NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

The Trust is a Recipient of Prestigious Rajyotsava State Award 2012 Conferred by the Government of Karnataka
Awarded Outstanding Technical Education Institute in Karnataka-2016
Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA

Academic Year 2019-20

AU – Automobile Engineering

Third and Fourth Semester

Scheme and Syllabus

CONTENTS

VISION

To be a centre of excellence in the field of automobile engineering by providing quality education meeting the ever changing requirements of the industry.

MISSION

- To promote research, consultancy and innovation leading to research publications & patents.
- To strengthen industry institute interaction by collaborating with industries for training, internships and industry expert talks.
- To inculcate ethical, social values and environment awareness by participation in co-curricular and extra-curricular activities.

Program Education objectives (PEOs)

PEO1	Engage in design of Automobile systems, tools and application in the field of Automobile Engineering and allied Engineering industries.
PEO2	Apply the knowledge of Automobile Engineering to solve the problems of social, environmental relevance and pursue higher education and research.
PEO3	Work effectively as individuals and as team members in multi-disciplinary projects abiding professional practices.
PEO4	Engage in life- long learning, career enhancement and adopt to change in professional and societal needs.

PEO to Mission Statement Mapping

Mission Statements	To promote research, consultancy and innovation leading to research publications & patents.	To strengthen industry institute interaction by collaborating with industries for training, internships, and industry expert talks.	To inculcate ethical, social values and environment awareness by participation in co- curricular and extra-curricular activities.
PEO1	**3**	**3**	**2**
PEO2	**3**	**2**	**3**
PEO3	**2**	**2**	**3**
PEO4	**3**	**2**	**2**

Correlation: 3- High, 2-Medium, 1-Low

Program Outcomes (POs) with Graduate Attributes

	Graduate Attributes	**Program Outcomes (POs)**
1	Engineering Knowledge	Apply the knowledge of mathematics, science, fundamentals, and an engineering specialization to the solution of complex engineering problems related to automobile engineering.
2	Problem analysis	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3	Design and 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.
4	Investigation of Problem	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 in automobile.
5	Modern Tool usage	Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6	Engineer and society	Apply reasoning informed by the contextual knowledge to assess automobile based societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
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.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual & team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex automobile 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.
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.
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.

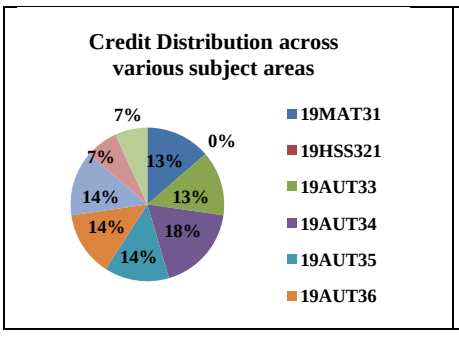
Program Specific Outcomes (PSO): After successful completion of Automobile Engineering program, the graduates will be able to :

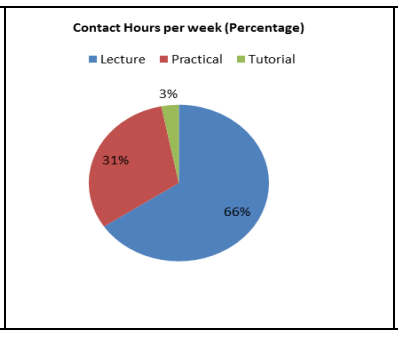
PSO 1: Analyse, design and evaluate Automobile components and systems using conventional and/or CAD/ CAM tools.

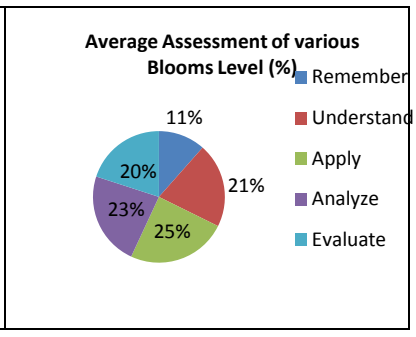
PSO 2 : Plan, process automation and quality assurance system for manufacturing of given Automobile components and systems.

New Horizon College of Engineering
Department of Automobile Engineering
Third Semester B.E Program–Scheme AY: 2019-2020

Sl. No.	Course Code	Course Name	Credit Distribution			Overall Credits	Contact Hrs Weekly	Marks		
			L	T	P			CIE	SEE	Total
1	19AUT31	Applied Mathematics - III	2	1	0	3	4	50	50	100
2	19HSS321	Economics for Engineers	2	0	0	2	2	25	25	50
3	19HSS323	Environmental Science and Awareness	1	0	0	1	1	25	25	50
4	19AUT33	Engineering Thermodynamics	3	1	0	4	5	50	50	100
5	19AUT34	Materials Science & Metallurgy	3	0	0	3	3	50	50	100
6	19AUT35	Fluid Mechanics	2	1	0	3	4	50	50	100
7	19AUT36	Automotive Manufacturing Process	3	0	0	3	3	50	50	100
8	19AUL37	Manufacturing Technology Lab	0	0	1.5	1.5	3	25	25	50
9	19AUL38	Fuel Testing and Fluid Mechanics Lab	0	0	1.5	1.5	3	25	25	50
Total						22	28	350	350	700

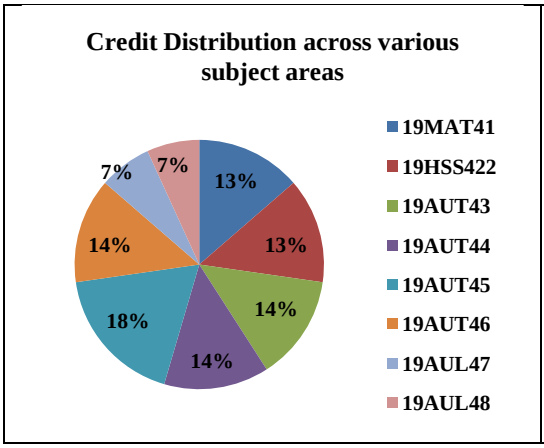


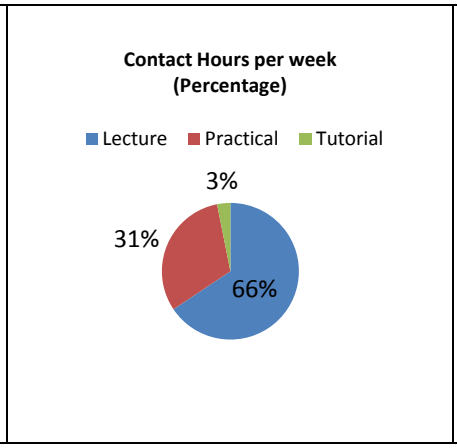


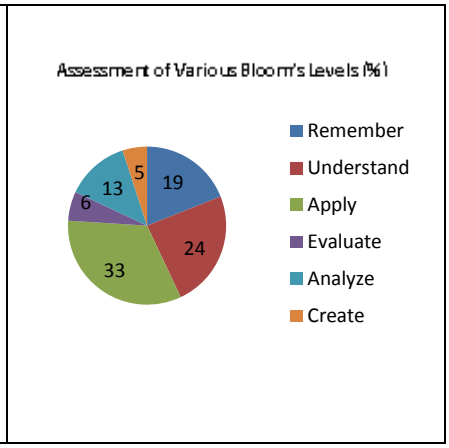


New Horizon College of Engineering
Department of Automobile Engineering
Fourth Semester B.E Program-Scheme AY: 2019-20

Sl. No.	Course Code	Course Name	Credit Distribution			Overall Credits	Contact Hrs Weekly	Marks		
			L	T	P			CIE	SEE	Total
1	19AUT41	Applied Mathematics - IV	2	1	0	3	4	50	50	100
2	19HSS422	Life Skills for Engineers	3	0	0	3	3	50	50	100
3	19AUT43	Automotive Fuels and Combustion	3	0	0	3	3	50	50	100
4	19AUT44	Mechanical Measurements & Metrology	3	0	0	3	3	50	50	100
5	19AUT45	Mechanics of Materials	3	1	0	4	5	50	50	100
6	19AUT46	Computer Aided Machine Drawing	2	1	0	3	4	50	50	100
7	19AUL47	Metallography and Material Testing Lab	0	0	1.5	1.5	3	25	25	50
8	19AUL48	Engine Testing Lab	0	0	1.5	1.5	3	25	25	50
9	19AUT49	Mini Project-I	-	-	-	2	0	25	25	50
Total						24	28	375	375	750







THIRD SEMESTER

(SYLLABUS)

APPLIED MATHEMATICS – III

Course Code : 19AUT31/19CIV31/19MEE31 **Credits : 03**
L:T:P:S : 2:1:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Use appropriate numerical methods to solve algebraic equations and transcendental equations
CO2	Evaluate a definite integral numerically and Use appropriate numerical methods to solve Boundary Value Problems in Partial differential equations
CO3	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data and obtain the extremal of a functional.
CO4	Express the periodic functions as Fourier series expansion analytically and numerically
CO5	Solve the Continuous model problems using Fourier transforms
CO6	Differentiate the physical problems numerically

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2	2	-	-	-	1	1	-	2
CO2	3	3	3	2	2	-	-	-	1	1	-	2
CO3	3	3	3	2	2	-	-	-	1	1	-	2
CO4	3	3	3	2	2	-	-	-	1	1	-	2
CO5	3	3	3	2	2	-	-	-	1	1	-	2
CO6	3	3	3	2	2	-	-	-	1	1	-	2

Course Syllabus			
Module No.	**Contents of the Module**	**Hours**	**Co's**
1.	**Numerical Methods-1:** Numerical solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method-Problems. Interpolation: Newton's forward and backward formulae for equal intervals, Newton divided difference and Lagrange's formulae for unequal intervals (without proofs)-Problems.	**9L + **	**CO1**

	RBT Levels: L1, L2, L3, L4, L5	**2T**	
2.	**Numerical Methods-2**: Numerical integration: Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule (without proofs)-Problems. Numerical solution of one-dimensional wave equation, heat equation and two-dimensional Laplace's equation. **Applications:** Application of numerical integration to velocity of a particle and volume of solids. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO2**
3.	**Statistical Methods and Calculus of Variation:** Fitting of the curves of the form $y = a + bx$, $y = a + bx + cx^2$, $y = ae^{bx}$, $y = ax^b$, and $y = ab^x$ by the method of least square-Problems. Correlation and Regression lines - Problems. Variation of a function and a functional, variational problems, Euler's equation and Isoperimetric problems. **Applications:** Minimal surface of revolution and Hanging cable. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO3**
4.	**Fourier series:** Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period $2l$, half range series-Problems. **Applications:** Fourier series and half Range Fourier series of periodic square wave, half wave rectifier, full wave rectifier, Saw-tooth wave with graphical representation, practical harmonic analysis-Problems. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO4**
5.	**Fourier Transforms:** Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transforms. **Numerical Differentiation:** Derivatives of first order and second order using Newton's forward differences and Newton's backward Differences. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO5, CO6**

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, 10th Edition, 2014, ISBN: 978-81-265-5423-2.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2014, ISBN: 978-81-7409-195-5.

Reference Books:

1. Glyn James, Modern Engineering Mathematics, Prentice Hall, 4th Edition, 2015, ISBN: 978-0-273-73409-3
2. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2016, ISBN: 978-0-07-063419-0.
3. H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., 28th Edition, 2012, ISBN: 81-219-0345-9.
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Edition, 2014, ISBN: 978-81-318-0832-0.

Assessment Pattern:

1. CIE- Continuous Internal Evaluation (50 Marks).

Bloom's Category	Tests (25 Marks)	Assignments (15 Marks)	Quizzes (10 Marks)
Remember	5	5	-
Understand	5	5	-
Apply	5	5	10
Analyze	5	-	-
Evaluate	5	-	-
Create	-	-	-

2. SEE- Semester End Examination (50 Marks).

Bloom's Category	Questions (50 Marks)
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	-

ECONOMICS FOR ENGINEERS

Course Code : HSS321/421 **Credits: 02**

L:P:T : 2:0:0 **CIE: 25**

Exam Hour: 03 **SEE: 25**

Course Outcomes: On completion of the course, the student will be able to:

CO1	Gain knowledge about importance of economics in decision making processes in a day to day life.
CO2	Analyze business environment at micro and macroeconomic level and its Impact on industries in country's economy.
CO3	Acquire knowledge about costing and estimation of projects for profit making.
CO4	Apply principles of budgeting and finance for entrepreneurial success.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	1	-	2	2	2	1	2	2
CO2	2	2	1	-	1	-	2	2	2	1	2	2
CO3	2	2	1	-	1	-	2	2	2	1	2	2
CO4	2	2	1	-	1	-	2	2	2	1	2	2
CO5	2	2	1	-	1	-	2	2	2	1	2	2
CO6	2	2	1	-	1	-	2	2	2	1	2	2

Module No.	Contents of Module	Hours	Cos
1	Introduction to Economics: Role of Engineer as an Economist, Types and problem of economies, Basics of economics (GDP, National income, inflation, business cycle, fiscal and monetary policies, balance of payment).	6	1,3
2	Basic concepts of Microeconomics: concept of Demand & Elasticity of Demand. Concept of Supply & Elasticity of Supply, Meaning of Production and factors of production, Production Possibility Curve, Law of variable proportions and returns to scale. Relevance of Depreciation towards industry, Depreciation computing methods.	6	2,3
3	Concepts of cost of production: different types of cost; accounting cost, sunk cost, marginal cost and opportunity cost. Break even analysis, Make or Buy decision. Cost estimation, Elements of cost as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads.	6	3,4
4	Capital budgeting: Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI. . Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment. Present worth, Future worth.	6	1,3, 4
5	Book Keeping and Accounts: Journal, Ledger, Trial balance,	6	1,2,

	asset Types, profit & loss account, balance sheet.		3,4

TEXT BOOKS:

1. Riggs J.L, Engineering Economy, TMH, 2012 edition
2. Jain T.R., Economics for Engineers, VK Publications,2008 Edition
3. IM PANDEY,Finacial Management, Vikas Pub. House, 2018 Edition
4. D N Dwivedi, MangerialEconomics ,Vikas Pub. House, 2018 Edition
5. Dr.A.R Sainath,Sasikala Devi,Engineering Economics and Financial Accounting,Charulatha Publications,2015 edition

REFERENCE BOOKS:

1. Thuesen H.G, Engineering Economy. PHI,1984
2. Prasanna Chandra, Financial Mangement,TMH,2007
3. Singh Seema, Economics for Engineers, IK International,2014
4. Chopra P. N, Principle of Economics, Kalyani Publishers,2012
5. Dewett K K, Modern Economic Theory, S. Chand,2006

Assessment pattern

CIE - Continuous Internal Evaluation (25 Marks, Theory)

Bloom's Category	Test	Assignment	SSR
Marks (out of 50)	**10**	**7.5**	**7.5**
Remember	2.5	-	-
Understand	2.5	-	-
Apply	2.5	-	-
Analyze	2.5	2.5	2.5
Evaluate	-	2.5	2.5
Create	-	2.5	2.5

SEE – Semester Ending Examination (25 Marks)

Bloom's Category	SEE Theory (25)
Remember	10
Understand	5
Apply	5
Analyze	5
Evaluate	-
Create	-

ENVIRONMENTAL SCIENCE AND AWARENESS

Course Code	**: 19HSS 323/423**	**Credits**	**: 01**
L : T : P	**: 1:0:0:0**	**CIE Marks**	**: 25**
Exam Hours	**: 02 Hrs**	**SEE Marks**	**: 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the concepts of environment, ecosystem, biodiversity and its interdependence on human life.
CO2	Develop an insight on types of natural resources and the concept of sustainable development.
CO3	Understand the different control measures of pollution and importance of waste management.
CO4	Think and apply technology as a solution for environment related concerns, keeping in view the different environmental acts and amendments.

Mapping of Course Outcomes to Program Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	1	1	3	3	3	1	1	1	1
CO2	2	1	1	1	1	3	3	3	1	1	1	3
CO3	3	3	3	3	3	3	3	3	3	1	2	3
CO4	3	3	3	3	3	3	3	3	3	1	3	3

Module No.	**Content of Module**	**Hrs**	**COs**
1	**Introduction to Environment, Ecosystem and biodiversity:** Environment - Components of Environment, Scope and importance of Environmental studies, Ecosystem: Types & Structure of Ecosystem, Energy flow in the ecosystem, Food chains – food webs & ecological pyramids. Biodiversity – Definition, Hot-spots of biodiversity, Threats to biodiversity, Conservation of biodiversity.	05	CO1
2	**Natural Resources:** Renewable and non-renewable resources – Natural resources and associated problems. Role of an individual in conservation of natural resources. Water conservation, rain water harvesting. Balanced use of resources for sustainable lifestyle – strategies.	04	CO2
3	**Environmental Pollution:** Definition, Causes, effects and control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal Pollution and Nuclear hazards. Role of an individual in prevention of pollution - Waste management – urban and industrial wastes.	04	CO3

4	**Social Issues and Environment:** Environmental ethics – issues and possible solutions. Environment protection act – Air (prevention and Control of pollution) act & Water (prevention and Control of pollution) act. Role of government: Swatch Bharat Abhiyan, National Mission for Clean Ganga (NMCG), River rejuvenation, Role of Non-governmental Organizations (NGOs), Global warming and climate change.	04	CO3 CO4
5	**Human Population and Environment:** Population growth & explosion, Family welfare programme. Environment and human health, Human rights, Value education. Role of Technology in protecting environment and human health.	05	CO4

Text Books:

1. "Environmental Studies: Basic Concepts" by Ahluwalia, V. K. . The Energy and Resources Institute (TERI) Publication, 2nd edition, 2016. ISBN: 817993571X, 9788179935712.
2. "Textbook of Environmental Studies for Undergraduate Courses of all branches of Higher Education" by Bharucha, Erach for UGC, New Delhi, 2004. ISBN: 8173715408, 9788173715402.

Reference Books:

1. Handbook of Environmental Engineering by Rao Surampalli, Tian C. Zhang, Satinder Kaur Brar, Krishnamoorthy Hegde, Rama Pulicharla, Mausam Verma; McGraw Hill Professional, 2018. ISBN: 125986023X, 9781259860232
2. Environmental Science and Engineering by P. Venugopala, Prentice Hall of India Pvt. Ltd, New Delhi, 2012 Edition. ISBN: 978-81-203-2893-8.
3. Environmental Science- Working with the earth by G Taylor Miller Jr, Brooks Cole Thompson Publications, 10 thEdition. ISBN: 10: 0534424082.
4. Elements of Environmental Science and Engineering by P. Meenakshi, Prentice Hall of India Pvt. Ltd, 2005 Edition. ISBN: 8120327748, 9788120327740.

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quiz**
Marks (out of 50)	**15**	**05**	**05**
Remember	5	2	2
Understand	5	2	2
Apply	5	1	1
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

SEE – Semester End Examination (25 Marks)

Bloom's Category	**Tests**
Remember	10
Understand	10
Apply	5
Analyze	0
Evaluate	0
Create	0

ENGINEERING THERMODYNAMICS

Course Code	**: 19AUT33**	**Credits**	**: 04**
L: T: P	**: 3:1:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the concepts of Energy in general and Heat and Work in particular.
CO2	Apply the concepts of thermodynamics to steady and unsteady flow processes.
CO3	Understand the basics of heat engine and heat pumps and second law of thermodynamics and corollaries.
CO4	Analyze air standard cycles.
CO5	Analyze refrigeration cycle and Air conditioning cycle.
CO6	Evaluate the output from reciprocating air compressors.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	2	2	-	-	1	-	2
CO2	3	3	1	1	-	2	2	-	-	1	-	2
CO3	3	2	1	1	-	2	2	-	-	1	-	2
CO4	3	2	1	1	-	2	2	-	-	1	-	2
CO5	3	2	1	1	-	2	2	-	-	1	-	2
CO6	3	3	1	1	-	2	2	-	-	1	-	2

Module No.	Module Contents	Hrs	CO's
1	**Fundamental Concepts & Definitions:** Definition of Thermodynamics. Microscopic and Macroscopic approaches to the study of thermodynamics. Definition of system (closed system) and control volume (Open system) with examples. Definition of thermodynamic property, Intensive and extensive properties, thermodynamic state, process, quasi- static process, thermodynamic cycle Thermodynamic equilibrium; definitions of thermal chemical and mechanical equilibrium. Zeroth law of thermodynamics, Concept of Temperature, types of commonly	9	**CO1**

	used temperature scales and relation between them Thermodynamic definition of work, sign convention and examples to illustrate the definition of work. Work done at the system boundary, process equation and expressions for work done in different processes. Definition of heat and sign convention. Comparison of work & heat. Simple numerical problems on work and heat transfer only.		
2	**First Law of Thermodynamics**: Statement of the First law of thermodynamics for a closed system undergoing a cyclic process. First law thermodynamics for a change of state of the system and concept of energy, Energy as a property of the system and its significance. Internal Energy, Enthalpy and Specific heats. Simple numerical problems on systems undergoing closed process Steady flow process, First law applied to steady flow process, derivation of steady flow energy equation and its applications to steady flow process Simple numerical problems on systems undergoing steady flow process.	9	**CO2**
3	**Second Law of Thermodynamics:** Limitations of the first law of Thermodynamics - Thermal energy reservoirs - KelvinPlanck statement of the second law of thermodynamics - Clausius statement - Equivalence of Kelvin-Planck and Clausius statements - Refrigerators, Heat Pump and Air-Conditioners –COP - Perpetual Motion Machines - Reversible and Irreversible process - Carnot cycle – Entropy - The Clausius inequality - Availability and irreversibility - Second law efficiency.	9	**CO3**
4	**Air Standard Cycles**: Carnot Cycle, Otto Cycle, and Diesel Cycle, their P-V & T-S diagrams, description, expression for efficiencies and definition of mean effective pressures. Comparison of Otto and Diesel cycles. **Reciprocating Air Compressors** : Operation of a single stage reciprocating air compressors, Work input using P-V diagram and steady state flow analysis, Effect of clearance and volumetric efficiency, Adiabatic, isothermal and mechanical efficiencies, Multistage compressors, saving in work, expression for optimum intermediate pressure. Imperfect inter cooling.	9	**CO4** **CO6**
5	**Refrigeration and Air Conditioning**: Introduction, Heat Engines and Heat Pumps, Pressure, enthalpy diagram. Vapor compression refrigeration systems, description, analysis, refrigerating effect, capacity, power required, units of refrigeration, and COP. Properties of atmospheric air: Dry Air, Relative Humidity, Specific humidity, degree of saturation, dry bulb and wet bulb temperature. Psychometric Chart and Psychometric Process: Sensible heating or cooling, cooling and dehumidification, heating and humidification and adiabatic mixing of two streams.	9	**CO5**

Text Books:

1. P .K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill, 2009

2. R K Rajput, Engineering Thermodynamics by ,Laxmi Publications Pvt Ltd 2011

Reference Books:

1. Prakash and Gupta, Engineering Thermodynamics

2. Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, TataMcGraw Hill publications, 2007, ISBN - 9780073305370

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**15**	**10**
Remember			
Understand	05		05
Apply	10		05
Analyze	05	7.5	
Evaluate	05	7.5	
Create			

SEE- Semester End Examination (50 Marks).

Bloom's Category	SEE (Theory)
Remember	
Understand	10
Apply	10
Analyze	20
Evaluate	10
Create	

MATERIAL SCIENCE AND METALLURGY

Course Code: 19AUT34 **Credits : 03**

L : T : P : 3:0:0 **CIE Marks :50**

Exam Hours: 03 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Compare structure property relationship, allow modification or engineering of materials to perform well in a specified application
CO2	Formulate the phases in solidification and understand the phase transformation in solids.
CO3	Understand the behavior of Iron and alloys of iron
CO4	Identify suitable heat treatment for fabrication of tools and dies, crankshafts, connecting rod etc.
CO5	Describe types, properties and application of composites and smart materials
CO6	Apply creep and fatigue theories for materials.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	1	1	1	1	-	1
CO2	3	3	3	2	-	1	1	1	1	1	-	1
CO3	3	3	2	2	-	1	1	1	1	1	-	1
CO4	3	2	2	2	-	1	1	1	1	1	-	1
CO5	3	2	2	2	-	1	1	1	1	1	-	1
CO6	3	3	2	2	-	1	1	1	1	1	-	1

Module No.	Contents of Module	Hrs	Cos
1	**Crystal Structure:** BCC, FCC and HCP Structures, coordination number and atomic packing factor. Crystal imperfections- Point, line and surface imperfections. Atomic diffusion-Fick's law of diffusion, factors affecting diffusion **Fracture**: Types, Griffith's criterion of brittle fracture, **Creep**: Description of Creep phenomenon with examples. Three stages of creep, creep properties, stress relaxation. **Fatigue**: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram.	09	**CO1** **CO6**
2	**Phase Diagram I**: Solid solutions Hume Rothary rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule. **Phase Diagram II**: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Different types invariant reactions – Eutectic, Eutectoid, Peritectic, Peritectoid reactions.	09	**CO2**

3	**Iron carbon equilibrium diagram:** Description of phases, solidification of steels and cast irons, invariant reactions. Heat treating of metals TTT curves, continuous cooling curves, Description of the heat treatment processes like normalizing, hardening, tempering, mar tempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding with industrial applications: annealing and its types.	09	**CO2** **CO4**
4	**Ferrous and non ferrous materials** : Properties, Composition and uses of **Grey cast iron, malleable iron, SG iron and steel , Copper alloys**-brasses and bronzes. • **Aluminum alloys**-Al-Cu,Al-Si,Al-Zn alloys. • **Titanium alloys**	09	**CO3**
5	**Composites** – Classification, Processing, Metal Matrix, Ceramic Matrix, polymer matrix – properties and applications. **Smart Materials:** Introduction ,Types ,Properties and Applications	09	**CO5**

TEXT BOOKS:

1. "Fundamentals of Material Science and Engineering", David G Rethwisch ,William D Callister, Jr. RethwischCallister , John Wiley & Sons Inc; 9 edition , 2013, ISBN 13: 9781118061602
2. "Material Science &Metallurgy",O P Khanna, DhanpatRai Publications,2014,ISBN-13: 978-9383182459
3. "Principles of Materials Science & Engineering", by, Smith William F-English-Tata Mcgraw Hill Education Private Limited,4th Edition, ISBN: 9780070667174

REFERENCE BOOKS:

4. 1."Mechanical Metallurgy", E. Dieter, 3rd Edition, McGraw Hill Education,2017,ISBN-13: 978-1259064791
5. 2. "Engineering Materials", Kenneth G. Budinski, Michael K. Budinski, Prentice Hall, 9thedition, 2010, ISBN: 9780137128426.
6. 3. "Material Science" by K R Phaneesh,8thedition,Sudha Publications,2016

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**15**	**10**
Remember	5		5
Understand	5		5
Apply	5		
Analyze	5	5	
Evaluate	5	5	
Create		5	

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	10
Analyze	05
Evaluate	05
Create	10

FLUID MECHANICS

Course Code : 19AUT35 **Credits : 03**

L: T: P : 2:1:0 **CIE Marks: 50**

Exam Hours : 03 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Investigate different fluid properties.
CO2	Analyze the types of fluid flows and different flow description
CO3	Understand and investigate the concept of Buoyancy.
CO4	Evaluate flow concepts and Bernoulli equation.
CO5	Analyze the types of fluid flows and different flow description to apply continuity equation and energy equation in solving problems.
CO6	Analyze the concepts of fluid dynamics

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	1	3
CO2	3	3	3	3	-	-	-	-	-	-	1	3
CO3	3	3	2	3	-	-	-	-	-	-	1	2
CO4	3	3	2	3	-	-	-	-	-	-	1	2
CO5	3	3	2	3	-	-	-	-	-	-	1	2
CO6	3	3	2	3	-	-	-	-	-	-	1	2

Module No	Contents of Module	Hrs	COs
1	**Fluid Properties:** Types of fluids, Mass Density, Specific Weight, Specific Gravity, Newton's Law of Viscosity, Dynamic Viscosity, Surface Tension, Capillarity, Compressibility, Vapour pressure, Fluid Statics,Pascal's law, pressure variation in a static fluid in 2D.	09	**CO1, CO2**
2	**Hydrostatics:** Definition, Total pressure, centre of pressure, total pressure on horizontal, vertical and inclined plane surface, total pressure on curved surfaces.	09	**CO2, CO3**
3	**Buoyancy:** Buoyancy, centre of buoyancy, Archimedes principle, principle of floatation, metacentre and metacentric height, stability of floating and submerged bodies, determination of Metacentric height by experimental method.	09	**CO2, CO3, CO4**
4	**Fluid Kinematics**: fluid flow description by Langrangian and Eulerian method, Types of Flow- steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, stream lines, path lines, streak lines. Continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential	09	**CO3, CO4**

	function and stream function Numerical problems.		
5	**Fluid Dynamics:** Introduction to Navier-Stroke's Equation, derivation of Euler equation of motion along a stream line, and Bernoulli's equation from Euler's equation and first principles. Numerical problems. Applications of Bernoulli's equation to Pitot tube, Venturimeter, orifices, orifice meter Numerical problems.	**09**	**CO4, CO6**

TEXT BOOKS:

1. A Textbook of Fluid Mechanics, By R.K. Bansal, Laxmi Publications (P) Ltd. New Delhi, Revised 9th Edition, 2010, ISBN-13: 9788131808153
2. A Textbook of Fluid Mechanics , By Er. R.k Rajput, S.Chand& Company Ltd., 6th Edition, 1998, ISBN- 9788121916677

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering, Dr. D.S. Kumar, S.K. Kataria& sons, 2013, ISBN - 9789350143926
2. Fluid Mechanics, Frank M. White, McGraw Hill Publication, 7th Edition, 2011, ISBN - 9780071311212
3. Fluid Mechanics, Cengel & Cimbla, Tata McGraw Hill, 3rd Edition, 2014, ISBN – 9789339204655

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	25	15	10
Remember	2		
Understand	3		
Apply	5	5	5
Analyze	5	5	5
Evaluate	5	3	
Create	5	2	

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**SEE (Theory)**
Remember	5
Understand	5
Apply	10
Analyze	10
Evaluate	10
Create	10

AUTOMOTIVE MANUFACTURING PROCESS

Course Code : 19AUT36 **Credits : 03**

L: T: P : 3: 0: 0 **CIE Marks: 50**

Exam Hours : 03 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Classify manufacturing processes and understand the concept of the sand moulding and application of castings for automotive applications
CO2	Compare the various forming processes, forging and extrusions processes.
CO3	Understand the concept of gear manufacturing and sheet metal operations
CO4	Understand the methods and machines in turning and milling processes.
CO5	Explain the recent trends in manufacturing of automotive components like CNC machines etc.
CO6	Evaluate the effect of cutting tool parameters on tool wear, life and tool failure and cutting tool materials.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	2	2	1	1	-	-	2
CO2	3	2	2	3	-	2	-	1	1	-	-	2
CO3	3	2	2	3	-	1	-	1	1	-	-	2
CO4	3	2	2	3	-	2	-	1	1	-	-	2
CO5	3	2	2	3	2	1	-	1	1	-	-	2
CO6	3	2	2	3	-	2	1	1	1	-	-	2

Module No.	Contents of Module	Hrs	COs
1	**Casting:** Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. **Patterns:** Definition, functions, Materials used for pattern, various pattern allowances. Classification of patterns, **Sand Moulding:** Types of base sand, requirement of base sand. Greensand, dry sand and skin dried moulds. Casting of engine block - conventional and expendable pattern, Casting for cylinder heads, forging of crank shaft, connecting rod and gudgeon pins, Casting of piston, upset forging of valves, piston ring manufacturing & Engine bearing manufacturing, Manufacturing of friction plates.	09	**CO1**
2	**Forming processes: Forging**: Classification of forging processes. Forging machines &equipment. Material flow lines in forging. Forging defects, Forging of valves – connecting rod, crank shaft, cam shaft,	09	**CO2**

	propeller shaft, transmission gear blanks. **Extrusions**: Classification of extrusion, extrusion of transmission shaft, steering worm blanks, rear axle drive shaft, axle housing spindles. Hydroforming: Process, hydroforming of manifold.		
3	**Gear Manufacturing:** Different methods of Gear manufacture, Gear hobbing, Shotpeen hardening of gears, Grinding and lapping of hobs and shaping cutters, gear honing, gear broaching. **Sheet Metal Operations:** Blanking - blank size calculation, draw ratio, drawingforce, Piercing, Punching, Trimming, Stretch forming – Process, stretch forming of auto body panels Rubber forming, Shearing, Bending,	09	**CO3**
4	**Theory of Metal Cutting:** Single point cutting tool nomenclature, Mechanism of Chip Formation, Types of Chips. Tool Wear and Tool and Tool failure, Effects of cutting parameters on tool life. **Cutting Tool Materials:** Desired properties and types of cutting tool materials – HSS, carbides coated carbides, ceramics. **Turning (Lathe):** Classification, constructional features of Turret and Capstan Lathe. **Milling machines**: Classification, constructional features, milling cutters nomenclature **Indexing:** Simple, compound indexing calculations.	09	**CO4** **CO6**
5	**Recent Trends in Manufacturing of Auto Components:** Powder injection moulding , Production of aluminium MMC liners for engine blocks, Plasma spray coating of engine blocks and valves, Recent developments in auto body panel forming, Squeeze casting of pistons ,aluminium composite brake rotors. **CNC Machines-**Introduction to CNC machines- Principles of operation. Axes of NC machine-Coordinate systems**.**	09	**CO5**

Text Books

1. Manufacturing Process-I, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2009.
2. Manufacturing & Technology: Foundry Forming and Welding, P.N.Rao, Volume1. Tata McGraw Hill Education Private Limited, 2013, ISBN 13: 978-9383286614
3. Production Technology, HMT, Tata McGraw Hill, 2008. ISBN-13: 978-0070964433

Reference Books

1. Workshop Technology, HazaraChoudhry, Vol-II, Media Promoters & Publishers Pvt.Ltd. 2010, ISBN 13 – 9788185099156.
2. Process and Materials of Manufacturing, Roy A Lindberg, Pearson Edu, 4th Ed. 2006, ISBN-13: 978-0205118175.

3. Manufacturing Engineering & Technology, Serope Kalpakjian, Steven. R. Schmid, Pearson Education Asia, 7th Ed. 2013, ISBN -13: 978-9810694067.
4. The Complete Book on Production of Automobile Components & Allied Products, B.P. Bhardwaj, NIIR Project Consultancy Services, 2014.

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Co-curricular
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5		5	
Understand	5		5	
Apply	5			
Analyze	5	5		
Evaluate	5	5		
Create				

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	

MANUFACTURING TECHNOLOGY LAB

Course Code : 19AUL37 **Credits : 1.5**

L: T: P : 0: 0: 1.5 **CIE Marks: 25**

Exam Hours : 03 **SEE Marks: 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Perform various skilled operations on lathe
CO2	Perform various skilled operations on milling and shaping
CO3	Understand various skills of sand preparation and moulding and forging methods
CO4	Develop programs for CNC turning and milling

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	1	2	1	1	2
CO2	3	3	3	3	2	-	-	1	3	1	1	2
CO3	3	3	3	3	2	-	1	1	3	2	1	2
CO4	3	3	3	3	3	-	1	1	2	-	1	2

Sl. No.	List of Experiment	Hrs
	PART- A	
1	Preparation of turning model various operations on lathe	**CO1**
2	Cutting of gear tooth using milling machine	**CO2**
3	Cutting of V grove/ dovetail/ rectangular groove using shaper	**CO2**
	PART- B	
4	Preparation of sand specimens and conduction of compression, shear, permeability, clay content and sieve analysis tests.	**CO3**
5	Preparation of moulds using patterns and without patterns (Demonstration Only)	**CO3**
6	Preparation of forging models using various forging techniques (Demonstration Only)	**CO3**
	Part - C	
7	Write CNC turning programme using G-codes and M-Codes.	**CO4**
8	Write CNC milling programme using G-codes and M-Codes.	**CO4**

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	Tests	Record	Quizzes/Viva
Marks (out of 50)	**10**	**10**	**05**
Remember	02	02	01
Understand	04	02	02
Apply	04	02	01
Analyze		04	01
Evaluate			
Create			

SEE– Semester End Examination

(25 Marks- Lab)

Bloom's Category	Tests(theory)
Remember	05
Understand	05
Apply	05
Analyze	05
Evaluate	03
Create	02

FUEL TESTING AND FLUID MECHANICS LAB

Course Code : 19AUL38 **Credits : 1.5**

L: T: P : 0:0:1.5 **CIE Marks: 25**

Exam Hours : 03 **SEE Marks: 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Analyze different fluid properties and fuel characteristics.
CO2	Analyze the types of fluid flows and different flow descriptions and apply continuity equation and energy equation in solving problems on flow through conduits incorporating with various losses concerned with flow through pipes.
CO3	Conduct the test of fuels and identify their ignition characteristics.
CO4	Apply the course content to new situations so as to evaluate potential industrial applications of fluid theory through both physical induction and mathematical analysis.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	1	2	1	-	-	-	2	-	1	1
CO2	3	3	1	1	1	-	-	-	2	-	1	1
CO3	3	3	2	3	1	-	-	-	2	-	1	2
CO4	2	3	2	-	1	-	-	-	2	-	1	1

Sl No	**List of Experiment**	**Hrs**
1	Determination of viscosity of given oil using Saybolt /Redwood/Torsion Viscometer	**CO1**
2	Carbon residue and moisture content test (Demonstration)	**CO1, CO3**
3	Determination of the Reynolds Number and hence the Type of Flow using the Reynolds apparatus.	**CO2,CO5**
4	To determine the cloud & pour point of a given fuel / lubricant / oil, using cloud & pour point apparatus.(Demonstration)	**CO1 , CO3**
5	To verify Bernoulli's equation by demonstrating the relationship between pressure head and kinetic head.	**CO2, CO4**

6	To determine the flash and fire points for the given oil.	**CO1, CO3**
7	Calibration of given Orifice meter and plotting the suitable calibration curve.	**CO2, CO4**
8	Calibration of given Venturimeter and plotting the suitable calibration curve.	**CO2, CO4**
9	Determination of coefficient of friction and Chezy's constant for Turbulent flow in pipes.	**CO4,CO2**
10	Determination of losses coefficient in flow through pipes due to sudden contraction and sudden expansion and friction.	**CO4, CO2**

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Record**	**Quizzes/Viva**
Marks (out of 50)	10	10	05
Remember	1	2	01
Understand	2	2	01
Apply	2	2	01
Analyze	2	2	01
Evaluate	1	2	01
Create	2		

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	**SEE (Lab)**
Remember	
Understand	5
Apply	5
Analyze	5
Evaluate	5
Create	5

BASIC APPLIED MATHEMATICS-I

Course Code : 19DMAT31 **Credits : 00**
L:T:P : 0:0:0 **CIE Marks : 25**
Exam Hours : 02 **SEE Marks : 25**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Learn the principles of engineering mathematics through calculus
CO2	Determine the power series expansion of a function
CO3	Find the definite integrals with standard limits and Also develop the ability to solve
CO4	Apply ideas from linear algebra in solving systems of linear equations and Determine the

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	1	1	-	1
CO2	3	2	3	2	2	-	-	-	1	1	-	1
CO3	3	2	3	2	2	-	-	-	1	1	-	1
CO4	3	2	3	2	2	-	-	-	1	1	-	1

Course Syllabus

Module No.	Contents of the Module	Hours	CO's
1.	**Differential Calculus:** Polar curves-Problems on angle between the radius vector and tangent, Angle between two curves-Problems, Pedal equation for polar curves-Problems. Macluren's theorems for function of one variable (statement only)-Problems.	**5L**	**CO1, CO2**
2.	**Partial differentiation:** Definition and Simple problems, Euler's theorem for Homogeneous function (NO Derivation and NO extended theorem)-Problems, Partial differentiation of composite functions (chain rule)-Problems, Jacobians of order two - definition and problems.	**5L**	**CO1**
3.	**Integral Calculus and Differential Equations:** Problems on reduction formulae for functions $\sin^n x$, $\cos^n x$, Problems on evaluation of these integrals with standard limits (0 to $\pi/2$). Solution of first order and first degree differential equations-Variable separable, Linear and Exact differential equations.	**5L**	**CO3**

4.	**Linear Algebra-1:** Problems on rank of a matrix by elementary transformations, consistency of a system of linear equations and solution (homogeneous and non-homogeneous)-Problems. Solution of system of linear equations by Gauss elimination method-Problems.	**5L**	**CO4**
5.	**Linear Algebra-2:** Linear transformation, Eigen values and Eigen vectors, diagonalisation of a square matrix-Problems.	**5L**	**CO4**

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, 10th Edition, 2014,ISBN: 978-81-265-5423-2.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2014, ISBN: 978-81-7409-195-5.

Reference Books:

1. Glyn James, Modern Engineering Mathematics, Prentice Hall, 4th Edition, 2015, ISBN: 978-0-273-73409-3
2. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2016, ISBN: 978-0-07-063419-0.
3. H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., 28th Edition, 2012, ISBN: 81-219-0345-9.
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Edition, 2014, ISBN: 978-81-318-0832-0.

Assessment Pattern:

1. CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	Tests (20 Marks)	Assignment (5 Marks)
Remember	5	-
Understand	5	5
Apply	5	-
Analyze	2.5	-
Evaluate	2.5	-
Create	-	-

2. SEE- Semester End Examination (25 Marks)

Bloom's Category	Questions (25 Marks)
Remember	5
Understand	10
Apply	5
Analyze	2.5
Evaluate	2.5
Create	-

FOURTH SEMESTER

(SYLLABUS)

APPLIED MATHEMATICS – IV

Course Code: 19AUT41/19CVE41/19MEE41 **Credits : 03**
L:T:P:S : 2:1:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Solve initial value problems using appropriate numerical methods
CO2	Understand the concepts of Complex variables and transformation for solving Engineering Problems
CO3	Understand the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems
CO4	Gain ability to use probability distributions to analyze and solve real time problems
CO5	Apply the concept of sampling distribution to solve engineering problems
CO6	Use the concepts to analyze the data to make decision about the hypothesis and understand the concepts of logic

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	1	1	-	1
CO2	3	2	3	2	2	-	-	-	1	1	-	1
CO3	3	2	3	2	2	-	-	-	1	1	-	1
CO4	3	2	3	2	2	-	-	-	1	1	-	1
CO5	3	2	3	2	2	-	-	-	1	1	-	1
CO6	3	2	3	2	2				1	1		1

Course Syllabus			
Module No.	**Contents of the Module**	**Hours**	**CO's**
1	**Numerical Methods:** Numerical solution of ordinary differential equations of first order and of first degree: Modified Euler's method and Runge-Kutta method of fourth-order-Problems. Milne's predictor and corrector methods-Problems. Numerical Solutions of second order ordinary differential equations by Runge-Kutta method of fourth-order-Problems. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO1**
2	**Complex Variables**: Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions-Problems using Milne-Thompson's method. **Applications:** Flow problems-Velocity potential, Stream functions and complex potential functions. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO2**

3	**Conformal Transformations and Complex Integrations:** $w = z^2$, $w = e^z$ and $w = z + (1/z)$. Cauchy's Theorem (with proof). Singularities, Poles and Residues, Residue theorem (without proof)-Problems. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO3**
4	**Probability distributions:** Random variables (discrete and continuous), probability density functions. Discrete Probability distributions: Binomial and Poisson distributions-Problems. Continuous Probability distributions: Exponential and Normal distributions-Problems. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO4**
5	**Sampling Theory:** Sampling, Sampling distributions, standard error, Test of hypothesis for small samples by Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit. **Mathematical Logic:** Connectives and Truth tables, Logical Equivalence, The laws of logic and logical implication. **RBT Levels: L1, L2, L3, L4, L5**	**9L + 2T**	**CO5, CO6**

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, 10th Edition, 2014, ISBN: 978-81-265-5423-2.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2014, ISBN: 978-81-7409-195-5.

Reference Books:

1. Glyn James, Modern Engineering Mathematics, Prentice Hall, 4th Edition, 2015, ISBN: 978-0-273-73409-3.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2016, ISBN: 978-0-07-063419-0.
3. H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., 28th Edition, 2012, ISBN: 81-219-0345-9.
4. N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Edition, 2014, ISBN: 978-81-318-0832-0.

Assessment Pattern:

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests (25 Marks)	Assignments (15 Marks)	Quizzes (10 Marks)
Remember	5	5	-
Understand	5	5	-
Apply	5	5	10
Analyze	5	-	-
Evaluate	5	-	-
Create	-	-	-

SEE- Semester End Examination (50 Marks).

Bloom's Category	Questions (50 Marks)
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	-

LIFE SKILLS FOR ENGINEERS

Course Code	**: HSS322/422**	**Credits**	**: 03**
L: P: T:	**: 3:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 3**	**SEE Marks**	**: 50**

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

CO1	Set personal and professional goals
CO2	Develop his critical thinking skills and practise creativity.
CO3	Demonstrate an understanding of personal and professional responsibility
CO4	Apply the concepts of personality development and grooming in real life
CO5	Understand self and work with groups
CO6	Articulate and convey his ideas and thoughts with clarity and focus

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						2		3	3	3	2	3
CO2						2		3	3	3	2	3
CO3						2		3	3	3	2	3
CO4						2		3	3	3	2	3
CO5						2		3	3	3	2	3
CO6						2		3	3	3	2	3

Module No.	**Module Contents**	**Hours**	**COs**
1	Goal Setting: Importance of Goals: Creating SMART goals; Critical Thinking and Problem Solving, Six Thinking Hats, Multiple Intelligences and Mind Mapping	6	CO1, CO2
2	Taking Ownership, Being Responsible and Accountable. Meaning of Ownership, Responsibility and Accountability, Practicing these philosophies in course, career and life, Developing a 'Credible Character Impression about self', Self-Motivation, Developing healthy Self-esteem, Leadership	8	CO3
3	Personality Development and Grooming: Expectations from the industry, building personal presence, corporate grooming, corporate etiquettes, Personal branding and image management	6	CO4
4	Self-Awareness and Self-Management: Emotional Intelligence, Knowing your own self- understanding personality, perception, values	8	CO5

	and attitude. Interpersonal skills - Knowing others, working well with others, developing the right attitude for work, being proactive and positive.		
5	Articulation and Group Discussion: Ideas generation, expressing thoughts in a logical flow, presenting views in a group	8	CO6

REFERENCE BOOKS:

1. The 7 – Habits of Highly Effective People, Stephen R Covey, Neha Publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to win friends and influence people Dale Carnegie

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Self-Study	Peer Evaluation
Marks (out of 50)	**10**	**15**	**15**	**10**
Remember	-	-	-	-
Understand	-	-	-	-
Apply	5	5	-	5
Analyze	-	-	5	-
Evaluate	-	-	-	
Create	5	10	10	5

SEE- Semester End Examination (50 Marks)

NOTE: Being a Life skills course we felt it would be suitable to do the final assessment through a structured group discussion which will provide an opportunity to test students in all levels of Bloom's Taxonomy.

Bloom's Category	Group Discussion
Remember	**5**
Understand	**10**
Apply	**10**
Analyse	**10**
Evaluate	**5**
Create	**10**

AUTOMOTIVE FUELS AND COMBUSTION

Course Code	**: 19AUT43**	**Credits**	**: 03**
L: T: P	**: 3:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Explain available energy sources for IC.Engines & discuss their advantages and limitations.
CO2	Describe refining process of petroleum and their by-products and their properties
CO3	Analyze the combustion phenomena of SI & CI Engine
CO4	Explain the construction and working principle of multi and dual fuel Engine and their advantages and limitation
CO5	Analyze recent developments in the field of IC.Engines.
CO6	Understand the design considerations for combustion chambers.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	-	-	1	1	-	-	1	-	2
CO2	3	1	2	-	-	1	1	-	-	1	-	1
CO3	3	1	2	-	-	1	1	-	-	1	-	2
CO4	2	1	2	-	-	1	1	-	-	1	-	2
CO5	2	1	2	-	-	1	1	-	-	1	-	2
CO6	3	1	3	-	-	1	1	-	-	1	-	2

Module No.	Module Contents	Hrs	CO's
1	**Introduction:** Exhaustible sources - crude oil, Natural gas, Inexhaustible sources - Solar energy, Wind power, Tidal Power, Geothermal power. Energy from Bio-gas, Synthetic fuels – Fuel Cells, Hydrogen- only a brief introduction. Biofuels, Alcohols, CNG, LPG. **Combustion of fuels**: Combustion equation, conversion of Gravimetric to Volumetric analysis, Determination of Theoretical minimum quantity of Air for complete combustion, Determination of Air Fuel for a given fuel, Numerical problems, flue gas analysis.	9	**CO1**
2	**Fuels:** Origin of petroleum, its chemistry, Refining of petroleum: Fractional distillation, Cracking, Reforming process, Thermal reforming, polymerization, alkylation, and isomerisation. Properties	9	**CO2**

	of fuels, diesel index, carbon residue and ash content determination. low sulphur diesels, Fuels for SI engines, Knock rating of SI engine fuels, octane number requirement, diesel fuels, Non petroleum fuels, Additives, Fuels for gas turbine and jet engines.		
3	**Combustion in S.I Engines**: Introduction, ignition limits, homogeneous mixture formation, Initiation of combustion, stages of combustion flame velocities, effect of variables on flame propagation, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, detonation, effects of engine variables on combustion, control of detonation, Types, features and design consideration of combustion chambers. **Combustion in C.I. Engines** : Introduction, mixture requirements, Various stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl, squish, tumble flow, velocities, delay period correlations, diesel knock and engine variables, types, features and design considerations of combustion chambers.	9	**CO3** **CO6**
4	**Dual fuel and Multi fuel Engines:** Introduction, construction and working of dual fuel and multi fuel engines, Combustion in dual fuel engines, Factor affecting combustion. Main types of gaseous fuels, Supercharge knock control & Performance of diesel fuel engines. Characteristics of multi fuel engines, Modification of fuel system, suitability of various engines as multi fuel unit, performance characteristics of multi fuel engines.	9	**CO4**
5	**Recent developments in IC Engines:** Introduction, Stratified charge engine, methods of Stratified charge engine, lean burn engines, VCR engines, Advantages and disadvantages of VCR engines , Multi Cycle Engines (MCE), CFR engine, Miller Cycle Engines, HCCI engines, & free piston engines.	9	**CO5**

Text Books:

1. Mathur & Sharma, I.C. Engines, Dhanpat Rai publications, New Delhi, 2013

2. S S Thipse, Internal combustion engine, JAICO publishing house, Mumbai,2012

Reference Books:

1. V Ganesan, Internal Combustion Engines, Tata McGraw Hill, 2005.

2. John B.Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998

3. Obert, E.F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1983.

4. Ram lingam, K.K., Internal Combustion Engines, SCITECH PUBLICATIONS (INDIA) Pvt. Ltd., 2014

Assessment Pattern:

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**15**	**10**
Remember			
Understand	10		05
Apply	10		05
Analyze	05	7.5	
Evaluate		7.5	
Create			

2. SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	Tests (Theory)
Remember	
Understand	20
Apply	20
Analyze	10
Evaluate	
Create	

MECHANICAL MEASUREMENTS AND METROLOGY

Course Code : 19AUT44 **Credits : 03**

L: T: P : 3: 0: 0 **CIE Marks: 50**

Exam Hours : 03 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Understand the basic concepts of Metrology and generalized measuring system.
CO2	Identify the appropriate measuring instruments for measurement of force, torque, pressure, temperature and strain.
CO3	Apply the knowledge of comparators and angular angle gauges for measuring linear and angular measurements.
CO4	Analyze the screw thread and gear tooth measurements.
CO5	Apply the concept of geometric dimensioning and tolerances (GD&T), Limits, fits and gauges.
CO6	Compare advanced measuring systems for linear and angular measurements.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	-	-	1	1	-	2
CO2	3	2	1	1	3	1	-	-	1	-	-	2
CO3	3	2	1	1	3	1	-	-	-	-	-	2
CO4	3	3	1	1	2	-	-	-	-	-	-	2
CO5	3	3	3	2	2	1	-	-	1	1	-	3
CO6	2	1	2	1	3	-	-	-	-	-	-	2

Module No.	Contents of Module	Hrs	Cos
1	**Standards of measurement:** Definition and Objectives of metrology, Material standards-International Prototype meter, Imperial standard yard, Airy points, Wave length standard, subdivision of standards, line and end standard, calibration of end bars , Indian Standards (M-45,M-87 M-112) of Slip gauges, Wringing phenomena, Numerical problems on building of slip gauges. **Measurements and measurement systems:** generalized measurement system, basic definitions, Errors in measurement, classification of errors.	09	**CO1**
2	**Limits, Fits, Tolerance and Gauge:** Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, hole basis system, shaft basis system,	09	**CO5**

	classification of gauges, brief concept of design of gauges (Taylor's principles), Types of gauges plain plug gauge, ring gauge.		
3	**Comparators:** Introduction to comparators, characteristics, classification of comparators, mechanical comparators- Johanson's Mikrokator, Sigma comparator, Dial gauge, optical comparator-Ziess ultra-optimeter, LVDT, pneumatic comparator-Solex pneumatic gauge, **Angular measurements:** Bevel protractor,sine principle and use of sine bar, angle gauges, numericals on building of angles using angle gauges. **Advanced measuring systems:** Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements, Coordinate measuring machine (CMM) - Constructional features, applications.	09	**CO3, CO6**
4	**Form Measurement:** Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear tooth terminology, gear tooth vernier caliper.	09	**CO4**
5	**Measurement of force, torque, pressure:** Principle of analytical balance, platform balance, proving ring. Torque measurement-Prony brake, hydraulic dynamometer. Pressure measurements- McLeod gauge, Pirani gauge. **Measurement of Temperature and strain:** Resistance thermometers, thermocouple, law of thermo couple, Strain measurements, electrical strain gauge.	09	**CO2**

TEXT BOOKS:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, 2012, ISBN-13: 978-8174091536.
2. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2007, ISBN 13: 978-8131717189.
3. Metrology and Measurement, Dr. T Chandrashekar, Subhas publication, 2013, ISBN: 9789383214198

REFERENCE BOOKS:

1. Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications, Delhi. 7th Edition, 2012, ISBN 13: 9788189928452
2. Metrology & Measurement, Anand K. Bewoor & Vinay A. Kulkarni, Tata McGraw Hill Pvt. Ltd., New Delhi, 2009, ISBN: 9781259081323
3. Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press, 2013, ISBN: 9780198085492
4. Engineering Metrology**,** K.J. Hume, Third (metric) Edition - Kalyani publishers.
5. Measurement systems, Ernest O Doeblin, McGraw Hill Publishers, 2011.

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Co-curricular
Marks (out of 50)	**25**	**10**	**5**	**10**
Remember	5		5	
Understand	5		5	
Apply	5			
Analyze	5	5		
Evaluate	5	3		
Create		2		

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

MECHANICS OF MATERIALS

Course Code : 19AUT45 **Credits : 04**

L:T:P : 3:1:0 **CIE Marks : 50**

Exams Hours : 03 **SEE Marks: 50**

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1	Understand the behavior of materials when subjected to various types of loading.
CO2	Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.
CO3	Analyze bending and shear stresses in beams.
CO4	Resolve the Torsional stresses, stiffness of shafts.
CO5	Evaluate the stresses induced in thin and thick cylinders.
CO6	Analyze the different approaches to calculate slope and deflection for various types of beams.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	3	-	1	2	-	-	2
CO2	3	3	3	3	1	3	-	1	2	-	-	2
CO3	3	3	3	3	1	3	-	1	2	-	-	2
CO4	3	3	3	3	1	3	-	1	2	-	-	2
CO5	3	3	3	3	1	3	-	1	2	-	-	2
CO6	3	3	3	3	1	3	-	1	2	-	-	2

Module	Contents	Hrs	Cos
1	**Simple Stress and Strain:** Assumptions in MOM, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain curve for Mild steel, cast iron and Aluminium. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Principle of super position, elastic constants.	**9**	**CO1**
2	**Shear Force and Bending Moment 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, uniformly distributed load (UDL), uniformly varying load (UVL) and couple for different types of beams.	**9**	**C02**

3	**Bending and Shear Stresses in Beams:** Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress 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.	**9**	**CO3**
4	**Torsion of Circular Shafts:** Introduction, Pure torsion, assumptions, derivation of torsional equations, polar modulus, Torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts. **Thin and Thick Cylinder**: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders - Lame's equation.	**9**	**C04** **C05**
5	**Deflection of Beams:** Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load and UDL, Macaulay's method.	**9**	**C06**

TEXT BOOKS:

1. **"**Strength of Materials", S.S. Rattan, McGraw Hill Education. 2nd Edition, 2011, ISBN-13:9780071072564.
2. "Strength of Materials", S.S.Bhavikatti, Vikas Publishing House Pvt. Ltd. NOIDA, 3rd Ed.,2008, ISBN – 13: 9788125927914

REFERENCE BOOKS:

1. "Mechanics of Materials", by R.C.Hibbeler, Pearson Education, 11-Jan 2016, ISBN:9780134321233
2. "Mechanics of materials", James.M.Gere, Cengage Learning, 2012, ISBN-13 - 9781111577735.
3. **"**Strength of Materials", S.Ramamrutham, Dhanpatrai publishing company Pvt.Ltd, 2014, ISBN-13: 978-9384378264.

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**15**	**10**
Remember			2
Understand	5		2
Apply	10	5	2
Analyze	5	5	2
Evaluate	5	5	2
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	SEE (Theory)
Remember	5
Understand	10
Apply	15
Analyze	5
Evaluate	15
Create	

COMPUTER AIDED MACHINE DRAWING

Course Code : 19AUT46 **Credits : 03**

L:T:P : 2:1:0 **CIE Marks : 50**

Exams Hours : 03 **SEE Marks: 50**

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1	Evaluate problems on sections of regular solids
CO2	Draw the orthographic views of simple machine parts, using first angle projection.
CO3	Draw different types of threads and fasteners using conventional representation.
CO4	Apply the concepts of limit, tolerance and fits.
CO5	Create solid models of different parts and assemble them and draw their sectional views using modeling software.
CO6	Draw different types of keys, cotter, knuckle and riveted joints.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	1	-	2	2	2	2	2
CO2	2	2	2	1	3	1	1	2	2	2	2	2
CO3	2	2	2	1	3	2	1	2	2	2	2	2
CO4	2	2	2	1	3	2	-	2	2	2	2	2
CO5	2	2	2	2	3	2	1	2	2	2	2	2
CO6	2	2	2	1	3	2	-	2	2	2	2	2

Module	Contents	Hrs	Cos
1	**Sections of Solids**: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids), True shape of sections **Orthographic Views**: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (BIS conventions are to be followed for the drawings).	**9**	**CO1** **CO2**
2	**Thread forms**: Thread terminology, forms of threads – BSW Thread, Sellers thread, ISO Metric thread, square and Acme thread. Conventional representation of threads. **Fasteners**: Hexagonal headed bolt and nut with washer (assembly), square-headed bolt and nut with washer (assembly). Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws.	**9**	**C03**

3	**Keys, cotter and knuckle joints**: Types of Keys, Cotter and knuckle Joints **Riveted Joints**: lap joints- single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).	**9**	**CO6**
4	**Limits, Fits and Tolerances**: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Need of Geometrical Tolerance, Geometrical characteristics of symbols, Indication of Geometrical Tolerance, Surface finish representation.	**9**	**C04**
5	Assembly drawing of following machine parts (3D parts to be created and assembled and then getting 2D drawing with required views, along with 3D part drawings). 1. Plummer block (Pedestal Bearing) 2. Petrol Engine piston 3. I.C. Engine connecting rod 4. Screw Jack 5. Single cylinder crank shaft 6. Machine vice	**9**	**C05**

TEXT BOOKS:

1. 'Machine Drawing', N.D.Bhat & V.M.Panchal, Charotar Publishing House Ltd, 53rd edition, 2014, ISBN - 9789380358468
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication, 20th Edition, 2014

REFERENCE BOOKS:

1. 'A Primer on Computer Aided Machine Drawing', Published by VTU,2007, Belgaum
2. 'A text book of machine drawing' by R K Dhawan, S CHAND Publication, 2nd revised edition, 2014, ISBN - 978-8121908245.

CIE- Continuous Internal Evaluation for Theory/ Lab (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**20**	**5**
Remember	5		
Understand	5		
Apply	5	5	
Analyze	5	5	5
Evaluate	5	5	
Create		5	

SEE – Semester End Examination (25 Marks -Lab)

Bloom's Category	SEE (Lab)
Remember	
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	10

METALLOGRAPHY AND MATERIAL TESTING LAB

Course Code : 19AUL47 **Credits : 1.5**

L:T:P : 0:0:1.5 **CIE Marks : 25**

Exams Hours : 03 **SEE Marks: 25**

COURSE OUTCOMES: At the end of the course, the students will be able to:

CO1	Prepare and examine metallographic examination of different engineering materials and evaluate the characteristics of the specimens through non destructive techniques.
CO2	Determine the hardness of metals using Rockwell, Brinell and Vicker's Hardness tester.
CO3	Evaluate impact energy and strength using Izod and Charpy test.
CO4	Investigate mechanical characteristics through Tensile, compression, bending, shear and torsion tests.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	1	1	3	1	-	2
CO2	3	3	2	1	2	2	2	1	3	1	-	2
CO3	3	3	2	1	1	1	2	1	3	1	-	2
CO4	3	3	2	1	1	1	2	1	3	1	-	2

Sl.No	Contents of Laboratory	Cos
1	Preparation of specimen for metallographic examination and identification of microstructures of ferrous and non-ferrous materials.	**CO1**
2	Determination of cracks in given material using dye penetrant test.	**CO1**
3	To determine the hardness number of given specimen using Rockwell, Brinell and Vickers's hardness test.	**CO2**
4	To determine the impact energy and strength of notched specimen using Charpy and Izod test.	**CO3**
5	To determine the elastic strength, ultimate tensile strength, young's modulus, % of elongation and %of reduction in area of given specimen by conducting tensile test on universal testing machine.	**CO4**
6	To determine the compressive strength, modulus of elasticity, % reduction in length and % increase in area of given specimen by conducting compression test on universal testing machine**.**	**CO4**

7	To determine the moment of inertia, modulus of elasticity and maximum bending stress of wood specimen by conducting bending test on universal testing machine**.**	**CO4**
8	To determine the ultimate shear strength of the given specimen in single and double shear using UTM.	**CO4**
9	To determine the modulus of rigidity, Torsional strength and modulus of toughness of given specimen using torsion test.	**CO4**

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Record**	**Quizzes/Viva**
Marks (out of 50)	**10**	**10**	**5**
Remember	1		
Understand	1	1	2
Apply	3	3	2
Analyze	2	2	1
Evaluate	3	3	
Create			

SEE – Semester End Examination (25 Marks -Lab)

Bloom's Category	**SEE (Lab)**
Remember	3
Understand	4
Apply	7
Analyze	4
Evaluate	7
Create	

ENGINE TESTING LAB

Course Code : 19AUL48 **Credits : 1.5**

L: T: P : 0:0:1.5 **CIE Marks : 25**

Exam Hours : 03 **SEE Marks : 25**

Course Outcomes: At the end of the Course, the student will be able to:

CO1	Draw Valve and Port timing diagram.
CO2	Determine area of Regular/Irregular surfaces using planimeter
CO3	Conduct performance test on any given engine and analyze various emission levels from engine
CO4	Calculate the IHP, FHP, indicated thermal efficiency and mechanical efficiency of an SI engine and CI engines by conducting morse test.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	-	1	1	-	2
CO2	3	2	2	2	2	1	1	-	1	1	-	1
CO3	3	2	2	2	2	1	3	-	1	1	-	2
CO4	3	2	2	2	2	1	1	-	1	1	-	2

Sl. No.	List of Experiment	Hrs	CO's
1	Port Timing Diagram and Valve Timing diagram	3	**CO1**
2	To find out area of regular/irregular surfaces using planimeter	3	**CO2**
3	Conduct performance test on multi cylinder SI engine	3	**CO3**
4	Conduct performance test on single cylinder CI engine	3	**CO3**
5	Conduct performance test on multi cylinder CI engine	3	**CO3**
6	Conduct Morse test on SI engine to find FP, IP, indicated thermal efficiency and mechanical efficiency.	3	**CO4**
7	Conduct Morse test on CI engine to find FP, IP, indicated thermal efficiency and mechanical efficiency	3	**CO4**
8	Study of engine performance using alternate fuels like alcohol, bio diesel and LPG	3	**CO3**
9	Test the performance of single cylinder CI engine by varying compression ratio	3	**CO1**
10	Emission testing for various engines and fuels	3	**CO3**

Assessment Pattern:

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	Tests	Record	Viva
Marks (out of 50)	**10**	**10**	**05**
Remember	02	02	01
Understand	02	02	01
Apply	02	02	01
Analyze	02	02	01
Evaluate	02	02	01
Create			

SEE – Semester End Examination (25 Marks -Lab)

Bloom's Category	SEE (Lab)
Remember	
Understand	05
Apply	05
Analyze	10
Evaluate	05
Create	

BASIC APPLIED MATHEMATICS-II

Course Code : 19DMAT41 **Credits : 00**
L:T:P : 0:0:0 **CIE Marks : 25**
Exam Hours : 02 **SEE Marks : 25**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Gain knowledge of basic operations of vectors
CO2	Use curl and divergence of a vector function in three dimensions
CO3	Develop the ability to solve higher order Linear differential equations
CO4	Understand basic concepts of Laplace transform to solve the Periodic and Step functions and also solve initial and boundary value problems using Laplace transform method

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	1	3	-	1
CO2	3	2	3	2	2	-	-	-	1	3	-	1
CO3	3	2	3	2	2	-	-	-	1	3	-	1
CO4	3	2	3	2	2	-	-	-	1	3	-	1

Course Syllabus

Module No.	Contents of the Module	Hours	CO's
1.	**Vectors:** Definition of scalar and vector, Vector addition, Subtraction and Multiplication-Dot product, Cross product, Scalar triple product. Orthogonal, Co-planar and Angle between vectors-Problems.	**5L**	**CO1**
2.	**Vector Differentiation:** Velocity and Accelerations, Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of a vector function-Problems. Solenoidal and irrotational vector fields-Problems.	**5L**	**CO2**
3.	**Linear differential equations with constant coefficients:** Solution of initial and boundary value problems, Inverse differential operator techniques for the functions-e^{ax}, $Sin\ (ax+b)$ and $\mathrm{Cos}\ (\mathrm{ax}+\mathrm{b})$.	**5L**	**CO3**
4.	**Laplace Transform:** Definition and Laplace transforms of elementary functions-Problems. Properties of Laplace transforms (without proof) ,Periodic functions(without proof), Heaviside function(without proof) - Problems.	**5L**	**CO4**

5.	**Inverse Laplace Transform:** Inverse Laplace Transform by partial fractions, completing the square method-Problems. Solution of linear differential equations using Laplace Transforms-Problems.	**5L**	**CO4**

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, 10th Edition, 2014, ISBN: 978-81-265-5423-2.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2014, ISBN: 978-81-7409-195-5.

Reference Books:

1. Glyn James, Modern Engineering Mathematics, Prentice Hall, 4th Edition, 2015, ISBN: 978-0-273-73409-3
2. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition, 2016, ISBN: 978-0-07-063419-0.
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Assessment Pattern:

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Category	Tests (20 Marks)	Assignment (5 Marks)
Remember	5	-
Understand	5	5
Apply	5	-
Analyze	2.5	-
Evaluate	2.5	-
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Category	Questions (25 Marks)
Remember	5
Understand	10
Apply	5
Analyze	2.5
Evaluate	2.5
Create	-

APPENDIX A

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

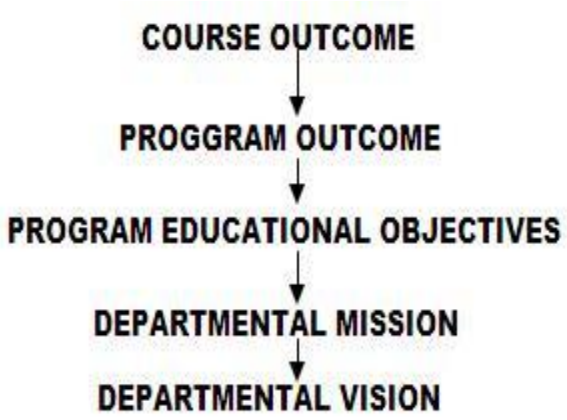
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX B

REVISED BLOOM'S TAXONOMY

Revised Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.