 2009
3. **Fundamentals of metal machining and machine tools**", G. Boothroyd, McGraw-Hill Publication. Edition 2007.

Reference Books:

1. Manufacturing Process-I, Dr. K. Radhakrishna, Sapna Book House, 2nd Edition 2007.
2. Process and Materials of Manufacturing**,** Roy A Lindberg, 4th Ed Pearson Edu. 2006
3. Manufacturing Technology Vol-I **, P.Radhakrishnan, Sceitch Publications,Chennai**

	Title of the Subject: Mechanics of Materials	Sem: 3		Code: UAU314C			Credits: 4						
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	To define the fundamental terms of mechanics of materials	2	2	2									2
2	To derive equations for the stresses, strains and deformations in structural elements subjected to different types of loads	3	2	2									2
3	To solve numerical problems using the analytical and graphical methods	3	3	3									2
4	To compute the bending / shear stresses and deflection of beams	3	3	3									2
5	The students are able to apply the concepts of solid mechanics in the design of simple machine elements.	3	3	3									2
6	Simulate the mechanical elements receiving axial compressive loads under different end conditions and determine their columnar stability	3	3	3						2			2

UAU314C: MECHANICS OF MATERIALS
4 Credits (L-T-P: 3-2-0)

UNIT - I **10L+6T HOURS**

SIMPLE STRESS AND STRAIN: Introduction, stress, strain, mechanical properties of materials, linear elasticity, Hooke's law and Poisson's ratio, stress - strain relation - behavior in tension for mild steel and non ferrous metals. Extension shortening of a bar, bars with cross sections varying in steps, bars with continuously varying (circular and rectangular), elongation due to self weight, principle of super position.

STRESS IN COMPOSITE SECTION: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

UNIT - II **10L+6T HOURS**

COMPOUND STRESSES: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

THICK AND THIN CYLINDERS: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), thick cylinders subjected to internal and external pressures (Lame's equation).

UNIT - III **10L+8T HOURS**

BENDING MOMENT AND SHEAR FORCE IN BEAMS: Introduction, types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (UDL) and couple for different types of beams.

BENDING AND SHEAR STRESSES IN BEAMS: Introduction, 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. Frames and over hanging beams.

UNIT - IV **10L+6T HOURS**

DEFLECTION OF BEAMS: Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and simply supported beams for point load, UDL, UVL and couple, Macaulay's method.

TORSION OF CIRCULAR SHAFTS AND ELASTIC STABILITY OF COLUMNS: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

TOTAL 40L+26T HOURS

TEXT BOOKS:

1. **Mechanics of Materials,** SI Edition, Barry J. Goodno, James M. GereCengage Learning, 2017
2. **A TEXTBOOK OF STRENGTH OF MATERIALS,** Dr. R. K. BansalISBN :9788131808146 6th Edition, 2019

REFERENCE BOOKS:

1. Strength of Materials**,** 4th edition, S S Bhavikatti, Vikas Publishing, 2013

2. Mechanics of Materials, Beer , Johnston, Dewolf, Mazurek, Sanghi, Jul 2017

	Title of the Subject: Automotive Chassis	Sem:3			Code: UAU325C								Credits: 3
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1.	To classify the different types of automotive layouts and differentiate them	1											2
2.	To be able to describe construction and working of different types of suspension systems	1											2
3.	To classify brakes and explain construction and operation of various braking systems	2	3	2	1								2
4.	To be able to solve numerical problems on steering and braking systems	3	3	2	2								2
5.	To be able to describe construction of wheels and factors affecting tyre life	1											2
6.	Ability to explain construction of front and rear axles	1		3	3								2

UAU325C: AUTOMOTIVE CHASSIS
3 Credits (L-T-P: 3-0-0)

UNIT - I **10 HOURS**

LAYOUTS AND FRAMES: Types of automobiles, different automobile layouts; front wheel drive, rear wheel drive, four wheel drive, rear engine layout. Types of frames, materials, different 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 frame defects.

SUSPENSION: Objects, 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 HOURS**

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. Numerical problems.

UNIT - III **10 HOURS**

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, jake brakes.

UNIT - IV **10 HOURS**

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 wheel balancing.

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.

TOTAL: 40HOURS

TEXT BOOKS:

1. **Automobile Engineering Vol. 1** (Chassis, Body), Dr. Kirpal Singh, 14th Edition/Reprint 2019 ISBN:9788180142420, Standard publications, New Delhi
2. **Automotive Chassis Engineering**, David C Barton, John D Fieldhouse, Springer, 2018

REFERENCE BOOKS:

1. The Automotive Chassis: Engineering Principles, Jornsen Reimpell, Helmut Stoll, Jurgen Betzler, Butterworth-Heinemann, Elsevier.
2. Automotive Mechanics - SIE Paperback , William Crouse, Donald Anglin, McGraw Hill, Jul 2017

Sl.No	Title of the Subject :Material science and metallurgy	Sem:3		Code: UAU306C									Credits: 3
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Discuss the concept of crystal structure, crystal imperfections, and laws governing the diffusion phenomena and apply the knowledge to solve simple problems	3	3	1	1								1
2	Analyze the mechanical behavior of materials for various loads(steady and dynamic), fatigue tests and mechanism of creep and various modes of failure and apply the knowledge to solve problems	3	3	3	2		1	1					3
3	Explain the basic terminologies involved in metallurgy, Construct and interpret different types of phase diagrams, Iron-carbon equilibrium diagram, TTT diagram and apply the knowledge to solve problems	3	1	1	3								1
4	Apply the heat treatment process knowledge for improving physical and mechanical properties of different types of engineering materials	3	2	1	1								1
5	Discuss composite manufacturing processes and list advantages and applications of engineering and composite materials.	3	2	1	1		1						1
6	Apply an integrated knowledge of structure, properties, process and performance in selection and developing of materials for an engineering application	3	2	1	2		1	1					3

UAU306C: MATERIAL SCIENCE AND METALLURGY
3 Credits (L-T-P: 3 - 0 - 0)

UNIT - I **10 HOURS**

CRYSTAL STRUCTURE: Fundamental concepts of unit cell space lattice, Bravais space lattices, unit cells for cubic structure and HCP, crystallographic planes and directions, Miller indices, calculations of radius, coordination number and atomic packing factor for different cubic structures. Crystal imperfections; point, line, surface and volume defects. Diffusion; diffusion mechanism, Fick's laws of diffusion.

MECHANICAL BEHAVIOR: Stress-strain diagram to show ductile and brittle behavior of materials, mechanism of elastic action, linear and nonlinear elastic properties, true stress and strain. Plastic deformation, dislocation, slips and twinning, fracture-types, stages in cup and cone, Griffith's criterion.

UNIT - II **10 HOURS**

FATIGUE: Stress cycles, effects of stress concentration, size effect, surface texture on fatigue, S-N curves, factors affecting fatigue life and protection methods.

CREEP: Creep curves, mechanisms of creep. Creep-resistant materials.

SOLIDIFICATION AND PHASE DIAGRAMS: Mechanism of solidification, homogeneous and heterogeneous nucleation, crystal growth, cast metal structures. Solid solutions - types, rules governing the formation of solids solutions. Phase diagrams: basic terms, Gibb's phase rule, construction of phase diagrams, interpretation of equilibrium diagrams, types of phase diagrams. Lever rule.

UNIT - III **10 HOURS**

IRON CARBON EQUILIBRIUM DIAGRAM: Phases in the Fe-C system, invariant reactions, critical temperatures, microstructure of slowly cooled steels, effect of alloying elements on the Fe-C diagram, ferrite and austenite stabilizers. TTT diagram, drawing of TTT diagram, TTT diagram for hypo and hyper-eutectoid steels, effect of alloying elements on TTT diagram.

HEAT TREATMENT OF STEEL: Definition and aims of heat treatment, annealing and its types, normalizing, hardening, tempering, martempering, austempering, surface hardening like case hardening, carburizing, cyaniding, nitriding, induction hardening, hardenability, Jominy end-quench test.

UNIT - IV **10 HOURS**

ENGINEERING ALLOYS: Properties, composition and uses of low, medium and high carbon steels. Steel designation and AISI - SAE designation. Cast irons, gray CI, white CI, malleable CI, SC iron. Microstructures of cast iron. Light alloys, Al, Mg and Titanium alloys. Copper and its alloys. Brasses and bronzes.

COMPOSITE MATERIALS: Definition, classification, types of matrix materials and reinforcements, fundamentals of production of FRP's, production of MMC's, advantages and applications of composites.

TOTAL: 40HOURS

Text books:

1. Smith, **Foundations of material science and engineering-5th** edition,McGraw Hill,2009 ISBN-10:0073529249 ISBN-13:978-0073529240
2. Murthy, **Structure and properties of engineering materials**, TATA McGraw Hill,2003, ISBN-007048287X9780070482876

Reference Books:

3. William D.Callister Jr. **"**Materials Science & Engineering- An Introduction" Wiley India Pvt. Ltd, New Delhi,2010 ISBN:9788126521432,8126521430
4. Donald R. Askland, Pradeep P.Phule Thomson, Essentials of Materials For Science And Engineering", Engineering, 2007
5. James F. Shackel Ford, **"**Introduction to Material Science for Engineering", 8th edition Pearson,Prentice Hall, New Jersey, 2015

	Title of the Subject : **Computer Aided Machine Drawing**	Sem:3			Code: UAU 317L							Credits : 1
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to utilize CAD software to generate 2D and 3D models.	3	1			3							2
2	Utilize CAD software commands and develop sections of solids.	3	2			3							2
3	Able to convert orthographic views to isometric views using CAD software.	3	2			3							2
4	Utilize advanced commands to generate assembly drawings of mechanical components.	3	2			3							2

UAU317L: COMPUTER AIDED MACHINE DRAWING

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.

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

3. **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.

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

4. **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.

5. **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.

6. **Couplings**
   Split Muff coupling, protected type flanged coupling, pin (bush) .type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint) GT&D, symbols.

Assembly Drawings (Part drawings should be given)

1) Plummer block (Pedestal Bearing)
2) Screw jack (Bottle type)
3) Petrol Engine piston
4) I.C. Engine connecting rod.

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

Sl.No	Title of the Subject :Machine Shop Practice	Sem:3 Code: UAU328L Credits 1										
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Develop skills to operate lathe for turning, facing, tapering, knurling, step turning, forming and threading operation.	3	2	2		2				2			2
2	Apply skills to develop jobs on shaper and slotting machine.	3	2	2		2				2			2
3	Apply skills to develop jobs using milling machine.	3	2	2		2				2			2
4	Apply skills to finish turned or milled jobs using surface grinder.	3	2	2		2				2			2
5	Calculate machining time for different operations.	3	2			2				2			2

UAU328L: MACHINE SHOP PRACTICE

1 Credit (0 - 0- 2)

PART - A

1. Minimum four jobs using lathe of following machining operations:
   Plain turning, taper turning, step turning, thread cutting, facing, knurling, eccentric turning.

12 HOURS

PART - B

1. Cutting of gear teeth using milling machine.
2. Cutting of V - groove / Dovetail / Rectangular groove using shaping machine.
3. Demonstration of surface grinding.

12 HOURS

Laboratory Assessment:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
2. Allocation of 50 marks for CIE
   a. Performance and journal write-up: Marks for each experiment = 30 marks/No. of proposed experiments.
   b. One practical test for 20 marks. (5 write-ups, 10 conduction, calculation, results etc., 5 viva-voce).
3. **Allocation of 50 marks for SEE**

Lathe work	: 30 Marks
Shaping or Milling	: 10 Marks
Viva-Voce	: 10 Marks

BE IV SEMESTER

Sl. No	Subject Code	Subject	Credits	Hours/ Week			Examination Marks		
				Lecture	Tutorial	Practical	CIE	SEE	Total
1	UMA433C	Mathematical methods for mechanical science	3	3	0	0	50	50	100
2	UAU412C	Fluid mechanics	3	3	0	0	50	50	100
3	UAU433C	Theory of machines	4	3	2	0	50	50	100
4	UAU424C	Design of machine elements - I	4	3	2	0	50	50	100
5	UAU415C	Theory of automotive engines	3	3	0	0	50	50	100
6	UAU416C	Automotive transmission systems	3	3	0	0	50	50	100
7	UHS001N/ UAU410L	Advanced quantitative aptitude & soft skills / Vehicular system drawing lab - I	1	1	0	1	50	50	100
8	UAU437L	Foundry and forging practice	1	0	0	2	50	50	100
9	UAU438L	IC Engine and fuels laboratory	1	0	0	2	50	50	100
10	UAU439L	Material testing and measurement laboratory	1	0	0	2	50	50	100
11	UMA430M*	Bridge course Mathematics - II	--	3	0	0	50	50	100*
		Total	24	19	4	7	500	500	1000

***Bridge course Mathematics – II is mandatory subject only for lateral entry Diploma students admitted to 3rd Semester during academic year 2019-20. Passing this subject is compulsory, however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for Passing/not passing the subject.**

QUESTION PAPER PATTERN:

1. Total of **8** Questions with **2** from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than **4** sub divisions.
3. Any **Five** Full questions are to be answered choosing at least **one** from each unit.

Branches: Mechanical Engineering, Industrial Production & Automobile Engineering.

UMA433C: Mathematical methods for Mechanical science

3 Credits (3-0-0)

Course Objectives:

To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them

- To form a specific relation for the given group of data using least square sense method.
- To specify probability is an area of study which involves predicting the relative likely hood of various outcomes.

Course outcomes:

On completion of this course, students are able

CO1: To apply the least square sense method to construct the specific relation for the given group of data.

CO2: To apply the concept of probability to find the physical significance of various distribution phenomena.

CO3: To apply the concept of probability to perform engineering duties in planning and designing, engines, machines and other mechanically functioning.

CO4: To apply the concept of probability to study the performance of Mechanical systems.

CO5: To apply the concept of Markov Chain for commercial and industry purpose.

Unit –I

Complex Variables: **10 Hours**

Analytic function, Cauchy-Reimann equations in Cartesian and polar forms. Construction of analytic function (Cartesian and polar forms)

Complex Integration:

Line integral, Cauchy's theorem – corollaries (without Proof), Cauchy's integral formula. Taylor's and Laurent's series (statements only), singularities, poles, calculation of residues, Cauchy's residue theorem (without proof) – problems.

Unit-II

Special Function: **10 Hours**

Series solution of Bessel's differential equation, recurrence formulae, generating function, orthogonal property, Bessel's integral formula.

Unit –III

Statistics and Probability **10 Hours**

Statistics: Curve fitting by the method of least squares: $y = a + bx$, $y = ab^x$ and $y = a + bx + cx^2$

Correlation and regression.

Probability: addition rule, conditional probability, multiplication rule, Baye's rule.

Unit –IV

Probability distributions: **10 Hours**

Binomial distributions Poisson distributions and Normal distributions (No drivations). Concept of joint probability, Joint distributions - discrete random variables, Independent random variables, Problems on expectation and variance.

Markov chains:

Markov chains: Introduction, Probability vectors, Stochastic Matrices, Fixed Points and Regular stochastic Matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Total: 40 Hours

Resources:

1. **Higher Engineering Mathematics** by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
2. **Theory and problems of probability** by Seymour Lipschutz (Schaum's Series).
3. **Advanced Engineering Mathematics** by H. K. Dass
4. **Advanced Engineering Mathematics** by E Kreyszig (John Wiley & Sons)
5. **Probability and stochastic processes** by Roy D. Yates and David J. Goodman, wiley India pvt.ltd 2nd edition 2012.
6. **Advanced Engineering Mathematics** by Peter V. O'Neil.

Question paper pattern for SEE:

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than four subdivisions.
3. Any five full questions are to be answered choosing at least one from each unit.

Assignment Test for 5 Marks: Ten objective type questions can be prepared from entire syllabus.

	Title of the Subject :Fluid Mechanics	Sem:4			Code: UAU 412C								Credits 3
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Demonstrate the basic principles of fluid mechanics, properties and concepts of fluid statics.	3	1		1		1						1
2	Compute force of buoyancy on a partially or fully submerged body and analyze the stability of a floating body.	3	3	1	1		1						1
3	Derive equations of motion of fluid and apply to fluid flow measurements	3	1		1		1						
4	Apply principles of dimensional analysis and similitude to simple problems and use dimensionless parameters	3	3	1	1		1						1
5	Identify and Apply the knowledge of types of fluid flow to analyze the fluid flow problems	3	3	1	1		1	1					3
6	Able to apply the knowledge to solve problems laminar flow and viscous effects.	3	3	1	1		1	1					2

UAU412C: FLUID MECHANICS

3 Credits (L-T-P: 3 - 0 - 0)

UNIT - I **10 HOURS**

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 **10 HOURS**

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 HOURS**

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 HOURS**

LAMINAR FLOW AND VISCOUS EFFECTS: Reynolds's number, critical Reynolds's number, laminar flow through circular pipe - Hagen Poiseulle's equation, laminar flow between parallel and stationary plates.

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.

TOTAL: 40HOURS

Text books:

1. Kumar.D.S, **"Fluid Mechanics and Fluid power Engineering**" Kataria and sons-2010
2. Dr.Bansal.R.K, **"Fluid Mechanics**" by Lakshmi Publications, 2010.
3.OijushK.Kundu, **IRAM COCHEN,** EL SEVIER 3 rd Ed. 2005.

Reference Books:

1. Yunus A, Cenegel, John M, Cimbala, Fluid Mechanics, Fundamentals and Applications Tata
   by TATA McGraw Hill, 2013.
2. John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Fluid Mechanics published by prentice hall 2007.

	Title of the Subject :Theory of machines	Sem:4			Code: UAU433C							Credits 4
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to understand basic definition, types and concepts of various mechanisms.	3	3	2	1	1	1			2		1	1
2	Ability to analyze and synthesize the velocity, acceleration and force analysis of different mechanisms with numerical.	3	3	2	1	1	1			2		1	1
3	Ability to analyze and synthesize the balancing of reciprocating and rotating masses and to solve the problems	3	3	2	1	1	1			2		1	1
4	Ability to understand the dynamics of gear trains and to solve the problems.	3	3	2	1	1	1			2		1	1
5	Ability to understand the dynamics of gyroscope and governors and its utility in engineering with problem solving	3	3	2	1	1	1			2		1	1
6	Ability to know and analyze different types of cam and followers. And to draw the cam profiles and generate the profiles through analysis of velocity acceleration diagrams.	3	3	2	1	1	1			2		1	1

UAU433C: THEORY OF MACHINES
4 Credits (L-T-P: 3-2-0)

UNIT - I 10L + 6T HOURS

INTRODUCTION: Definitions: link or element, kinematics pairs, degrees of freedom, Grubler's criterion, 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.

VELOCITY ANALYSIS BY INSTANTANEOUS CENTER METHOD: Definition, Kennedy's theorem, determination of linear and angular velocity using instantaneous center method. Klein's construction: Analysis of velocity and acceleration of single slider crank mechanism.

UNIT - II 10L + 8T HOURS

STATIC FORCE ANALYSIS: 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.

DYNAMIC FORCE ANALYSIS: De Alembert's principle, inertia force, inertia torque, dynamic force analysis of four - bar mechanism and slider crank mechanism. Dynamically equivalent systems. Turning moment diagrams of flywheel, fluctuation of energy. Determination of flywheel size.

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 10L + 8T HOURS

BALANCING OF RECIPROCATING MASSES: Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder inline engine , primary and secondary forces, V - engine and radial engine.

GOVERNORS: Types of governors, controlling force, stability, sensitiveness, isochronism, effort and power. Force analysis of Porter and Hartnell governors**.**

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 train.

UNIT - IV 10L +6T HOURS

GYROSCOPE: Vectorial representation of angular motion, gyroscopic couple. Effect of gyroscopic couple on ship,plane disc, aeroplane, stability of two wheelers and four wheelers**.**

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, follower motions including SHM, uniform velocity, uniform acceleration and retardation and cycloidal motion.

TOTAL: 40L + 26T HOURS

Text Books:

1. "**Theory of Machines**", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. "**Theory of Machines**", Sadhu Singh,Pearson Edn (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2nd Edi. 2006.

Reference books:

1. "Theory of Machines & Mechanisms", Shigley. J. V. and Uickers, J.J., OXFORD University press.2004.

2."Theory of Machines -I", by A.S.Ravindra, Sudha Publications Revised 5th Edi. 2004.

	Title of the Subject : Design of machine elements - I	Sem:3			Code: UAU424C								Credits: 4
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Classify the design approaches, design procedure and consideration	3	1	2									1
2	Analyze the stress and strain of mechanical components, and identify, quantify failure modes for mechanical parts.	3	2	2	2								2
3	Design and analysis of shafts and other mechanical component subjected to twisting and bending moment.	3	3	3	3								2
4	Design and analyze keys, coupling, and knuckle joints for various load condition.	3	3	3	3								2
5	Ability to design and analyze screw threaded fastener for various load condition.	3	3	3	3								2

UAU424C: DESIGN OF MACHINE ELEMENTS - I

4 Credits (L T P: 3 - 2 - 0)

UNIT - I **10L +8T HOURS**

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, stress concentration factor, variable stresses, endurance limit, fatigue stress concentration factor, notch sensitivity, impact loading, design criteria.

UNIT - II **10L +8T HOURS**

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 basis of rigidity, ASME and ISI codes for design of transmission shafting.

KEYS, COUPLINGS, COTTER AND KNUCKLE JOINTS: Types of keys, design of keys, shafts couplings; types, design of muff coupling, flange coupling, pin type flexible coupling. Oldham's coupling, universal coupling, socket and spigot type cotter joint, knuckle joint.

UNIT - III **10L +6T HOURS**

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 **10L +6T HOURS**

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.

TOTAL: 40L + 26T HOURS

TEXT BOOKS:

1. **Theory and problems of Machine Design** by Hall (Schaum's 'Outline)
2. **Design of Machine Members** by Vallance and doughtIe
3. **Machine design** by Maleev and Hartman.

REFERENCES:

1. A Text book of Machine Design by R.S.Khurmi and J.K.Gupta.
2. Elements of Machine Design by Pandya and Shah. Machine Design by Black
3. Mechanical Engineering Design by Shigley. Machine Design Elements by M.P. Sports.

DATA HANDBOOKS:

1. Machine design data hand book by Lingiah.
2. Machine design data hand book by Balaveera Reddy.

	Title of the subject : **Theory of automotive engines**	Sem: 4			Code: UAU 415C			Credits: 4				
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to compare and correlate between principle of engine operation, theoretical and actual cycle diagrams.	3	3	2	3		1	2					3
2	Able to correlate between and different types of power plants and operational, fuel air cycle and valve timing diagrams of CI and SI Engines.	3	3	2	3		1	2					3
3	The students able to analyze different phases of combustion and their significance in Engine performance and study of combustion chambers.	3	3	1	3		1	2					2
4	Able to analyze the onset abnormal combustion and its impact on engine performance and emissions.	3	3	1	3		1	2					3
5	Able to know principle and working of dual and multi fuel engines and various types of engines.	3	3	1	3		1	2					2
6	The students understand the basics of IC engine principle, operation and combustion analysis.	3	3	1	3		1	2					3

AU415C: THEORY OF AUTOMOTIVE ENGINES
3 Credits (3- 0 - 0)

UNIT - I **10 HOURS**

INTRODUCTION: Historical development of automobiles. 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 HOURS**

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 HOURS**

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 HOURS**

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

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

DIESEL FUELS: 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, supercharge 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.

TOTAL: 40 HOURS

Text books:

1**. I.C. Engines** By Mathur & Sharma, Dhanpat Rai & Sons, New Delhi, 1994

2.**Fuels & Combustion** by S.P. Sharma & Chandramohan, Tata McGrawHill, New Delhi ,1987

Reference books:

1. **I.C. Engines & Air pollution** by Obert, Harper & Row Roni publishers, New york, 1973 Fuels & Combustion by Smith & Stinson,
2. **I.C. Engines** by Lichty
3. **I.C. Engines** by Maleev, CBS Pub.
4. **Combustion fundamentals** by Roger A Strehlow

	Title of the Subject : **Automotive transmission systems**	Sem: 4			Code: UAU 416C			Credits: 3				
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to know the various resistances offered to motion of the vehicle, performance curves and traction.	3	2	1	1					1	1	1	1
2	To study and comprehend the construction, working and types of clutches with trouble shooting aspects.	3	1	1	1					1	1	1	1
3	Elucidate the working, scope and significance of fluid flywheel and torque converter.	3	2	1	1					1	1	1	1
4	To understand the scope and working of automatic transmission systems.	3	1	1	1					1	1	1	1
5	To study and comprehend the working of final drives and its elements	3	2	1	1					1	1	1	1
6	To know and analyze the construction, working and classification of gear box with trouble shooting aspects.	3	2	1	1					1	1	1	1

UAU416C: AUTOMOTIVE TRANSMISSION SYSTEMS

3 Credits (3 - 0 - 0)

UNIT - I **10 HOURS**

POWER REQUIRED FOR PROPULSION: Resistances: wind, gradient and rolling resistances of an automobile. Traction, tractive effort, road performance curves; acceleration, gradability, drawbar pull, numerical problems.

CLUTCH: Need of clutch, requirements, materials, different types of clutches, principle of friction clutches, single plate, multi-plate, diaphragm, cone, centrifugal clutch, semi- centrifugal clutch. Method of actuation; mechanical, electromagnetic, hydraulic and vacuum, adjustment of clutch, wet and dry friction clutches, clutch trouble shooting diagnosis and numerical problems.

UNIT - II **10 HOURS**

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 **10 HOURS**

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 HOURS**

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.

TOTAL: 40HOURS

TEXT BOOKS:

1. **Automobile Engineering – I & II –** Kirpal Singh
2. **Automobile Engineering –** G. B. S. Narang
3. **Automotive Mechanics –** William Crouse

	Title of the Subject :**Foundry & forging practice**	Sem:3				Code: UAU437L							Credits 1
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	To have understood various processes carried out in Foundry.	3	2							2			1
2	Ability to prepare different types of mold cavities and different sand testing methods.	3	2	2						1			
3	Demonstrate various skills of sand preparation and different molding methods.	3	2	2		2		1		2			
4	Able to know manufacturing process that in turn provide the student with the capacity to better understand and realization of engineering products and system.	3	2	2		2							1
5	Aware of importance of manufacturing process in an industry and the applications.	3	2	2		2				2			1

UAU437L: FOUNDRY AND FORGING PRACTICE

1 Credit (0 - 0 - 2)

Part - A

1. TESTING OF MOLDING SAND AND CORE SAND

Preparation of sand specimens and conduction of the following tests:

a. Compression, shear and tensile tests on universal sand testing machine.
b. Permeability test
c. Core hardness & mould hardness tests
d. Grain fineness number test (Sieve analysis test)
e. Clay content test
f. Moisture content test.

Part - B

2. FOUNDRY PRACTICE

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

Part - C

3. FORGING OPERATIONS

a. Preparing minimum three forged models involving upsetting, drawing and bending operations.
b. Out of these three models, at least one model is to be prepared by using power hammer.

Laboratory Assessment:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE)
2. Allocation of 50 marks for CIE
3. Performance and journal write-up: Marks for each experiment = 30 marks/No. of proposed experiments.

a. One practical test for 20 marks. (5 write-up, 10 conduction, calculation, results etc.5 (viva voce).

2. Allocation of 50 marks for SEE:

Part-A	: 20 Marks
Part-B or Part-C	: 20 Marks
Viva-Voce	: 10 Marks

	Title of the Subject **: IC Engine and fuels laboratory**	Sem: 4					Code: UAU 438L						Credits : 1
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	Able to know and analyze the various properties of fuels	3	2							2			1
2	Able to know and analyze the valve timing diagram for different engines	3	2							1			
3	Able to know and analyze and to perform experiments on various engines	3	2							2			
4	To conduct performance study against malfunctioning and emission tests	3	2										1

UAU438: I. C. ENGINE AND FUELS LABORATORY.

1 Credit (0-0-2)

Part - A

FUELS LAB:

1. Determination of flash point and fire point of lubricating oil using Ables'apparatus.
2. Determination of flash point and fire point of lubricating oil using Pensky Martin apparatus.
3. Determination of viscosity of lubricating oil using Redwood viscometer.
4. Determination of viscosity of lubricating oil using Saybolt viscometer.

Part - B

TESTS ON IC ENGINES:

1. Performance tests on I.C engines, calculations of IP, BP, FP, Thermal, volumetric and mechanical efficiency, SFC and heat balance sheet for:

   a) Four stroke single cylinder petrol engine.
   b) Four stroke single cylinder diesel engine.
   c) Four stroke twin cylinder diesel engine.
   d) Multi cylinder petrol engine for Morse test.
   e) Computerized single cylinder four stroke diesel engine.
2. Valve timing opening diagram of four stroke diesel / petrol engine.

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 practical test for 20 marks. (5 write-up, 10 conduction, calculation, results etc., 5 viva-voce).
3. **Allocation of 50 marks for SEE**

Part-A	: 10 Marks
Part-B	: 30 Marks
Viva-Voce	: 10 Marks

	Title of the Subject: Material testing & Measurement laboratory	Sem:3 Code: UAU439L Credits 1										
	Course Outcomes	**Engineering knowledge**	**Problem analysis:**	**Design/development of solutions**	**Conduct investigations of complex**	**Modern tool usage:**	**The engineer and society:**	**Environment and sustainability:**	**Ethics:**	**Individual and team work**	**Communication:**	**Project management and finance:**	**Life-long learning:**
1	To conduct impact tests and find impact value of specimens.	3	1										2
2	To conduct hardness tests and find hardness number for different specimens.	3	2										2
3	To utilize UTM for tensile, compression and bending tests on mild steel and wooden specimens.	3	2										2
4.	Demonstrate calibration techniques to various measuring devices to standardize the instruments.	3	1										2
5.	Acquire knowledge about Measurements and Measuring procedures.	3	2										2

UAU439L: MATERIAL TESTING AND MEASUREMENT LABORATORY

1 Credit (0 - 0 - 2)

PART - A

a. Tensile and compression test of metallic and non - metallic specimens using a universal testing machine.
b. Shear test of metallic and non - metallic specimens using a universal testing machine
c. Bending test on metallic and non - metallic specimen.
d. Impact test: Izode and Charpy tests on M.S. Specimen.
e. Hardness test: Brinell, Rockwell and Vickers's test.

PART - B

a. Calibration of pressure gauge.
b. Calibration of micrometer using slip gauges.
c. Measurement of angle using sine bar/sine centre.
d. Measurement of screw thread parameters by two wire method.

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 practical test for 20 marks. (5 write-up, 10 conduction, calculation, results etc., 5 viva-voce).
3. **Allocation of 50 marks for SEE**

Part-A	: 20 Marks
Part-B	: 20 Marks
Viva-Voce	: 10 Marks

Time / Day	8.00 am to 9.00 pm	9.00 am to 10.00pm	TEA BREAK	10.15 am to 11.15am	11.15am to 12.15pm	LUNCH BREAK	2.00 pm to 05.00pm
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							