SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

B.E-Mechanical Engineering

CURRICULUM and SYLLABI

[For students admitted in 2019-2020]

B.E / B.Tech Regulation 2019

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester I under Regulations 2019 (CBCS)
Branch: Mechanical Engineering

S.No	Course Code	Course Title	L	T	P	C	Category
Theory							
1	U19CHE104E	Chemistry for Mechanical Engineering	3	1	0	4	BS
2	U19MAT102A	Linear Algebra and Calculus	3	1	0	4	BS
3	U19EE106	Electrical Drives and ARM Processor	3	0	0	3	ES
4	U19EGR106	Engineering Graphics**	2	0	2	3	ES
Practical							
5	U19CHL109	Chemistry Laboratory	0	0	3	1.5	BS
6	U19EEL114	Electrical Drives and ARM Processor Laboratory	0	0	4	2	ES
7	U19WPL112	Workshop Practice	0	0	2	1	ES
8	U19ENL115	Communication Skills in English - I	0	0	2	1	HS
9	U19GE101	Basic Aptitude - I	0	0	2	0	EEC
Total Credits						**19.5**	
Optional Language Elective*							
10	U19OLE1101	French					
11	U19OLE1102	German	0	0	2	1	HS
12	U19OLE1103	Japanese					

*Students may opt for foreign languages viz., German/French/Japanese with additional one credit (Not accounted for CGPA calculation)
** The examination will be conducted for 3 hours through CAD software and manual drafting.

Approved By

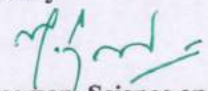| Chairperson, Science and Humanities BoS	Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.M.Renuga	**Dr.D.Senthilkumar**	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

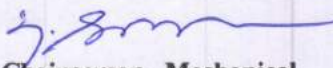HOD/Mechanical, First Semester BE Mechanical Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester II under Regulations 2019 (CBCS)
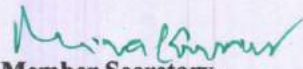### Branch: Mechanical Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Category
Theory							
1	U19PHY203D	Physics for Mechanical Engineering	3	1	0	4	BS
2	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BS
3	U19PPR205	Problem Solving Using Python Programming	3	0	0	3	ES
4	U19ME201	Manufacturing Process	3	0	2	4	ES
5	U19ENG201D	Communication Skills in English for Engineers and Technocrats	2	0	2	3	HS
Practical							
6	U19PHL210	Physics Laboratory	0	0	3	1.5	BS
7	U19PPL211	Python Programming Laboratory	0	0	2	1	ES
8	U19GE201	Basic Aptitude - II	0	0	2	0	EEC
					Total Credits	20.5	
Optional Language Elective*							
9	U19OLE1201	French					
10	U19OLE1202	German	0	0	2	1	HS
11	U19OLE1203	Japanese					

*Students may opt for foreign languages viz., German/French/Japanese with additional one credit (Not accounted for CGPA calculation)

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Chairperson, Science and Humanities BoS	Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.M.Renuga	Dr.D.Senthilkumar	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

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(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester III under Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U19MAT301B	Probability and Statistics	3	1	0	4
2	U19ME301	Engineering Mechanics - Statics and Dynamics	3	1	0	4
3	U19ME302	Engineering Thermodynamics	3	1	0	4
4	U19ME303	Fluid Mechanics and Machinery	3	0	0	3
5	U19ME304	Conventional and Smart Manufacturing	3	0	0	3
6	U19ME305	Instrumentation and Control Systems	3	0	0	3
7	U19GE302	**Mandatory course**: Environment and Climate Science	2	0	0	0
Practical						
8	U19ME306	Fluid Mechanics and Machinery Laboratory	0	0	2	1
9	U19ME307	Special Machines Laboratory	0	0	2	1
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1
					Total Credits	**24**

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S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U19ME401	Thermal Engineering	3	0	0	3
2	U19ME402	Strength of Materials	3	0	0	3
3	U19ME403	Engineering Materials and Metallurgy	3	0	0	3
4	U19ME404	Object Oriented Programming for Mechanical Engineering	3	0	0	3
5	U19ME405	Kinematics of Machines	3	0	0	3
6	U19GE403	**Mandatory Course:** Essence of Indian Traditional Knowledge	1	0	0	0
Practical						
7	U19ME406	Thermal Engineering Laboratory	0	0	2	1
8	U19ME407	Strength of Materials Laboratory	0	0	2	1
9	U19ME408	Object Oriented Programming Laboratory for Mechanical Engineering	0	0	2	1
10	U19GE401	Soft Skills and Aptitude - II	0	0	2	1
					Total Credits	**19**

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Courses of Study for B.E/B.Tech. Semester V Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19ME501	Heat and Mass Transfer	3	0	0	3	45
2	U19ME502	Dynamics of Machinery	3	0	0	3	45
3	U19ME503	Computer Aided Design and Analysis	3	0	0	3	45
4	noc21-me115	**Elective NPTEL-** Fundamentals of Additive Manufacturing Technologies	3	0	0	3	45
5	noc21-cs63	**Elective NPTEL-** Introduction to Internet of Things	3	0	0	3	45
6	U19ME901	**Elective-** Machine Learning with Python Programming	3	0	0	3	45
Practical							
7	U19ME504	Heat and Mass Transfer Laboratory	0	0	2	1	30
8	U19ME505	Dynamics of Machinery Laboratory	0	0	2	1	30
9	U19ME506	Computer Aided Design and Analysis Laboratory	0	0	2	1	30
10	U19GE501	Soft Skills and Aptitude - III	0	0	2	1	30
					Total Credits	**19**	

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Chairperson, Mechanical Engineering BoS　　　**Member Secretary, Academic Council**　　　**Chairperson, Academic Council & Principal**

Dr.D.Senthilkumar　　　　　　　　　　　Dr.R.Shivakumar　　　　　　　　　　　Dr.S.R.R.Senthil Kumar

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16.06.2021　　　　　　　　　　　　　　　　　　Regulations-2019

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(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VI Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19ME601	Design of Machine Elements	3	1	0	4	60
2	U19ME602	Mechatronics System Design	3	0	0	3	45
3	U19ME603	Operations Research	3	1	0	4	60
4	U19ME902	**Professional Elective -** Data Analytics	3	0	0	3	45
5	U19ME903	**Professional Elective -** Data Structures using Python					
6	U19ME904	**Professional Elective -** Heating Ventilation and Air Conditioning Design	3	0	0	3	45
7	U19ME905	**Professional Elective -** Modern Vehicle Technology and Automotive Testing					
8		***Open Elective - I**	3	0	0	3	45
Practical							
7	U19ME604	Mechatronics and Simulation Laboratory	0	0	4	2	60
8	U19ME605	Computer Aided Manufacturing and Measurements Laboratory	0	0	4	2	60
9	U19GE601	Soft Skills and Aptitude - IV	0	0	2	1	30
					Total Credits	**25**	

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S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		*Open Elective - I					
1	U19BM1001	Hospital Management	3	0	0	3	45
2	U19CE1001	Building Services and Safety Regulations	3	0	0	3	45
3	U19CE1003	Energy Efficiency and Green Building	3	0	0	3	45
4	U19CS1001	Big Data Analytics	3	0	0	3	45
5	U19CS1002	Cloud Computing	3	0	0	3	45
6	U19CS1006	Data Science	3	0	0	3	45
7	U19EC1003	Sensors and Smart Structures Technologies	3	0	0	3	45
8	U19EC1006	Mobile Technology and Its Applications	3	0	0	3	45
9	U19EE1001	Electric Mobility	3	0	0	3	45
10	U19EE1002	Energy Conservation and Management	3	0	0	3	45
11	U19EE1003	Innovation, IPR and Entrepreneurship Development	3	0	0	3	45
12	U19EE1004	Renewable Energy Systems	3	0	0	3	45
13	U19FT1001	Fundamentals of Fashion Design	3	0	0	3	45
14	U19FT1002	Garment Manufacturing Technology	3	0	0	3	45
15	U19IT1001	Problem Solving Techniques using Java Programming	3	0	0	3	45

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S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory						
1	U19ME701	Design of Transmission Systems		3	1	0	4	60
2	U19ME702	Design of Jigs, Fixtures and Press Tools		3	1	0	4	60
3	U19GE701	Professional Ethics and Human Values		3	0	0	3	45
4	U19ME906	**Professional Elective**	Product Life Cycle Management	3	0	0	3	45
5	U19ME907		Quality and Reliability Engineering					
6	U19ME908	**Professional Elective**	Enterprise Resource Planning	3	0	0	3	45
7	U19ME909		Supply Chain Management and Analytics					
8		***Open Elective**		3	0	0	3	45
		Practical						
9	U19ME703	Project Design		0	0	6	3	90
						Total Credits	23	

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HOD/Mechanical Engineering, Seventh Semester BE Mechanical Students and Staff, COE

Page 1

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
*Open Elective							
1	U19CE1004	Disaster Management					
2	U19CS1002	Cloud Computing					
3	U19CS1003	Internet of Things					
4	U19CS1004	Mobile Application Development					
5	U19CS1006	Data Science					
6	U19EC1001	Biomedical Instrumentation and Measurements					
7	U19EC1002	Embedded and Real Time Systems					
8	U19EC1003	Sensors and Smart Structures Technologies					
9	U19EC1005	Signal and Image Processing					
10	U19EC1007	CMOS VLSI Design	3	0	0	3	45
11	U19EE1001	Electric Mobility					
12	U19EE1002	Energy Conservation and Management					
13	U19EE1003	Innovation, IPR and Entrepreneurship Development					
14	U19EE1004	Renewable Energy Systems					
15	U19EE1005	Electrification in Building Construction					
16	U19FT1001	Fundamentals of Fashion Design					
17	U19FT1002	Garment Manufacturing Technology					
18	U19MC1003	Smart Automation					
19	U19MC1004	Fundamentals of Robotics					

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Practical					
1	U19ME801	Project Work	0	0	24	12	360
					Total Credits	**12**	

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Dr.D.Senthilkumar	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester I under Regulations 2019 (CBCS)
Branch: Mechanical Engineering

S.No	Course Code	Course Title	L	T	P	C	Category
Theory							
1	U19CHE104E	Chemistry for Mechanical Engineering	3	1	0	4	BS
2	U19MAT102A	Linear Algebra and Calculus	3	1	0	4	BS
3	U19EE106	Electrical Drives and ARM Processor	3	0	0	3	ES
4	U19EGR106	Engineering Graphics**	2	0	2	3	ES
Practical							
5	U19CHL109	Chemistry Laboratory	0	0	3	1.5	BS
6	U19EEL114	Electrical Drives and ARM Processor Laboratory	0	0	4	2	ES
7	U19WPL112	Workshop Practice	0	0	2	1	ES
8	U19ENL115	Communication Skills in English - I	0	0	2	1	HS
9	U19GE101	Basic Aptitude - I	0	0	2	0	EEC
Total Credits						**19.5**	
Optional Language Elective*							
10	U19OLE1101	French	0	0	2	1	HS
11	U19OLE1102	German					
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** The examination will be conducted for 3 hours through CAD software and manual drafting.

Approved By

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Dr.M.Renuga	**Dr.D.Senthilkumar**	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

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U19CHE104E - CHEMISTRY FOR MECHANICAL ENGINEERING

	L	T	P	C
	3	1	0	4

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

CO1: Outline the principle, applications of electrochemistry, types of corrosion and its control methods.

CO2: Describe the basic concepts, applications of surface chemistry and catalysis in engineering and technology.

CO3: Discuss the chemistry of fuels and combustion.

CO4: Analyze the industrial importance of phase rule and alloys.

CO5: Outline the principle and processes of metallurgy and powder metallurgy.

UNIT I - ELECTROCHEMISTRY AND CORROSION   12

Electrode potential – Nernst Equation – derivation and problems based on single electrode potential calculation – reference electrodes – standard hydrogen electrode – calomel electrode – Ion selective electrode – glass electrode – measurement of pH – electrochemical series – significance – electrolytic and electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – potentiometric titrations (redox – Fe^{2+} vs dichromate) – conductometric titrations (acid-base – HCl vs NaOH) – Corrosion – types – dry and wet corrosion – examples – Corrosion control methods – Sacrificial anode and impressed cathode current method.

UNIT II - SURFACE CHEMISTRY AND CATALYSIS   12

Adsorption – types-physical and chemical adsorption – adsorption of gases on solids-adsorption isotherms – Freundlich and Langmuir isotherms-adsorption of solutes from solution – applications of adsorption-role of adsorption in catalytic reactions – ion exchange adsorption- basic principles in adsorption chromatography – adsorption in pollution abatement (granular activated carbnon and powdered activated carbon) – catalysis-types - characteristics of catalysts – autocatalysis – definition and examples.

UNIT III - FUELS AND COMBUSTION   12

Fuels – calorific value – gross and net calorific values - problems based on the calculation of calorific value of a fuel – coal – proximate and ultimate analyses – metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – types – Methods of synthesis of petrol – Bergius and Fischer Tropsch processes - knocking – octane number and cetane number – power alcohol – manufacture, advantages and disadvantages – biodiesel manufacture by Transesterification process – advantages and disadvantages - Gaseous fuels – Water gas, producer gas, CNG and LPG, Combustion – flue gas analysis by Orsat's method.

UNIT IV - PHASE RULE AND ALLOYS **12**

Statement and explanation of terms involved - limitations and applications of phase rule - simple problems on the calculation of number of phases and number of components of systems in equilibrium (water system, decomposition of $CaCO_3$, PCl_5 and NH_4Cl) – Construction of phase diagram for one component system; water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead – silver system only).

Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements - ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V – METALLURGY **12**

Metallurgy – extraction of metals from its ores – froth floatation, electromagnetic separation and chemical methods – refining of metals – liquation and electrolytic refining methods – metallurgy of iron and nickel - Powder metallurgy – principle – characteristics of metal powders – methods of producing metal powders (mechanical pulverization, atomization, chemical reduction, electrolytic process, decomposition) – mixing and blending – compacting – sintering – applications, advantages and limitations of powder metallurgy, Applications of Chemistry in mechanical engineering.

TOTAL: 60 Hours

TEXT BOOKS
- P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi , 2010.
- R. Venkatesh et al, "Chemistry For Mechanical Engineering" Sonaversity, Sona College of Technology, Salem, 2019.

REFERENCE BOOKS
- O G Palana, Engineering Chemistry", Tata McGraw Hill Education (India) Private Limited, Chennai, Second Edition, 2017.
- B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Pub. Co. Ltd., New Delhi (2008).
- B.K. Sharma, "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut (2001).
- N. Krishnamurthy, K. Jeyasubramanian and P. Vallinayagam, "Applied Chemistry", Tata McGraw-Hill Publishing Company Limited, New Delhi (1999).

U19MAT102A - LINEAR ALGEBRA AND CALCULUS
Common to CIVIL, MECH, EEE, CSE, IT and MCT

	L	T	P	C
	3	1	0	4

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

- find the rank of the matrix and solve linear system of equations by direct and indirect methods
- apply the concepts of vector spaces and linear transformations in real world applications
- apply the concepts of eigen values and eigen vectors of a real matrix and their properties in diagonalization and the reduction of a real symmetric matrix from quadratic form to canonical form
- find the Taylor's series expansion, Jacobians and the maxima and minima of functions of two variables
- apply appropriate techniques of multiple integrals to find the area and volume.

UNIT I - LINEAR SYSTEM OF EQUATIONS   **12**

Rank of a matrix – Solution of linear system of equations by matrix method, Gauss elimination, Gauss-Jordan, Gauss-Jacobi and Gauss-Seidel methods.

UNIT II - VECTOR SPACES   **12**

Vector Space – Linear independence and dependence of vectors – Basis – Dimension – Linear transformations (maps) – Matrix associated with a linear map – Range and kernel of a linear map – Rank-nullity theorem (without proof).

UNIT III - EIGEN VALUES AND EIGEN VECTORS   **12**

Eigen values and eigen vectors of real matrices – Properties of eigen values and eigen vectors – Cayley-Hamilton theorem – Diagonalization of real symmetric matrices – Reduction of quadratic form to canonical form.

UNIT IV - MULTIVARIABLE CALCULUS   **12**

Functions of several variables – Partial differentiation – Total derivative – Jacobians – Taylor's theorem for function of two variables – Maxima and minima of function of two variables without constraints – Constrained maxima and minima by Lagrange's method of undetermined multipliers.

UNIT V - MULTIPLE INTEGRALS   **12**

Double integrals – Change of order of integration – Change of variables from Cartesian to polar coordinates – Area as double integrals in Cartesian coordinates – Triple integrals – Volume as triple integrals in Cartesian coordinates.

Theory: 45 hours; Tutorial: 15 hours
TOTAL: 60 Hours

TEXT BOOKS

1. T. Veerarajan, "Linear Algebra and Partial Differential Equations", McGraw Hill Publishers, 1st Edition, 2018.
2. T. Veerarajan, "Engineering Mathematics for Semesters I & II", McGraw Hill Publishers, 1st Edition, 2019.

REFERENCE BOOKS

1. S. Lipschutz and M. L. Lipson, "Linear Algebra", McGraw Hill Publishers, 6th Edition, 2018.
2. E. Kreyszig, "Advanced Engineering Mathematics", Wiley Publishers, 10th Edition, Reprint, 2017.
3. C. Prasad and R. Garg, "Advanced Engineering Mathematics", Khanna Publishers, 1st Edition, 2018.
4. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill Publishers, 29th Reprint, 2017.
5. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2018.

U19EE106 - ELECTRICAL DRIVES AND ARM PROCESSOR

	L	T	P	C
	3	0	0	3

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

CO1 Explain the Construction, operation, starting and characteristics of DC motors.

CO2 Explain the Construction, Types, Operation and characteristics of Three Phase and Single Phase Induction motors.

CO3 Describe about Types of electric drives, Heating and Cooling curves and selection of power rating for motors.

CO4 Discuss about the Solid State Speed control of DC motors and Three phase induction motors.

CO5 Identify the features of Intel 8085 Microprocessor and writing simple programs.

UNIT I - DC MOTORS **L 9**

Construction, principle of operation, torque-speed characteristics - Starters-Speed control of DC series and shunt motors (Conventional Methods) – Armature and field control, Ward-Leonard control system, Applications.

UNIT II - INDUCTION MOTORS **L 9**

Three-phase induction motor: Construction- types- principle of operation- torque-slip characteristics- starting methods and speed control (Conventional Methods)-Single phase Induction motor, Applications.

UNIT III - ELECTRIC DRIVES INTRODUCTION **L 9**

Basic Elements – Types of Electric Drives – factors are influencing the choice of electrical drives –Heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT IV - SOLID STATE SPEED CONTROL OF AC AND DC DRIVES **L 9**

Introduction- Half wave and Full Wave Rectifiers -Single phase half controlled and fully controlled bridge rectifier fed DC drives- single phase full bridge inverter with resistive and inductive load- voltage source inverter(VSI) and current source inverter (CSI) fed induction motor drives-slip power recovery scheme (Scherbious system and Kramers system)

UNIT V - ARM PROCESSOR FUNDAMENTALS   L 9

Architecture: Registers, Program status Register, Pipeline, Memory- ARM Instruction Set - Data processing Instructions, Branch Instructions, Load, store instructions, Software Interrupt Instruction, Program Statys Register Instructions, Loading Constants and Conditional Executions Basic Programming Using C.

Total: 45 hours

TEXT BOOKS

1. Vedam Subramanyan, Electrical Drives concepts and applications, Tata McGraw Hill Publications, 2014
2. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, Fourth Edition 2010.

REFERENCE BOOKS

1. Pillai.S.K "A first course on Electric drives", Wiley Eastern Limited,3rd Edition Reprint 2015.
2. Jonathan W. Valvano., "Embedded System: Introduction to ARM Cortex-M Microcontrollers", 5th Edition, 2017, ISBN-13: 978-1477508992
3. Electrical Drives and Microprocessor, Sonaversity.

U19EGR106 - ENGINEERING GRAPHICS

	L	T	P	C
	2	0	2	3

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

CO1   Predict the construction of various curves in civil elevation, plan and machine components.

CO2   Analyze the principles of projection of various planes by different angle to project points, lines and planes.

CO3   Draw the principles of projection of simple solid by the axis is inclined to one reference plane by change of position method.

CO4   Understand the interior details of complex components, machineries by sectioning the solid body. Study the development of surfaces for prisms and pyramids.

CO5   Draw the projection of three dimensional objects representation of machine structure and explain standards of orthographic views by different methods.

CONCEPTS AND CONVENTIONS (Not for Examination)   L 3

Importance of graphics in engineering applications, Use of drafting instrument, BIS conventions and specifications - Size, layout and folding of drawing sheets, Lettering and dimensioning.

COMPUTER AIDED DRAFTING (Not for Examination)   L 3

Importance 2d Drafting, sketching, modifying, transforming and dimensioning.

UNIT I - PLANE CURVES (Manual drafting)   L 6

Curves used in engineering practices Conics – Construction of ellipse – Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II - PROJECTION OF POINTS, LINES AND PLANE SURFACES   L 12
(CAD Software)

Projection of points – Projection of straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to one reference planes.

UNIT III - PROJECTION OF SOLIDS   L 12
(CAD Software)

Creation of 3D CAD models of pyramids, prisms and solids of revolutions - Sectional views - **(Not for Examination)**

Projection of simple solids like prisms – pyramids – cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV - SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES L 12
(CAD Software)

Sectioning of simple solids like prisms – pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other, (Obtaining true shape of section is not required). Development of lateral surfaces of simple and truncated solids – Prisms – pyramids – cylinders and cones.

UNIT V - CONVERSION OF ISOMETRIC VIEWS TO ORTHOGRAPHIC VIEWS   L 12
(Manual drafting)

Representation of three dimensional objects – General Principles of Orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout of views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

TOTAL: 60 Hours

TEXT BOOKS
1. P. Suresh et al., "Engineering Graphics and Drawing", Sonaversity, Sona College of Technology, Salem, Revised edition, 2012.
2. K.V. Natarajan Engineering Graphics by, Chennai, 17th edition 2003.

REFERENCE BOOKS
1. Dhananjay A. JoIhe, Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Company Limited, 2008.
2. Basant Agarwal and Agarwal C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. K. R. Gopalakrishnana, Engineering Drawing (Vol. I & II), Subhas Publications, 1998.
4. Bertoline & Wiebe fundamentals of graphics communication III edition McGrawhill 2002.

U19CHL109 - CHEMISTRY LABORATORY

	L	T	P	C
	0	0	3	1.5

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

- Estimate the amount of total, temporary and permanent hardness in the given water sample
- Analyse the different types of alkalinity and determine their amount in the given water sample
- Analyse the two given water samples and find which one possesses more chloride content in the given water samples by argentometric method.
- Analyse the two given brass samples and find which one possesses more copper content in the brass samples.
- Estimate the amount of hydrochloric acid present in the given solution using pH metry.
- Evaluate the iron content of the water by spectrophotometry.
- Estimate the amount of hydrochloric acid present in the given solution using conductivity meter.
- Estimate the amount of hydrochloric acid and acetic acid present in the given solution using conductivity meter.
- Describe the estimation of ferrous iron present in the given solution using potentiometer.
- Describe the method of determining the molecular weight of a given polymer.
- Analyse the two given water samples and find which one possesses more dissolved oxygen in the given water samples by Winkler's method.
- Analyse the two given waste waters and find which one possesses more chromium content.

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method.
2. Estimation of alkalinity of water sample by indicator method.
3. Estimation of chloride ion present in the sample water by argentometric method.
4. Estimation of copper in brass by EDTA method.
5. Estimation of HCl by pH metry.
6. Determination of iron content in water by spectrophotometric method.
7. Estimation of HCl by conductometry. (HCl vs NaOH)
8. Estimation of mixture of acids by conductometry. (HCl + CH_3COOH vs NaOH)
9.
10. Estimation of ferrous ion by potentiometric titration.
11. Determination of Molecular weight of a polymer by viscosity measurements.
12. Determination of Dissolved Oxygen of water by Winkler's method.
13. Estimation of chromium in waste water.

Total: 45 Hours

U19EEL114 - ELECTRICAL DRIVES AND ARM PROCESSOR LABORATORY

L	T	P	C
0	0	4	2

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

CO1   Analyze the characteristics and determine the efficiency of DC and AC motors.

CO2   Control the speed of DC and AC motors using rheostat and solid state controllers.

CO3   Execute a simple program interfacing with ARM processor.

LIST OF EXPERIMENTS

1. Load test on DC Shunt motor.
2. Load test on DC Series motor.
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on three phase squirrel cage Induction motor
5. Load test on single phase Induction Motor.
6. Speed control of three phase slip ring Induction Motor.
7. Single phase half controlled converter using R, RL Loads.
8. Single phase fully controlled converter using R, RL Loads.
9. Speed control of DC motor using 3Phase converter.
10. Speed control of 3 Phase Induction motor using Voltage Source Inverter (VSI).
11. Study of ARM evaluation system.
12. Write a program to interface stepper motor using ARM processor.
13. Write a program for an on chip ADC using ARM processor.

TOTAL: 60 hours

U19WPL112 - WORKSHOP PRACTICE

	L	T	P	C
	0	0	2	1

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

CO1   Familiarize with the basic of tools and equipment's used in fitting, carpentry, welding and sheet metal.

CO2   Fabricate the different simple products in above trades.

CO3   Produce different joining of metals.

LIST OF EXPERIMENTS

SECTION 1:   **FITTING**

Tools and Equipment's- Practice in filling.

Making of Vee joint and square (T-fitting) joint.

SECTION 2:   **SHEET METAL**

Tools and Equipment's- Practice

Making of Dust Pan and Funnel.

SECTION 3:   **WELDING**

Tools and Equipment's – Practice

Arc welding of Butt joint and Lap Joint.

SECTION 4:   **CARPENTRY**

Tools and Equipment's- Planning Practice

Making of Half Lap joint and Dovetail Joint.

TOTAL: 30 Hours

U19ENL115 - COMMUNICATION SKILLS IN ENGLISH – I

	L	T	P	C
	0	0	2	1

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

- Communicate competitively among themselves
- Demonstrate improved ability to communicate effectively in work place and at home
- Introduce themselves, deliver speeches on general topics and make technical presentation

Part – 1

- Extempore presentation – story narration, simple, general, abstract topics and incidents

Part - 2

- Self- introduction - personal information, name, home background, study details, area of interest, hobbies, strengths and weaknesses
- Mini presentation in small groups of two or three on office arrangements, facilities, office functions, sales, purchases, training recruitment, advertising, applying for financial assistance, applying for a job, team work, discussion, presentation

- Situational Role Play - between examiner and candidate, teacher and student, customer and sales manager, hotel manager and organiser, team leader and team member, bank manager and candidate, interviewer and applicant, car driver and client, industrialist and candidate

Total: 30 hours

U19GE101 - BASIC APTITUDE – I
(Common to All Departments)

L	T	P	C
0	0	2	0

Course Outcomes: At the end of course, the students will be able to
1. Solve fundamental problems in specific areas of quantitative aptitude
2. Solve basic problems in stated areas of logical reasoning
3. Demonstrate rudimentary verbal aptitude skills in English with regard to specific topics

1. Quantitative Aptitude and Logical Reasoning
Solving simple problems with reference to the following topics:
a. Numbers – HCF & LCM
b. Decimal fractions
c. Square roots & cube roots
d. Surds & Indices
e. Logarithms
f. Percentage
g. Averages
h. Coding and Decoding & Visual language

2. Verbal Aptitude
Demonstrating plain English language skills with reference to the following topics:
a. Synonyms
b. Antonyms
c. Verbal analogy
d. Editing passages
e. Sentence filler words

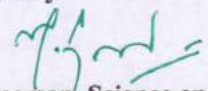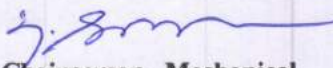**TOTAL: 30 hours**

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester II under Regulations 2019 (CBCS)
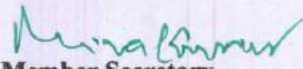### Branch: Mechanical Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Category
		Theory					
1	U19PHY203D	Physics for Mechanical Engineering	3	1	0	4	BS
2	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BS
3	U19PPR205	Problem Solving Using Python Programming	3	0	0	3	ES
4	U19ME201	Manufacturing Process	3	0	2	4	ES
5	U19ENG201D	Communication Skills in English for Engineers and Technocrats	2	0	2	3	HS
		Practical					
6	U19PHL210	Physics Laboratory	0	0	3	1.5	BS
7	U19PPL211	Python Programming Laboratory	0	0	2	1	ES
8	U19GE201	Basic Aptitude - II	0	0	2	0	EEC
					Total Credits	20.5	
		Optional Language Elective*					
9	U19OLE1201	French	0	0	2	1	HS
10	U19OLE1202	German					
11	U19OLE1203	Japanese					

*Students may opt for foreign languages viz., German/French/Japanese with additional one credit (Not accounted for CGPA calculation)

Approved By

Chairperson, Science and Humanities BoS Dr.M.Renuga	Chairperson, Mechanical Engineering BoS Dr.D.Senthilkumar	Member Secretary, Academic Council Dr.R.Shivakumar	Chairperson, Academic Council & Principal Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/Mechanical, Second Semester BE Mechanical Students and Staff, COE

U19PHY203D - PHYSICS FOR MECHANICAL ENGINEERING

	L	T	P	C
	3	1	0	4

Course Outcomes: At the end of the course, the students will be able to,
CO1: explain motion of objects in two dimension.
CO2: discuss different types of waves and their uses
CO3: illustrate electromagnetic waves and their applications.
CO4: explain optical phenomena of waves and their propagation
CO5: describe quantum physics concepts and their uses.

UNIT I - MECHANICS   12
Vectors: Introduction to vector – coordinate systems – vector and scalar quantities – some properties of vectors – components of a vector and unit vectors
Motion in Two Dimensions: The position, velocity and acceleration vectors – Two-dimension motion with constant acceleration – Projectile motion – Analysis mode; Particle in uniform circular motion – tangential and radial acceleration – relative velocity and relative acceleration.

UNIT II - MECHANICAL WAVES   12
Wave Motion: Propagation of a disturbance – Analysis Model – travelling wave – the speed of waves on strings – reflection and transmission – rate of energy transfer by sinusoidal waves on strings – the linear wave equation.
Sound Waves: Pressure variations in sound waves – speed of sound waves – intensity of periodic sound waves – The Doppler effect.

UNIT III - DC CURRENT AND ELECTROMAGNETIC WAVES   12
Direct Current Circuits: Electromotive force – Resistors in series and parallel – Kirchhoff's rules – RC circuits – Household wiring and electrical safety.
Electromagnetic waves: Displacement current and the general form of Ampere's law – Maxwell's equations and Hertz's discoveries – plane electromagnetic waves – Energy carried by electromagnetic waves – momentum and radiation pressure – Production of electromagnetic waves by antenna – the spectrum of electromagnetic waves.

UNIT IV - WAVE OPTICS, DIFFRACTION PATTERNS AND POLARIZATION   12

Wave Optics: Young's double-slit experiment – Analysis Model: Waves in interference – Intensity distribution of the double-slit interference pattern – change of phase due to reflection – interference in thin films – The Michelson's interferometer.

Diffraction Patterns and Polarization: Introduction to diffraction patterns – diffraction patterns from narrow slits – resolution of single-slit and circular apertures – The diffraction grating – diffraction of x-ray by crystals – polarization of light waves.

UNIT V – QUANTUM PHYSICS   12

Particle nature of radiation: Compton Effect - expression for Compton shift (no derivation)

Wave nature of matter: de Broglie waves - Schrodinger's time independent and time dependent wave equations - Physical significance of wave function - Energy and wave function of an electron trapped in one dimensional box- A particle in a well of finite height and width.

Application of wave nature of particles: Introduction to electron microscope- Comparison of optical and electron microscope - Scanning electron microscope- Limitations of electron microscope.

TOTAL: 60 Hours

TEXT BOOKS

1. Physics for Scientists and Engineers by Serway & Jewett – Cengage Publications 9th edition.
2. B. K. Pandey and Manoj K. Harbola, Cengage Learning India Pvt. Ltd., Delhi, 2012

REFERENCES

1. C. Shanthi etal., Engineering Physics, Sonaversity, Sona College of Technology, Salem (Revised edition, 2016).
2. M.N. Avadhanulu and PG Kshirsagar, A Text book of Engineering Physics, S.Chand and company, Ltd., New Delhi, 2005.
3. Rajendran.V and Marikani. A, Engineering Physics, Tata Mc Graw Hill Publications Ltd, III Edition, New Delhi, 2004.

U19MAT202A - DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

$$
\begin{array}{cccc}
\textbf{L} & \textbf{T} & \textbf{P} & \textbf{C} \\
\textbf{3} & \textbf{1} & \textbf{0} & \textbf{4}
\end{array}
$$

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

CO1: apply the classical methods to solve linear ordinary differential equations.

CO2: apply the appropriate numerical methods to solve ordinary differential equations.

CO3: apply the Laplace transforms technique to solve ordinary differential equations.

CO4: apply the classical method to solve partial differential equations.

CO5: apply the concepts of vector differentiation and integration to determine the line, surface and volume integrals

UNIT I - ORDINARY DIFFERENTIAL EQUATIONS   12

Linear higher order ordinary differential equations with constant coefficients – Cauchy's and Legendre's homogeneous linear ordinary differential equations – Method of variation of parameters.

UNIT II - NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS   12

Single Step Methods: Taylor's series – Euler and Modified Euler methods – Fourth order Runge – Kutta method for solving first and second order ordinary differential equations.

Multi Step Methods: Milne's and Adam's predictor-corrector methods.

UNIT III - LAPLACE TRANSFORMS   12

Laplace transform: Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse function – Initial and final value theorems – Transform of periodic functions.

Inverse Laplace transform: Standard results – Statement of convolution theorem and its applications– Solution of linear second order ordinary differential equations with constant coefficients using Laplace transform.

UNIT IV - PARTIAL DIFFERENTIAL EQUATIONS   12

Formation of partial differential equations – Lagrange's linear equation – Solution of standard types of first order partial differential equations – Linear partial differential equations of second and higher order with constant coefficients.

UNIT V - VECTOR CALCULUS   12

Vector differentiation: Scalar and vector valued functions – Gradient, directional derivative, divergence and curl – Scalar potential.

Vector integration: Line, surface and volume integrals – Statements of Green's, Stoke's and Gauss divergence theorem – Simple applications involving squares, rectangles, cubes and rectangular parallelopiped.

TOTAL: 60 Hours

TEXT BOOK

1. T. Veerarajan, "Linear Algebra and Partial Differential Equations", McGraw Hill Publishers, 1st Edition, 2018.
2. T. Veerarajan, "Engineering Mathematics for Semesters I & II", McGraw Hill Publishers, 1st Edition, 2019.

REFERENCES

1. J. Stewart, "Calculus", Cengage Publishers, 8th Edition, 2016.
2. C. Prasad and R. Garg, "Advanced Engineering Mathematics", Khanna Publishers, 1st Edition, 2018.
3. E. Kreyszig., "Advanced Engineering Mathematics", Wiley Publishers, 10th Edition, Reprint, 2017.
4. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2018.
5. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill Publishers, 29th Reprint, 2017.

U19PPR205 - PROBLEM SOLVING USING PYTHON PROGRAMMING

	L	T	P	C
	3	0	0	3

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

CO1: develop algorithmic solutions to simple computational problems
CO2: write simple Python programs
CO3: write programs with the various control statements and handling strings in Python
CO4: develop Python programs using functions and files
CO5: analyze a problem and use appropriate data structures to solve it.

UNIT I - ALGORITHMIC PROBLEM SOLVING   9

Need for computer languages, Generation and Classification of computers - Basic organization of a computer, Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

UNIT II - BASICS OF PYTHON PROGRAMMING   9

Introduction - Python Interpreter-Interactive and script mode -Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, input function, print function, Formatting numbers and strings, implicit/explicit type conversion.

UNIT III - CONTROL STATEMENTS AND STRINGS   9

Conditional (if), alternative (if-else), chained conditional (if-elif-else). Iteration-while, for, infinite loop, break, continue, pass, else. Strings-String slices, immutability, string methods and operations.

UNIT IV - FUNCTIONS AND FILES   9

Functions - Introduction, inbuilt functions, user defined functions, passing parameters - positional arguments, default arguments, keyword arguments, return values, local and global scope, recursion, and lambda functions. Files -Text files, reading and writing files.

UNIT V - DATA STRUCTURES: LISTS, SETS, TUPLES, DICTIONARIES   9

Lists-creating lists, list operations, list methods, mutability list functions, searching and sorting, Sets-creating sets, set operations. Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Nested Dictionaries.

.

TOTAL: 45 Hours

REFERENCES

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education, 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013.

U19ME201- MANUFACTURING PROCESS

	L	T	P	C
	3	0	2	4

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

CO1: explain the major concepts of material removal process and characterization of tool wear and its types

CO2: make clear the cutting tool materials and its specific purpose and explain about lathe details, main dissimilarity of capstan and turret lathes.

CO3; describe the various types of welding process for the engineering application and investigate the welding defects.

CO4: explain the sand casting process, pattern materials and special casting processes.

CO5: discuss the various types of moulding processes in manufacturing of plastic components..

SECTION - A

UNIT I - THEORY OF METAL CUTTING   9

Introduction: material removal processes, nomenclature of single point cutting tool-chip formation, orthogonal cutting, oblique cutting- shear angle in orthogonal cutting-cutting tool materials, tool wear, Taylors tool life, factors affecting tool life – Tool life Calculations -surface finish, cutting fluids..

UNIT II - CENTRE LATHE AND SPECIAL PURPOSE LATHES   9

Centre lathe: constructional features- various operations, tool and work holding devices- taper turning methods, special attachments, Lathe machining time calculations. Capstan and turret lathes – automats –Swiss type- - geneva mechanism, Bar feed mechanism.

UNIT III - METAL JOINING PROCESS   9

Gas welding: Types- oxy- acetylene, Flame characteristics- Arc welding: Types- Metal arc welding-TIG welding- MIG welding-Plasma arc welding- Submerged arc welding- Electro slag welding - Resistant welding: Butt- Spot- Seam welding, Friction welding-Electron beam welding. Thermit Welding - Brazing- Soldering- Welding defects.

UNIT IV - METAL CASTING   9

Sand Casting- Moulding Tools- Types of Patterns- Pattern Materials- Pattern Allowances- Types of Moulding Sand- Properties- Core Making- Methods of Sand Testing- Moulding Machines: Types- Melting Furnaces: Cupola, Crucible and Electric

arc furnace- Special Casting Process: Shell, Investment Casting - Lost Wax Process-Pressure Die Casting- Centrifugal Casting- CO2 Process- Sand Casting Defects-Inspection Methods.

UNIT V - MANUFACTURING OF PLASTIC COMPONENTS   9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion.

TOTAL: 45 Hours

SECTION – B

PRACTICAL

LIST OF EXPERIMENTS
1. Experiment on Simple Facing & Turning.
2. Exercise on Step And Taper Turning Model.
3. Exercise on Grooving And Thread Cutting Operation.
4. Exercise on Drilling, Boring.
5. Exercise on Arc Welding (Tee Joint)
6. Exercise on TIG Welding
7. Exercise on MIG Welding

TOTAL: 45 Hours

Total Number of Hours : 75

Learning Resources

TEXT BOOKS
1. J.P .Kaushish "Manufacturing Processes" PHI Learning Private limited, second edition 2010.
2. Hajra Choudhury, "Elements of Workshop Technology, Vol. I Media Promoters & Publishers pvt ltd .2009

REFERENCES
1. B.S. Magendran parashar & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.

2. P.N. Rao, Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2009.

LIST OF EQUIPMENTS

1. Centre Lathe with accessories   -   15 No
2. Pillar type drilling machine   -   01 No
3. Table top drilling machine   -   01 No
4. Arc Welding Unit   -   01 No
5. TIG Welding Unit   -   01 No
6. MIG Welding Unit   -   01 No

U19PHL210 - PHYSICS LABORATORY

	L	T	P	C
	0	0	3	1.5

Course Outcomes: At the end of the course, the students will be able to,
1. apply the principles of optics and thermal physics to determine the Engineering properties of materials.
2. apply the principles of elasticity and electricity to determine the Engineering properties of materials.
3. determine the resistivity of the given fuse wire used for house hold applications.

List of Experiments

1. Determination of the thickness of a thin wire by forming interference fringes using air wedge apparatus.
2. Determination of wavelength of prominent colors in mercury spectrum using a spectrometer.
3. Determination of dispersive power of the prism for various pairs of colors in the mercury spectrum using a spectrometer.
4. Determination of wavelength of the laser source.
5. Determination of particle size of lycopodium powder using diode laser.
6. Determination of acceptance angle and numerical aperture of an optical fibre using diode laser.
7. Determination of the thermal conductivity of a bad conductor using Lee's Disc apparatus.
8. Determination of rigidity modulus of the material of wire using torsion pendulum
9. Determination of specific resistance of a given wire using Carey Foster's bridge.
10. Determination of coefficient of viscosity of liquid by Poiseuille's method.
11. Determination of the Young's modulus of the given material by non-uniform bending method.
12. Determination of the Young's modulus of the given material by uniform bending method.
13. Determination of band gap of the given semiconductor diode.

14. Determination of velocity of ultrasonic waves and compressibility of the given liquid using ultrasonic interferometer.

Total: 45 Hours

II Semester

U19ENG201D - Communication Skills in English for Engineers and Technocrats

MECH

Course Outcome: At the end of course, the students will be able to
1. Use grammatical components effectively in both written and spoken communication
2. Read for gathering and understanding information, following directions and giving responses
3. Develop effective reading skills and reinforce language skills required for using grammar and building vocabulary.
4. Write email, formal letters and descriptions of graphics
5. Develop skills for writing reports and proposals, and for general purpose and technical writing.

UNIT -I

- Focus on language -articles- prepositions - modal verbs- prefixes and suffixes.
- Understanding notice, messages, timetable, advertisements, graphs, Etc.
- Writing e-mail, constructing paragraphs and essays

UNIT – II

- Focus on language - active and passive voice, tenses
- Reading passages for specific information transfer.
- Letter Writing - inviting dignitaries, accepting and declining invitations letter writing

UNIT - III
- Focus on language - Collocation, concord,
- Reading passage with multiple choice questions
- Proposal

UNIT - IV
- Focus on language - if conditional clauses, cause and effect expresions
- Short reading passage: gap-filling exercise related to grammar
- Writing- resume, instructions.

UNIT - V
- Focus on language - pronoun, adverbs
- Short reading passages for sentence matching exercises, picking out specific information in a short text
- Writing- note making, report writing
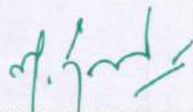
Textbook:
1. Technical English I & II, Dr. M. Renuga et al. Sonaversity, 2016.

Extensive Reading
1. Who Moved my Cheese? – Spencer Johnson-G. P. Putnam's Sons
2. Discover the Diamond in You – Arindham Chaudhari – Vikas Publishing House Pvt. Ltd.

Reference
1. Norman Whitby, Business Benchmark – Pre-Intermediate to Intermediate, Students Book, Cambridge University Press, 2006.
2. A Course in Communication Skills, P. Kiranmai Dutt, Geetha Rajeevan, C. L. N. Prakash, published by Cambridge University Press India Pvt. Ltd.

Dr. M. Renuga
BoS – Chairperson,
Science & Humanities
HOD / H&L

U19PPL211 - PYTHON PROGRAMMING LABORATORY

L T P C
0 0 2 1

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

CO1: implement the algorithms using basic control structures in Python

CO2: develop Python programs to use functions, strings and data structures to solve different types of problems

CO3: implement persistent storing information through file operations

List of Experiments

1. Draw flowchart using any open source software.
2. Implement programs with simple language features.
3. Implement various branching statements in python.
4. Implement various looping statements in python.
5. Develop python programs to perform various string operations like concatenation, slicing, indexing.
6. Implement user defined functions using python.
7. Implement recursion using python.
8. Develop python programs to perform operations on list and tuples
9. Implement dictionary and set in python
10. Implement python program to perform file operations.

TOTAL: 30 Hours

U19GE201 - BASIC APTITUDE – II

	L	T	P	C
	0	0	2	0

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

CO1: solve more elaborate problems than those in BA-I in specific areas of quantitative aptitude.

CO2: solve problems of greater intricacy than those in BA-I in stated areas of logical reasoning.

CO3: demonstrate higher than BA-I level verbal aptitude skills in English with regard to specific topics.

List of Experiments

1. **QUANTITATIVE APTITUDE AND LOGICAL REASONING**

   Solving quantitative aptitude and logical reasoning problems with reference to the following topics

   a. Ratio and proportion
   b. Partnership
   c. Chain rule
   d. Ages
   e. Profit, loss and discount
   f. Geometry
   g. Area and volume
   h. Data arrangement

2. **VERBAL APTITUDE**

   Demonstrating verbal aptitude skills in English with reference to the following topics

   a. Jumbled sentences
   b. Reconstructions of sentences (PQRS)
   c. Sentence fillers two words
   d. Idioms and phrases
   e. Spotting errors
   f. Writing captions for given pictures

TOTAL: 24 Hours

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester III under Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
		Theory				
1	U19MAT301B	Probability and Statistics	3	1	0	4
2	U19ME301	Engineering Mechanics - Statics and Dynamics	3	1	0	4
3	U19ME302	Engineering Thermodynamics	3	1	0	4
4	U19ME303	Fluid Mechanics and Machinery	3	0	0	3
5	U19ME304	Conventional and Smart Manufacturing	3	0	0	3
6	U19ME305	Instrumentation and Control Systems	3	0	0	3
7	U19GE302	**Mandatory course**: Environment and Climate Science	2	0	0	0
		Practical				
8	U19ME306	Fluid Mechanics and Machinery Laboratory	0	0	2	1
9	U19ME307	Special Machines Laboratory	0	0	2	1
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1
					Total Credits	**24**

Approved By

Chairperson, Mechanical Engineering BoS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**

Dr.D.Senthilkumar   Dr.R.Shivakumar   Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/Mechanical Engineering, Third Semester BE Mechanical Students and Staff, COE

COURSE CODE   U19MAT301B   L T P C

COURSE NAME   PROBABILITY AND STATISTICS   3 1 0 4

Course Outcomes

Upon completion of this course the students will be able to

CO1 Apply the concepts in measure of central tendency, dispersion, correlation and regression for the given data and analyze the results.

CO2 Apply the concepts of random variables and their properties to generate the moments.

CO3 Fit the suitable distribution and its properties to the real world problems and interpret   the results.

CO4 Apply the concepts of joint probability distribution and its properties to find the   covariance.

CO5 Test the hypothesis of the population using sample information.

Unit – I   BASIC STATISTICS   L 9 T 3

Measures of central tendency (simple arithmetic mean, median, mode) – Quartiles – Measures of dispersion (range, inter-quartile range, quartile deviation, mean deviation, standard deviation, coefficient of variation) – Simple correlation – Curve fitting (straight line and parabola).

Unit – II   RANDOM VARIABLES   L 9 T 3

Discrete and continuous random variables – Probability mass function, probability density function, moments, moment generating function and their properties.

Unit – III   THEORETICAL DISTRIBUTIONS   L 9 T 3

Binomial, Poisson, geometric, uniform, exponential and normal distributions and their properties. Applications.

Unit – IV   TWO DIMENSIONAL RANDOM VARIABLES   L 9 T 3

Joint distributions, marginal and conditional distributions – Covariance – Correlation – Central limit theorem.

Unit – V   TESTING OF SIGNIFICANCE   L 9 T 3

Sampling distributions - Testing of hypothesis for mean, standard deviation, variance, proportion and differences using normal and t distributions - χ^2- tests for independence of attributes and goodness of fit and F distribution.

Total Number of hours: 60

Learning Resources

Text Books

1. S. C. Gupta, V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, Reprint, 2019.
2. T. Veerarajan, "Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks", McGraw Hill Publishers, 4th Edition, 7th Reprint, 2018.

Reference Books

3. R. A. Johnson and C. B. Gupta, "Miller and Freund's, Probability and Statistics for Engineers", Pearson Publishers, 9th Edition, 2018.
4. S. Ross, "A first course in probability", Pearson Publishers, 9th Edition, 2019.
5. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall Publishers, Reprint, 2003.
6. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Edition, Wiley Publishers, 2008.
7. S. P. Gupta, "Statistical Methods", Sultan Chand and Sons Publishers, 15th Edition, 2012.

COURSE CODE   **U19ME301**   L T P C

COURSE NAME   **ENGINEERING MECHANICS – STATICS AND DYNAMICS**   3 1 0 4

Course Outcomes

Upon completion of this course the students will be able to

CO1   Provide an introduction to the basic quantities and idealizations of mechanics and examine the standard procedures for performing numerical calculations.

CO2   Solve particle equilibrium problems using the equations of equilibrium and analyze the forces acting on the members of frames.

CO3   Compute the centroid of plane surfaces and develop a method for determining the moment of inertia.

CO4   Examine the principles of relative motion of two particles and to analyze the mechanics of elastic body impact

CO5   Analyze the mechanics of friction

Unit – I   **FUNDAMENTAL CONCEPTS OF MECHANICS**   L 9 T 3

Introduction to mechanics – Fundamental concepts, units and dimensions – Scalars & vectors - General procedure for analyses – unit conversion – Laws of Mechanics (parallelogram law, Lami's theorem and triangular law of forces) – Types of forces acting on a body – Equilibrium of a particle - Equivalent system of forces and computation of resultant forces – Principle of transmissibility.

Unit – II   **EQUILLIBRIUM OF RIGID BODIES & STRUCTURAL ANALYSIS**   L 9 T 3

Conditions for Rigid-Body Equilibrium – Free-Body Diagrams – Equations of Equilibrium – Two and Three-Force Members – Equations of Equilibrium – Constraints and Statical Determinacy – Introduction to truss elements – Analysis of simple trusses by the method of joints.

Unit – III   **CENTRIODS AND AREA MOMENT OF INERTIA**   L   9   T   3

Introduction – Centroids of simple Plane Areas and Curves (rectangle, triangle, circle, hollow circle, T-section & I-section) – Area moment of inertia for rectangle, circle, hollow circle, triangle, I-Section and T-Section.

Unit – IV   **KINETICS AND KINEMATICS OF PARTICLES**   L 9 T 3

Concept of displacement, velocity and acceleration – Newton's laws of motion(fundamentals) – Work–Energy principle – introduction to Impulse and momentum – analyses of impact of elastic bodies – Introduction to principle of virtual work (Qualitative treatment only).

Unit – V   FRICTION   L 9 T 3

Types of friction – laws of sliding friction – Equilibrium analyses of simple systems with sliding friction – Angle of friction – cone of friction – Equilibrium of bodies on inclined plane – Ladder friction - Wedge Friction

Total Number of hours: 60

Learning Resources

Text Books

1. R. C. Hibbler, Engineering Mechanics: Statics & Dynamics, Person Prentice hall, 12th   edition
2. Meriam J.L. and Kraige L.G., "Engineering Mechanics - Statics – Volume 1, Dynamics - Volume 2", Third Edition, John Wiley & Sons.

Reference books:

3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education.
4. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi.
5. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing Company.

COURSE CODE   **U19ME302**   L T P C

COURSE NAME   **ENGINEERING THERMODYNAMICS**   3 1 0 4

COURSE OUTCOME:

Upon completion of this course the students will be able to

CO1   Discuss the thermodynamic properties of system and apply the first Law of Thermodynamics to solve engineering problems.

CO2   Apply the Second law of Thermodynamics and entropy principle to various processes and thermodynamic cycles.

CO3   Determine the thermodynamic properties of pure substance in flow and non-flow processes.

CO4   Compare the ideal and real gases and its thermodynamic relations and formulate Maxwell's relation, Clausius Clapeyron equations.

CO5   Calculate the cooling, heating and humidifier capacities for air-conditioner using psychrometric chart.

UNIT I   BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS   L 9 T 3

Basic concepts of thermodynamics, macroscopic and microscopic concepts, system, surroundings, Concept of Universe and control volume, properties of system-Intensive and Extensive, state, process and cycle, Definition of Thermodynamic Work -- Units for Work -- Forms of Work – Definition of Heat -- Inter Convertibility of Heat/work into Work/heat -- Governing Principles -- Sign Convention, temperature, law of conservation of mass, momentum and energy, - Concept of Quasi static process, thermodynamic equilibrium, zeroth law of thermodynamics, Statement of First Law of Thermodynamics , The Constant Volume and Constant Pressure Specific Heats -- The internal Energy, Enthalpy and Specific Heats of An Ideal Gas, application of first law to non-flow processes and steady flow systems.

UNIT II   SECOND LAW OF THERMODYNAMICS AND CONCEPTS OF ENTROPY   L 9 T 3

Definition of Heat Engine and Reservoirs -- Kelvin-Planck and Clausius Statements of the Second Law -- Reversible and Irreversible Engines and processes -- Causes of Irreversibility -- Internal and External Irreversibility, heat pump and refrigerator, The Efficiency of a Carnot Cycle -- The Thermodynamic Temperature Scale -, Clausius theorem and third law of thermodynamics, Clausius Inequality -- Entropy -- A Property of A System -- The Entropy of A Pure Substance -- Entropy Change in Reversible Process -- Principle of Increase of Entropy, availability and irreversibility (theory only).

UNIT III   PROPERTIES OF PURE SUBSTANCE   L 9 T 3

Properties of pure substance, thermodynamic properties of pure substance in solid, liquid and vapour phases, phase rule, Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. thermodynamic properties of steam. Calculations of work done and heat transfer in non flow and flow processes. Determination of steam quality.

UNIT IV   IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS   L 9 T 3

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. –Generalized Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Joule-Thomson Coefficient, Clausius Clapeyron equation.

UNIT V   PSYCHROMETRY   L 9 T 3

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Total Number of hours: 60

Text book:

1. Chattopadhya,P. Engineering Thermodynamics, Oxford university press, New Delhi,2016.

2. Cengel, 'Thermodynamics – An Engineering Approach' eighth Edition, Tata McGraw Hill, New Delhi, 2014.

REFERENCES

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.

2. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2015.

3. Holman.J.P., "Thermodynamics", 4th Ed. McGraw-Hill, 2008.

4. Michael J Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Baily, "Fundamentals of Engineering Thermodynamics" 8th Edition, John Wiley& sons, 2014

5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2004.

COURSE CODE	U19ME303	L T P C
COURSE NAME	**FLUID MECHANICS AND MACHINERY**	3 0 0 3

Pre-requisites subject: Engineering Physics and Transforms & Partial differential equations

Course Outcomes

Upon completion of this course the students will be able to

CO1 Apply mathematical knowledge to predict the properties and concept of pressure measurement.

CO2 Analyze the fluid flow problems using continuity equation and Bernoulli's equation with their applications.

CO3 Distinguish laminar and turbulent flow through circular pipes and power transmission through pipes.

CO4 Solve the real time problems with help of dimensional analysis by using Buckingham's ∏ theorem.

CO5 Analyze the performance of hydraulic turbines and pumps.

Unit – I   FLUID PROPERTIES AND PRESSURE MEASUREMENT   L 9

Definitions – Fluid - Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension, cavitation and capillarity - Pressure measurement- manometry, buoyancy, stability of floating bodies, forces on submerged bodies.

Unit – II   FLUID KINEMATICS AND DYNAMICS   L 9

Types of fluid flow - application of continuity equation, Continuity equations in Cartesian coordinates. Euler's equation of motion along streamline, Bernoulli's equation, and its applications- Orifice meter, Venturimeter, Pitot tube.

Unit – III   FLOW THROUGH PIPES   L 9

Laminar flow though circular pipes – Hagen Poiseuille equation - Boundary layer concept- Turbulent flow through circular pipes - Darcy Weisbach equation – friction factor - Moody diagram - Energy losses, pipes in series and parallel - Power transmission through pipes.

Unit – IV   DIMENSIONAL ANALYSIS   L 9

Need for dimensional analysis – methods of dimensional analysis – Buckingham's π theorem, Dimensionless parameters - application of dimensionless parameters. Models and Similitude - Model laws.

Unit – V   HYDRAULIC TURBINES AND PUMPS   L 9

Hydraulic turbines-classification and working principle. Pelton wheel turbine -Francis turbine -Kaplan turbine- Velocity triangle-work done- Efficiencies- Performance calculations.

Centrifugal pumps– working principle – work done by the impeller – performance curves – Reciprocating pump- working principle – comparison.

Total Number of hours: 45

Learning Resources

Text Books

1. Sukumar Pati., "Fluid Mechanics and Hydraulics Machines", Tata McGraw Hill publications (P) Ltd, New Delhi, 2012.

2. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, (9th edition), Laxmi publications (P) Ltd, New Delhi, 2017

Reference Books

3. C.S.P.Ojha, R.Berndtsson, P.N.Chandramouli., Fluid Mechanics and Machinery, Oxford University Press, New Delhi, 2010

4. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House 20th edition, New Delhi 2015.

5. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.9th edition.

6. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004.

7. Ramamritham. S, Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai & Sons, Delhi, edition 2012.

COURSE CODE   **U19ME304**   L T P C

COURSE NAME   **CONVENTIONAL AND SMART MANUFACTURING**   3 0 0 3

Pre-requisites subject: Manufacturing Process

Course Outcomes

Upon completion of this course the students will be able to

CO1   Acquire knowledge about principle of special machine tools and its operating mechanisms.

CO2   Demonstrate the working of various bulb deformation processes involving drawing, forging, rolling, and extrusion process.

CO3   Acquire knowledge and analyze the various sheet metal processes.

CO4   Classify additive manufacturing process and identify suitable RP process for product manufacturing.

CO5   Enhance and adopt smart manufacturing knowledge towards industry development.

Unit – I   SPECIAL MACHINE TOOLS   L 9

Construction, Types, Operations and mechanisms of Shaper, Planner, Slotter and Broaching. Operations: drilling –Reaming, Boring- Tapping. Milling operations-types of milling cutter. Gear: cutting, forming, milling, hobbing and gear shaping. Grinding: cylindrical grinding, surface grinding, Centreless grinding – honing, lapping and buffing.

Unit – II   SHEET METAL PROCESSES   L 9

Sheet metal: characteristics-typical shearing operations-bending and drawing operations – stretch forming operations – formability of sheet metal – test methods–working principle and application of special forming processes –hydro forming - Rubber pad forming - Metal spinning-Introduction to Explosive forming - Magnetic pulse forming-peen forming - super plastic forming.

Unit – III   BULK DEFORMATION PROCESSES   L 9

Hot and Cold working Process- Drawing Process: Wire drawing, Tube drawing, Metal Spinning, Embossing- Coining- **Forging Process**: Open and closed die forging- operations- Forging machine, **Rolling**: Type of rolling mills- Principle of rod and wire drawing – Tube drawing- Defects in rolling parts, **Extrusion**:- Principles of Extrusion – Types – Hot and Cold extrusion.

Unit – IV   DIGITAL MANUFACTURING   L 9

Introduction, Classification, Fusion Deposition Modeling, Stereo-lithography, Solid Ground Curing, Selective Laser Sintering, 3D printers: Principle – process parameters – process details – machine details, Software's, Applications.

Unit – V   SMART MANUFACTURING   L 9

Introduction, Industry 4.0, Internet of Things (IoT) for manufacturing, IoT enabling technologies, IoT design methodology, logical design, IoT physical devices. Cloud computing-introduction, Cloud services and platforms, Case studies: Industrial automation, Production Monitoring, Applications.

Total Number of hours: 45

Learning Resources

Text Book:
1. Mikell P Groover, " Principles of Modern Manufacturing" Wiley India Pvt Ltd. 2014.
2. S. Jeschke, C Brecher, H. Song and D.B Rawat, "Industrial Internet of Things: Cyber manufacturing Systems", Springer, 1st edition, 2013.
3. Pham D.T. & Dimov.S.S., "Rapid manufacturing", Springer-Verlag, London, 2001.

Reference Books:
1. P.N. Rao, "Manufacturing Technology: Metal Cutting and Machine Tools, Volume 2"
2. Published by Tata McGraw-Hill Education Pvt. Ltd (2013)
3. B.L. Juneja,G.S. Sekhon, Nitin Seth, "Fundamentals of Metal Cutting and Machine Tools" Published by New Age International (P) Limited (2014)
4. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Company Ltd, revised edition, 2011.
5. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.
6. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping", Wiley, 2006

COURSE CODE	U19ME305	L T P C

COURSE CODE   **U19ME305**   L T P C

COURSE NAME   **INSTRUMENTATION AND CONTROL SYSTEM**   3 0 0 3

Pre-requisites subject: Physics for Mechanical Engineering

Course outcome:

Upon completion of this course the students will be able to

CO1   Explain the fundamental elements of instrumentation, measurement and control systems.

CO2   Measure the parameters and performance of transducers.

CO3   Develop the measurement techniques used for mechanical systems.

CO4   Apply control engineering techniques to the automatic control systems found in modern manufacturing, processing and transportation environments.

CO5   Design the mechanical control system for automation.

Unit – I   **MEASURING SYSTEM**   L 9

General concepts of Mechanical measuring instruments – Elements of a measuring system – Requirements of measuring instruments – Static and dynamic characteristics of measuring instruments – Errors in measurements - Loading effect and impedance matching- statistical analysis-Least square method- uncertainty analysis- Zero and first order system- step response and impulse response.

Unit – II   **TRANSDUCER ENGINEERING**   L 9

Transducers and Sensors–Classification and types- Mathematical model of transducer-static and dynamic characteristics- resistive transducers- Inductive and capacitive transducers -Transducer Troubleshooting- special transducers-Smart sensors-Nano sensors.

Unit – III   **INDUSTRIAL INSTRUMENTATION**   L 9

Measurement of vibrations – Accelerometer – Measurement of Low, Medium, and High pressures- Measurement of temperature: pyrometer, Fiber optics sensor for temperature measurement - Measurement of flow- hot wire anemometer – magnetic flow meter– ultrasonic meter. Measurement of displacement – Measurement of Force –Strain gauge, Load cells- Measurement of torque – Measurement of Speed – Case study assignments.

Unit – IV   **CONTROL SYSTEM**   L 9

Introduction to Control systems – Open and Closed loop systems – servomechanisms. Transfer function: Block diagram reduction algebra, signal flow graphs – Pollution Control system- Basics of Controllers and response analysis- Problems.

Unit – V   **DESIGN OF AUTOMATION AND CONTROLS SYSTEM**   L 9

Automated systems- introduction to systems –design of hydraulic and pneumatic control system controls- sequence operations- Applications of relays/switches- design of – electro pneumatics - Programmable controllers - Design of components for assembly - Cost considerations - programmable logic controllers - PLC languages- case studies.

Total Number of hours: 45

Learning Resources

Text Book:

1. Ernest O. Doebelin, Dhanesh N. Manik (2019) Doebelin's Measurement Systems: 7th Edition, McGraw-Hill; Seventh edition, ISBN-13: 978-9353168711.

2. Alan S. Morris, Reza Langari (2016) Measurement and Instrumentation: Theory and application, Academic Press, ISBN No. 978-0-12-3819604.

Reference Books:

1. D Patranabis (2017) Transducers and Instrumentation, McGraw Hill education; 3 edition, ISBN-13: 978-0070699717

2. Arun K. Ghosh (2012) Introduction to measurements and instrumentation, PHI Learning Pvt. Ltd.

3. U.A.Bakshi A.V. Bakshi (2009) Measurements and instrumentation, Technical Publications, ISBN No. 9788184315295

4. Zoran Gajić, M. Lelic (2013) Modern control systems Engineering, Dover Publications.

COURSE CODE	**U19ME306**	L	T	P	C
COURSE NAME	**FLUID MECHANICS AND MACHINERY LABORATORY**	0	0	2	1

Course Outcomes

Upon completion of this course the students will be able to

CO1 Calibrate the various flow measuring instruments.

CO2 Analyze the energy losses occur in flow of fluid through pipes.

CO3 Analyze the performance of the various pumps and turbines (Pelton, Francis and Kaplan turbine).

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Determination of minor losses for a given set of pipes.
5. Determination of velocity of air using pitot tube.
6. Conducting experiments and drawing the characteristic curves of Pelton wheel.
7. Conducting experiments and drawing the characteristics curves of Francis turbine.
8. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
9. Conducting experiments and drawing the characteristic curves of centrifugal pump.
10. Conducting experiments and drawing the characteristic curves of Reciprocating pump.

List of Equipment's: (for a batch of 30 students)

1. Orifice meter setup.
2. Venturi meter setup.
3. Friction loss setup.
4. Fitting loss setup.
5. Pitot-tube setup.
6. Pelton wheel turbine setup.
7. Francis turbine setup.
8. Kaplan turbine setup.
9. Centrifugal pump.
10. Reciprocating pump.

Total Number of hours 30

COURSE CODE	**U19ME307**	L	T	P	C
COURSE NAME	**SPECIAL MACHINES LABORATORY**	0	0	2	1

Pre-requisites subject: Manufacturing technology Laboratory

Course Outcomes

Upon completion of this course the students will be able to

   CO1   Perform various metal cutting operations to generate gears.

   CO2   Do grinding operations using commonly used machine tools.

   CO3   Demonstrate shaping and slotting operations using commonly used machine tools.

LIST OF EXPERIMENTS

1. Exercises on Horizontal milling machine –gear generating.
2. Exercises on Vertical milling machine –key way generating.
3. Grinding of flat surface using surface grinder machine.
4. Grinding of cylindrical surfaces using cylindrical grinding machine.
5. Shaping operations- two or more Exercises (Round to square, Hexagonal Shape and dovetail)
6. Internal key way slotting in slotting machine.
7. Exercises on capstan or turret lathe and study of bar feed mechanism in turret lathe.

List of Equipment's: (for a batch of 30 students)

1. Turret and Capstan Lathes - 1 No
2. Horizontal Milling Machine - 1 No
3. Vertical Milling Machine - 1 No
4. Surface Grinding Machine - 1 No
5. Cylindrical Grinding Machine - 1 No
6. Shaper - 2 Nos.
7. Slotter - 1 No

Total Number of hours 30

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Semester-III	U19 GE301- SOFT SKILLS AND APTITUDE – I	L	T	P	C	Marks
		0	0	2	1	100

Course Outcomes

At the end of the course the student will be able to:

1. Demonstrate capabilities in specific soft-skill areas using hands-on and/or case-study approaches
2. Solve problems of greater intricacy in stated areas of quantitative aptitude and logical reasoning
3. Demonstrate higher levels of verbal aptitude skills in English with regard to specific topics

1.Soft Skills	**Demonstrating soft-skill capabilities with reference to the following topics:** a. Attitude building b. Dealing with criticism c. Innovation and creativity d. Problem solving and decision making e. Public speaking f. Group discussions
2. Quantitative Aptitude and Logical Reasoning	**Solving problems with reference to the following topics:** a. **Vedic Maths:** Fast arithmetic, multiplications technique, Criss cross, Base technique, Square root, Cube root, Surds, Indices, Simplification. b. **Numbers:** Types, Power cycle, Divisibility, Prime factors & multiples, HCF & LCM, Remainder theorem, Unit digit, highest power. c. **Averages:** Basics of averages and weighted average. d. **Percentages**: Basics of percentage and Successive percentages. e. **Ratio and proportion:** Basics of R &P, Alligations, Mixture and Partnership. f. **Profit ,Loss and Discount**: Basic & Advanced PLD g. **Data Interpretation**: Tables, Bar diagram, Venn diagram, Line graphs, Pie charts, Caselets, Mixed varieties, Network diagram and other forms of data interpretation. h. **Syllogism:** Six set syllogism using Venn diagram and tick and cross method
3. Verbal Aptitude	**Demonstrating English language skills with reference to the following topics:** a. Verbal analogy b. Tenses c. Prepositions d. Reading comprehension e. Choosing correct / incorrect sentences f. Describing pictures g. Error spotting

1

Sona College of Technology, Salem   **Department of Sciences (Chemistry)**

SEMESTER – III

MANDATORY COURSE

U19GE302 - ENVIRONMENT AND CLIMATE SCIENCE

(Common for CSE, CIVIL, EEE, MECH)

Course Outcomes:

L	T	P	C
2	0	0	0

At the end of the course, the student will be able to

1. state the importance of the acute need for environmental awareness and discuss significant aspects of natural resources like forests, water and food resources.
2. explain the concepts of an ecosystem and provide an overview of biodiversity and its conservation.
3. explain environmental based pollution their causes, effects and their remedial measures
4. discuss their causes, effects and the control measures of Global Warming, Acid Rain, Ozone Layer Depletion
5. describe the effect of climate change due to pollution

UNIT I   INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES   6

Definition, Scope and Importance Forest Resources:- Use and over - exploitation, deforestation, Case Studies, Water Resources:- Use and Over-Utilization of Surface and ground water , Floods, Drought, Food Resources- Effects of Modern Agriculture, Fertilizer- Pesticide Problems–Role of an Individual in Conservation of Natural Resources.

UNIT II   ECOSYSTEMS AND BIODIVERSITY   6

Structure and Function of an Ecosystem– Energy Flow in the Ecosystem -Food Chains, Food Webs and Ecological Pyramids.

Introduction to Biodiversity –Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values –India as a Mega-Diversity Nation — Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – Endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.

UNIT III   ENVIRONMENTAL POLLUTION   6

Definition – Causes, Effects and Control Measures of:- (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution, Solid Waste Management- Effects and Control Measures of Acid Rain,– Role of an Individual in Prevention of Pollution..

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UNIT IV   CLIMATE CHANGE ON THE ENVIRONMENT   6

Sustainable Development- - Climate Change- Causes and effects of Global Warming - Effect of global warming in food supply, plants, sea, coral reef, forest, agriculture, economy - Kyoto Protocol in reduction of greenhouse gases - Ozone Layer Depletion - mechanism, effects and control measures- Montreal Protocol to protect ozone layer depletion - Rain Water Harvesting - .Effect of climate change due to air pollution Case study - CNG vehicles in Delhi

UNIT V   EFFECT OF CLIMATE CHANGE ON POLLUTION   6
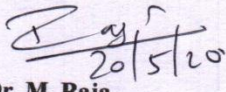
Fungal diseases in forests and agricultural crops due to climatic fluctuations - Growing energy needs - effect of climate change due to non-renewable energy resources. Renewable energy resources in the prevention of climatic changes- Effect of climatic changes in ground water table, garments, monuments, buildings, consumption of energy, agriculture and in electric power sector - Carbon credit - carbon footprint - disaster management -Role of an individual to reduce climate change.
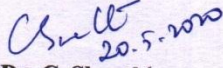
TOTAL: 30 HOURS

Text Books:
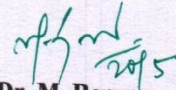
1. Miller, T.G. Jr., "Environmental Science", Wadsworth Pub. Co. 2018
2. Anubha Kaushik and Kaushik, "Environmental Science and Engineering" New Age International Publication, 4th Multicolour Edition, New Delhi, 2014.

References:

1. S. Radjarejesri et al., "Environmental Science" Sonaversity, Sona College of Technology, Salem, 2018.
2. Masters, G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 2nd Edition, 2004.
3. Erach, B., "The Biodiversity of India", Mapin Publishing P.Ltd.,Ahmedabad, India.
4. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 2005, University Grands Commission, Universities Press India Private Limited, Hyderguda, Hyderabad – 500029.

Dr. M. Raja
Course Coordinator / Sciences

Dr. C. Shanthi
HOD / Sciences

Dr. M. Renuga
Chairperson BOS,
Science and Humanities

20.05.2020   B.E. / B.Tech. Regulations 2019

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
theory		**Theory**				
1	U19ME401	Thermal Engineering	3	0	0	3
2	U19ME402	Strength of Materials	3	0	0	3
3	U19ME403	Engineering Materials and Metallurgy	3	0	0	3
4	U19ME404	Object Oriented Programming for Mechanical Engineering	3	0	0	3
5	U19ME405	Kinematics of Machines	3	0	0	3
6	U19GE403	**Mandatory Course:** Essence of Indian Traditional Knowledge	1	0	0	0
		Practical				
7	U19ME406	Thermal Engineering Laboratory	0	0	2	1
8	U19ME407	Strength of Materials Laboratory	0	0	2	1
9	U19ME408	Object Oriented Programming Laboratory for Mechanical Engineering	0	0	2	1
10	U19GE401	Soft Skills and Aptitude - II	0	0	2	1
					Total Credits	**19**

Approved By

Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.D.Senthilkumar	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-
    HOD/Mechanical Engineering, Fourth Semester BE Mechanical Students and Staff, COE

COURSE CODE   **U19ME401**   L T P C

COURSE NAME   **THERMAL ENGINEERING**   3 0 0 3

Pre-Requisites Subject: Engineering Physics, Engineering Mathematics, Python   Programming and Engineering Thermodynamics.

Course Outcomes

Upon completion of this course the students will be able to

- **CO1**   Calculate the mean effective pressure and air standard efficiency of various gas power cycles.
- **CO2**   Test the performance of Internal Combustion engines under different load conditions.
- **CO3**   Estimate steam flow rate through nozzle and analyze steam power cycle.
- **CO4**   Determine various performance characteristics of air compressors.
- **CO5**   Determine the COP of vapor compression refrigeration systems and solve cooling load   estimation problems with python programming.

Unit – I   **GAS POWER CYCLES**   L 9 T 0

Otto, Diesel, Dual, Stirling, Brayton cycles. P-V and T-S diagram, Calculation of mean effective pressure and air standard efficiency, comparison of Otto, diesel and dual cycles.

Unit – II   **INTERNAL COMBUSTION ENGINES**   L 9 T 0

Classification of I.C engines, four stroke and two stroke cycle engines, combustion phenomenon and knocking in SI and CI engine, Valve and port timing diagrams – super-charging - Ignition system and fuel injection system. Cooling and lubrication system. Engine tests - performance, heat balance, and retardation - Morse test.

Unit – III   **NOZZLES AND STEAM POWER CYCLES**   L 9 T 0

Steam nozzles- flow through steam nozzles, effect of friction, critical pressure ratio and super saturated flow. Steam power cycle-, Rankine, Reheat and regeneration cycle.

Unit – IV   **AIR COMPRESSORS**   L 9 T 0

Classifications of compressors - Reciprocating air compressor - performance characteristics, effect of clearance volume, free air delivery and displacement, intercooler, –Description of Rotary compressor, vane, centrifugal and axial compressors.

Unit – V   REFRIGERATION AND AIR CONDITIONING   L 9 T 0

Fundamentals of refrigeration – COP - Vapour compression refrigeration system - cycle, p-h chart, Vapour absorption system- comparison, properties of refrigerants. Fundamentals of air conditioning system, types and working principles. Python programming for solving cooling load estimation in air conditioning design (simple problems).

Total Number of hours: 45

Learning Resources

Text Books

1. R.K.Rajput, "Thermal Engineering" , Laxmi Publications, New Delhi, Sixth edition, 2005

2. Kothandaraman C.P, Domkundwar and A.V. Domkundwar, "A course in Thermal Engineering", Dhanpat Rai & Sons, Fifth Edition, 2002.

3. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education, 2018.

Reference Books

4. Sarkar B.K., "Thermal Engineering", Tata McGraw-Hill, New Delhi New Delhi, 2001

5. Arora C.P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 2000.

6. Holman J.P. "Thermodynamics", McGraw-Hill, 1985.

7. V.Ganesan, "Internal Combustion Engines", Tata McGraw-Hill, New Delhi, 2008.

8. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.

COURSE CODE   **U19ME402**   L T P C

COURSE NAME   **STRENGTH OF MATERIALS**   3 0 0 3

Pre-requisite subjects: Engineering Physics, Engineering Mechanics, Python Programming

Course Outcomes

Upon completion of this course the students will be able to

CO1   Analyze the stress and strain for engineering components with different loading conditions and their use in design of machine members and structures.

CO2   Determine the effect of various loading combinations on a mechanical/ structural member by determining the principal stresses, principal planes and maximum shear stress under various combinations of axial stress under various combinations of axial loads on machine and structural ports using Mohr's circle.

CO3   Propose the principles, equations and necessary tools to analyze structural members under axial loads, bending, shear and torsion.

CO4   Illustrate the material behavior under a condition of pure torsion on circular shafts and analyze and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic behavior of materials.

CO5   Design of beams, columns and struts under various loading conditions using the appropriate methods and Python programming.

Unit – I   STRESS, STRAIN AND DEFORMATION OF SOLIDS   L 9 T 0

Simple stress and strain – Stresses and strains due to axial force - Stress-strain curve – Hooke's law - Factor of safety – Stepped shafts – Uniformly varying sections – Stresses in composite sections - Temperature stresses – Poisson's ratio - elastic constants.

Unit – II   ANALYSIS OF STRESSES IN TWO DIMENSIONS   L   9   T   0

State of stresses at a point – Normal and tangential stresses on inclined planes - Principal planes and stresses – Plane of maximum shear stress - Mohr's circle for biaxial stresses –Hoop and longitudinal stresses in thin cylinders and shells – under internal pressure – deformation of thin cylinders and shells.

Unit – III   BEAMS - LOADS AND STRESSES   L 9 T 0

Beams – types of supports – simple and fixed, types of load – concentrated, uniformly distributed, varying distributed load, combination of above loading. Bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Point of contra flexure. Introduction to Theory of simple bending.

Unit – IV   TORSION IN SHAFTS AND SPRINGS   L 9 T 0

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness. Springs- Classification – Leaf springs, closed coil helical springs - Application of various springs – Maximum shear stress in spring – Deflection of helical coil springs under axial loads.

Unit – V   DEFLECTION OF BEAMS   L 9 T 0

Deflection of beams – double integration method – Macaulay's method – slope and deflection using moment area method. Columns: Buckling of long columns due to axial load - Equivalent length of a column – Euler's and Rankine's formulae for columns of different end conditions –Slenderness ratio. Introduction to Python- Write a Python program to find slope and deflection of Beams.

Total Number of hours: 45

Learning Resources

Text Books

1. R K Bansal, "A text book of Strength of Materials", Lakshmi Publications (P) Limited, New Delhi, Sixth Edition, 2018.

2. SS Rattan, '' Strength of Materials'', McGraw Hill Education (India) Private Limited.   Chennai, Third Edition, 2017.

3. R K Rajput, "Strength of Materials", S Chand & Co., New Delhi, Sixth Edition 2018.

Reference books:

4. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.

5. Singh D.K "Mechanics of Solids" Pearson Education 2002.

6. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.

7. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi , Second Edition 2012.

8. Robert L Mott and Joseph A. Untener, ''Applied Strength of Materials'', CRC Press, Sixth Edition , 2016.

9. Nagar Sandeep. Introduction to Python: For Scientists and Engineers, independently published (2016)

10. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

11. Opensource documentation at https://docs.python.org/3/library/index.html

COURSE CODE   **U19ME403**   L T P C

COURSE NAME   **ENGINEERING MATERIALS AND METALLURGY**   3 0 0 3

Pre-requisites subjects: Engineering Chemistry, Engineering Physics.

COURSE OUTCOME:

Upon completion of this course the students will be able to

CO1   Discuss constitutions of alloys with their formation reactions of solid solutions and phase diagrams.

CO2   Analyze the various heat treatments process and different kinds of heat treatment diagrams for real time applications.

CO3   Compare the Various ferrous & non-ferrous metals and its various alloys in the engineering scope.

CO4   List the non-metallic materials with its properties and its importance and compare themselves with the normal metals and their alloys.

CO5   Test the mechanical properties of various materials by different testing methods and identify suitable material for emerging products.

Unit I   **CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS**   L 9 T 0

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectoid reactions, imperfections in solids: vacancies, interstitials, linear defects, edge and screw dislocations, interfacial defects, Equilibrium diagram- Iron – Iron carbon.

Unit II **HEAT TREATMENT**   L 9 T 0

Diffusion-steady-state and non-steady-state, Isothermal transformation diagrams – cooling curves superimposed on I.T diagram- CCR. Full annealing, recrystallization and spheroidising –normalizing, hardening, Jominy end quench test –Austempering, martempering – case hardening - carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening.

Unit III   **FERROUS AND NONFERROUS METALS**   L 9 T 0

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti& W) - stainless and tool steels– HSLA - maraging steels – Cast Irons - Grey, White, malleable, spheroidal graphite, alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al alloys – Bearing alloys.

Unit IV   **NON-METALLIC MATERIALS**   L 9 T 0

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK,PTFE, Polymer Composites -particle and fibre reinforced plastics. Ceramics, Cermets, Glass (amorphous) and Carbon Products.

Unit V   TESTING AND THE METHODOLOGY OF MATERIAL SELECTION   L 9 T 0

Mechanism of plastic deformation, slip and twinning, Types of fracture, Corrosion and Degradation of Materials -Testing of materials under tension, compression and shear loads, Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests. Selection of Materials: part and material requirements- material system- list candidate materials- properties of requirements-select best match and specify it- case histories.

Total Number of hours: 45

Learning Resources

Text books:

1. R.K.Rajput "Engineering Materials & Metallurgy" S Chand Publications. 2006
2. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2014.
3. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials properties and selection" Pearson India Education Services Pvt ltd, 9 edition, 2017.

Reference books:

1. William D Callister, "Material Science and Engineering", John Wiley and Sons 2007.
2. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.

COURSE CODE   **U19ME404**   L T P C

COURSE NAME   **OBJECT ORIENTED PROGRAMMING FOR**
                         MECHANICAL ENGINEERING   3 0 0 3

Course Outcomes

Upon completion of this course the students will be able to

CO1   Demonstrate the use of various OOPs concepts in connection with C++.

CO2   Describe arrays, function arguments and utilization of constructors and destructors.

CO3   Write C++ program to solve real world problem with code reusability through inheritance.

CO4   Write C++ programs for various applications with file handling.

CO5   Illustrate the various templates and applications of exceptional handling.

Unit – I   **INTRODUCTION TO OOP'S**   L 9 T 0

Overview of C - Basic concepts and benefits of OOP - Structure of C++ program – Tokens-Keywords – Identifiers – constants - Data types - Basic, User defined, Derived - Reference variables - Scope resolution operator - Type casting - Function Prototyping - call by reference, return by reference - Inline function - Default arguments – Function overloading. Solve problems of Projectile's, Centroid of symmetrical, T – Section and Principal stresses by using user defined function.

Unit – II   **CLASSES AND OBJECTS**   L 9 T 0

Class specification - Access qualifiers - Static data members and member functions - Array of objects - Objects as function arguments - Friend functions - Returning objects - Local classes -Constructors - Destructors - Operator Overloading: Operator function – Overloading unary and binary operator - Overloading the operator using friend function. Program for inventory management of Hydraulic pump, Air compressor and Electric vehicle industries.

Unit – III   **INHERITANCE AND POINTERS**   L 9 T 0

Derived classes - Single Inheritance - Multiple Inheritance - Multi level inheritance - Hierarchical Inheritance - Hybrid Inheritance - Constructors in derived classes. Pointers - Pointers to objects – this pointer - Virtual functions. Program for vehicles production management of an automobile industry.

Unit – IV   **MANAGING CONSOLES AND WORKING WITH FILES**   L 9 T 0

Stream classes - Formatted I/O - I/O Manipulators - User defined manipulators File handling - File pointer and manipulation - Sequential and random access - Error handling.

Unit – V   TEMPLATES AND EXCEPTION HANDLING   L 9 T 0

Function templates, overloaded function templates, user defined template arguments, class templates. Exception Handling: Exception handling mechanism, multiple catch, nested try, re-throwing the exception.

Total Number of hours: 45

Learning Resources

Text Books:

1. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill, Sixth Edition, 2013.

Reference Books:

2. K.S. Easwarakumar, " Object Oriented Data Structures Using C++", Vikas Publication House Pvt Ltd, First Edition, 2000.

3. Hubbard John, "Programming with C++" , Tata McGraw Hill, 2000.

4. Robert Lafore, "Object Oriented Programming in Turbo C++", Galgotia Publications, 2006.

5. K. R.Venugopal, Rajkumar, T.Ravishankar, "Mastering C++", Tata McGraw Hill, 2007.

6. B.Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

7. Bjarne Stroustrup, "The C++ Programming Language", Pearson Education, Fourth Edition, 2013.

COURSE CODE   U19ME405   L T P C

COURSE NAME   KINEMATICS OF MACHINES   3 0 0 3

Pre-requisites subject: Engineering Physics and Mathematical geometry, Python Programming

Course outcome:

Upon completion of this course the students will be able to

CO1   Apply Kutzbach and Gruebler's criterion, Grashoff's law to solve problems in various mechanisms using python.

CO2   Determine the displacement, velocity, and acceleration in simple mechanisms.

CO3   Construct displacement diagrams and cam profile for radial cam.

CO4   Design the simple, compound and epicyclic geartrains.

CO5   Synthesize a four-bar mechanism and analyze the characteristics of robot arm kinematics.

Unit – I   BASICS OF MECHANISMS   L 9 T 0

Basic concepts of Link, Kinematic pair, Kinematic chain, Mechanism, Machine, Degree of Freedom, Kutzbach and Grubler's criterion and Grashoff's law- Degree of freedom calculation using python programming - Kinematic Inversions of four bar chain and slider crank chain - Mechanical Advantage - Transmission angle. Description of common Mechanisms – Single, Double and Offset slider mechanism. Straight line Mechanisms (Exact & Approximate Straight line).

Unit – II   KINEMATICS OF LINKAGE MECHANISMS   L 9 T 0

Analysis of simple mechanisms (single slider crank mechanism, four bar mechanism) - Graphical methods for displacement, velocity and acceleration polygons; Coincident points – Coriolis acceleration. Velocity analysis using instantaneous centers of simple mechanisms (Single slider crank mechanism and four bar mechanism).

Unit – III   KINEMATICS OF CAM MECHANISMS   L 9 T 0

Classifications of cam and follower – Displacement, Velocity & Acceleration diagram – Follower Motion (Uniform Velocity Motion, Simple Harmonic Motion, Uniform Acceleration and Retardation motion, Cycloidal motions) – Graphical construction of displacement, Velocity & Acceleration diagram and cam profile for a radial cam - Pressure angle and undercutting.

Unit – IV   GEARS AND GEAR TRAINS   L 9 T 0

Classification of gears – Gear tooth terminology –involute tooth profile. Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio - Interference and undercutting – Nonstandard gear teeth – helical, bevel, worm, rack and pinion gears (basics only). Gear trains – Simple, compound and Epicyclic gear trains.

Unit – V   **SYNTHESIS OF MECHANISMS AND ROBOT ARM KINEMATICS**   L 9 T 0

Classification of synthesis – type, dimension, number, Synthesis of four bar mechanism -Chebyshev Method. Robot Arm kinematics – Denavit - Hartenberg Parameters - Forward and inverse kinematics of robot manipulators.

Total Number of hours: 45

Learning Resources

Text Book:

1. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2010. ISBN: 9789351340201
2. Sadhu Singh, "Theory of Machines", Pearson Education, New Delhi, 3rd Edition, 2011, ISBN-13: 978-8131760697.
3. S.S.Rattan, "Theory of Machines & Mechanisms", Tata Mcgraw hill publishers, 4th Edition, 2014, ISBN-13: 978-9351343479.
4. Uicker J.J.,Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms" (Indian Edition), Oxford University Press, 2014, ISBN-13: 978-0199454167.
5. K.S. Fu, R.C Gonzalez, "Robotics control, sensing, Vision, and Intelligence", Tata McGraw-Hill, 2016, ISBN-13: 978-0-07-026510-3.
6. Reema Thareja, Problem Solving and Programming with Python: With Free Access to Coding Simulator, Oxford University Press, 2018, ISBN-13: 978-0-19-948949-7.

Reference Books:

1. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2nd Edition, 1992, ISBN-13: 978-8122404265.
2. John Hannah and Stephens R.C, "Mechanics of Machines", Viva Low-Prices, Student Edition, 1999.
3. P.L.Ballaney, "Theory of Machines", Khanna publishers, 23rd Edition, 2003, ISBN 817409122X, 9788174091222.
4. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005, ISBN-13: 978-8123908748.
5. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2008, ISBN-13: 978-8185938936.
6. Ramamurti,V.,'' Mechanism and Machine Theory", Second Edition, Narosa Publishing House, New Delhi, 3rd Edition, 2010, ISBN: 978-81-7319-892-2.

COURSE CODE	U19ME406			L	T	P	C
COURSE NAME	**THERMAL ENGINEERING LABORATORY**			0	0	2	1

Pre-requisites subject: Engineering thermodynamics and Thermal engineering.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Identify components and experience the function of each component of Internal combustion engine and analyze the suitability of fuels for engines.

CO2 Compare the volumetric efficiency of IC engines and air compressors under various delivery pressures.

CO3 Evaluate the performance of IC engines, refrigeration and air conditioning systems.

List of Experiments:
1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Retardation Test to find Frictional Power of a Diesel Engine.
5. Determination of Calorific value of Fuel using Bomb Calorimeter.
6. Determination of Viscosity using Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.
8. Performance test on reciprocating air compressor.
9. Determination of COP of a Refrigeration system.
10. Determination of COP of an air conditioning system.
11. Demo on Morse Test on Multi cylinder Petrol Engine.

List of Equipment's: (for a batch of 30 students)
1. Single Cylinder 4-Stroke 5 HP Kirloskar Diesel Engines with Eddy Current Dynamometer.
2. Single Cylinder 4-Stroke 5 HP Kirloskar Diesel Engine With Electrical Loading.
3. Single Cylinder 4-Stroke 5 HP Kirloskar Diesel Engine With Mechanical Loading.
4. Multi-cylinder 4-Stroke Isuzu Petrol Engine with Hydraulic Dynamometer and Exhaust Gas Calorimeter.
5. Twin Cylinder 4-Stroke Texvel Diesel Engine with Bulb Loading and Exhaust Gas Calorimeter.
6. Cut Section Model of Actual Single Cylinder 4-Stroke Petrol Engine.
7. Cut Section Model of Actual Single Cylinder 4-Stroke Diesel Engine.
8. Section Model of Actual Single Cylinder 2-Stroke Petrol Engine.
9. Two Stage Air Compressor Test Rig.
10. Flash and Fire Point Apparatus.
11. Red Wood Viscometer.
12. Refrigeration Test Rig.
13. Air Conditioning Test Rig.
14. Bomb Calorimeter.

Total Number of hours: 30

COURSE CODE	U19ME407		L	T	P	C
COURSE NAME	STRENGTH OF MATERIALS LABORATORY		0	0	2	1

Course Outcomes

Upon completion of this course the students will be able to

CO1 Determine the compressive strength and tensile strength of various engineering.

CO2 Calculate various mechanical properties of materials using appropriate testing machines.

CO3 Analyze the bending moments of different beams under different loading conditions.

List of Experiments:

1. Tension test on MS rod.

2. Compression test – Bricks & Concrete cubes.

3. Double shear test.

4. Deflection test – Cantilever & Simply supported beam

5. Impact test – Charpy & Izod

6. Hardness test on various materials (Vickers, Rockwell & Brinell)

7. Tests on spring – Tension & Compression

8. Fatigue test of metallic materials

9. Torsion test of metallic materials

10. Non –destructive testing (NDT) on materials.

11. Micro hardness test on coated and hardened samples

List of Equipment's (for a batch of 30 students)

1. Universal testing machine.

2. Compression testing machine.

3. Shear testing machine.

4. Deflection testing machine.

5. Rockwell hardness tester.

6. Brinell hardness tester.

7. Vickers hardness tester.

8. Fatigue testing machine.

9. Impact testing machine.

10. Ultrasonic pulse velocity.

11. Vickers micro hardness tester.

Total Number of hours 30

COURSE CODE	U19ME408	L T P C
COURSE NAME	OBJECT ORIENTED PROGRAMMING LABORATORY FOR MECHANICAL ENGINEERING	0 0 2 1

Course Outcomes

Upon completion of this course the students will be able to

CO1 Design and develop programs using the concept of classes, static members and constructors

CO2 Apply polymorphism using operator overloading, virtual functions and inheritance.

CO3 Develop file handling, exception handling and generic programming.

List of Experiments:

1. A projectile is launched at an angle θ and speed of V0. Write a c++ program to find the projectile's travel time, maximum travel distance and maximum height. The projectile's travel time t_{travel}, maximum travel distance x_{max}, and maximum height h_{max} are given by :

$$t_{travel} = 2\frac{V_0}{g}\sin\theta_0, \qquad x_{max} = 2\frac{V_0^2}{g}\sin\theta_0\cos\theta_0, \qquad h_{max} = 2\frac{V_0^2}{g}\sin^2\theta_0$$

2. Write a C++ program to implement the matrix ADT using a class. The operations supported by this ADT are:

3. a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices.

4. e) Multiplication of matrices

5. A two dimensional state of stress at a point in a loaded material is defined by three components of stress σ_{xx}, σ_{yy} and τ_{xy}. The maximum and minimum nominal stresses σ_{max} and σ_{min} are calculated from the stress components by

$$\sigma_{\substack{max \\ min}} = \frac{\sigma_{xx}+\sigma_{yy}}{2} \pm \sqrt{\left(\frac{\sigma_{xx}+\sigma_{yy}}{2}\right)^2 + \tau_{xy}^2}$$. Write a user defined function that determines the principal

stresses from the stress components. For the function name and arguments use [Smax,Smin] = principalstress (Sxx,Syy,Sxy).

6. Write a user defined function that determines the coordinate y_c of the centroid of the T-shaped cross-sectional area shown in the figure. For the function name and arguments use y_c = centroidT(w,h,t,d), where the input arguments w,h,t and d are the dimensions shown in the figure and the output argument yc is the coordinate y_c is the coordinate y_c
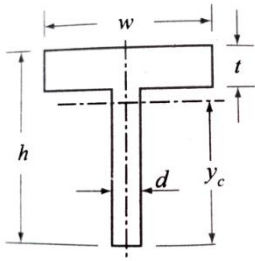
7. Write a C++ program to illustrate the usage of following: Default Constructor, Parameterized Constructor and Copy Constructor.

8. Write a C++ Program to create a class vehicle and then declare its two derived classes.

9. Write a C++ program that overloads the binary + operator and the unary ++ operators.

10. Write a C++ program to display the contents of a text file.

11. Write a program to define the function template for calculating the square of given numbers with different data types.

12. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

Total Number of hours: 30

Semester – IV	U19 GE401 SOFT SKILLS AND APTITUDE – II	L	T	P	C	Marks
		0	0	2	1	100

Course Outcomes

At the end of the course the student will be able to:

1. Demonstrate capabilities in additional soft-skill areas using hands-on and/or case-study approaches

2. Solve problems of increasing difficulty than those in SSA-I in given areas of quantitative aptitude and logical reasoning and score 65-70% marks in company-specific internal tests

3. Demonstrate greater than SSA-I level of verbal aptitude skills in English with regard to given topics and score 65-70% marks in company-specific internal tests

1.Soft Skills	**Demonstrating soft-skill capabilities with reference to the following topics:** a. SWOT b. Goal setting c. Time management d. Stress management e. Interpersonal skills and Intrapersonal skills f. Presentation skills g. Group discussions
2. Quantitative Aptitude and Logical Reasoning	**Solving problems with reference to the following topics:** a. Equations: Basics of equations , Linear, Quadratic Equations of Higher Degree and Problem on ages. b. Logarithms, Inequalities and Modulus c. Sequence and Series: Arithmetic Progression, Geometric Progression, Harmonic Progression, and Special Series. d. Time and Work: Pipes & Cistern and Work Equivalence. e. Time, Speed and Distance: Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks and Escalators. f. Arithmetic and Critical Reasoning: Arrangement, Sequencing, Scheduling, Network Diagram, Binary Logic, and Logical Connection. h. Binary number System.- Binary to decimal, Octal, Hexadecimal
3. Verbal Aptitude	**Demonstrating English language skills with reference to the following topics:** a. Critical reasoning b. Theme detection c. Verbal analogy d. Prepositions e. Articles f. Cloze test g. Company specific aptitude questions

1

SEMESTER – IV

MANDATORY COURSE

U19GE403 - ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Common for EEE, CIVIL, MECH and CSE)

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L  T  P  C
2  0  0  0
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Course Outcomes

At the end of the course, the students will be able to,

1. understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.
2. show an ability to comment critically on curriculum proposals that aim to promote science citizenship/scientific literacy
3. communicate using common medical and psychological terminology, including the skill to discuss commonly used medications, supplements, and surgical procedures
4. use effective oral and written language skills to communicate scientific data and ideas
5. describe the fundamentals of yoga and its importance

Unit I

- Introduction to Vedas   6
- Traditional methodology of Veda – Sat Angas
- Types of Vedas and their application
- Sub Veda – Ayurveda - their modern day application

Unit II

- Basics of Applied Vedic Science   6
- Modern day application of Vedas and procedure
- Ancient Indian Scientific thoughts
- Introduction to the Vedic language "Sanskrit"

UNIT – III- Modern science

- Introduction – modern science   6
- Objectives – modern science
- Architecture in ancient India

UNIT – IV Technology

- India's contribution to science and technology (from ancient to modern)   6
- Nobel laureates of Indian origin and their contribution
- India in space
- Latest achievement from Jan – 2017

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UNIT – V- Yoga and Holistic Health Care   6
- Fundamentals of yoga and holistic health
- Human biology
- Diet and nutrition
- Life management
- Contemporary yogic models – case study
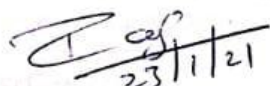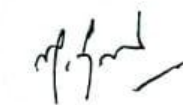
References
1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.
4. Roshan Dalal The Vedas: An Introduction to Hinduism's Sacred Texts, Penguin Books 2014. ISBN 13: 9780143066385
5. Raja Ram Mohan Roy, Vedic Physics, Mount Meru Publication ISBN : 9781988207049

Total: 30 HOURS

Dr. M. Raja
Course Coordinator / Sciences

Dr. C. Shanthi
HOD / Sciences

Dr. M. Renuga
Chairperson BOS,
Science and Humanities

23.01.2021   B.E. / B.Tech. Regulations 2019

16.12.2020   Regulations-2019

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory					
1	U19ME501	Heat and Mass Transfer	3	0	0	3	45
2	U19ME502	Dynamics of Machinery	3	0	0	3	45
3	U19ME503	Computer Aided Design and Analysis	3	0	0	3	45
4	noc21-me115	**Elective NPTEL-** Fundamentals of Additive Manufacturing Technologies	3	0	0	3	45
5	noc21-cs63	**Elective NPTEL-** Introduction to Internet of Things	3	0	0	3	45
6	U19ME901	**Elective-** Machine Learning with Python Programming	3	0	0	3	45
		Practical					
7	U19ME504	Heat and Mass Transfer Laboratory	0	0	2	1	30
8	U19ME505	Dynamics of Machinery Laboratory	0	0	2	1	30
9	U19ME506	Computer Aided Design and Analysis Laboratory	0	0	2	1	30
10	U19GE501	Soft Skills and Aptitude - III	0	0	2	1	30
					Total Credits	19	

Approved By

Chairperson, Mechanical Engineering BoS
Dr.D.Senthilkumar

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
    HOD/Mechanical Engineering, Fifth Semester BE Mechanical Students and Staff, COE

COURSE CODE   **U19ME501**   L T P C

COURSE NAME   **HEAT AND MASS TRANSFER**   3 0 0 3

Pre-Requisites Subject: Engineering Thermodynamics, Thermal Engineering.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Evaluate the heat conduction through plane walls, cylinder and composite walls and with internal heat generation.

CO2   Analyze the various fin efficiencies and effectiveness and unsteady heat conduction with lumped heat system.

CO3   Apply the convective heat transfer concepts in forced convection and free convection systems and describe the concept of boiling and condensation.

CO4   Determine the heat transfer in heat exchangers by LMTD and NTU methods and analysis the mass diffusion.

CO5   Evaluate the radiation heat exchange between surfaces and thermal shields.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
CO – 1	3	3	3	3	3	3	2	3	3	1	3	1	2	2
CO – 2	3	3	3	2	3	3	3	3	3	3	-	2	3	2
CO – 3	3	3	3	2	3	3	3	3	-	3	3	3	3	3
CO – 4	3	3	3	3	3	3	3	2	3	2	-	2	2	3
CO - 5	3	3	3	3	-	3	3	3	3	1	3	3	3	2

Unit – I   **CONDUCTION**   L 9 T 0

Introduction - modes of heat transfer - conduction - steady state heat conduction - Fourier Law of Conduction - thermal conductivity - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction through Plane Wall, Cylinders and Spherical systems - Composite Systems - Conduction with Internal Heat Generation - Critical radius of insulation.

Solving simple steady state conduction problems using Python.

Unit – II   **EXTENDED SURFACES & UNSTEADY STATE HEAT CONDUCTION**   L 9 T 0

Types of Fins - Circumferential and longitudinal fins- Heat Flow Calculations - Evaluation of fin performance: Fin efficiency, Fin effectiveness. Introduction to unsteady state heat conduction –transient heat conduction - Lumped systems - Semi Infinite Solid and Infinite Solid - Use of Heisler's Chart.

Unit – III   CONVECTION, BOILING AND CONDENSATION   L 9 T 0

Boundary Layer Concept - Types of Convection - Forced Convection - External Flow - Flow over Plates, Cylinders and Spheres. Internal Flow - Laminar and Turbulent Flow - Combined laminar and Turbulent.

Free Convection - Flow over Vertical Plate, Horizontal Plate, Cylinders and Spheres. Introduction to Boiling and condensation – Pool Boiling, Flow Boiling, Boiling Curve - film wise and drop wise condensation (elementary treatment only).

Unit – IV   HEAT EXCHANGERS   L 9 T 0

Heat Exchangers types - Overall Heat Transfer Coefficient - Fouling Factors - LMTD Method of heat Exchanger Analysis - Effectiveness - NTU Method of Heat Exchanger Analysis - Physical significance of NTU - Introduction to compact heat exchangers.

Unit – V   RADIATION & MASS TRANSFER   L 9 T 0

Fundamental Concepts - Stefan Boltzman Law – Kirchhoff's law - Relation to Irradiation and Radiosity – Absorptivity, Reflectivity and Transmissivity. Radiation exchange between surfaces -Shape Factor relations – Electrical Analogy - Radiation Shields - Introduction to Gas Radiation.

Introduction to mass transfer -   Fick's Law of Diffusion - Diffusion Mass Transfer - transient diffusion- Steady state Molecular Diffusion..

Note: *(Use of standard* heat and mass transfer data book is permitted in the University *examination)*

Total Number of hours: 45

Learning Resources

Text Books
1. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2000.
2. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2005.

Reference Books
1. Incropera, Frank.P; Dewitt,David. P "Fundamentals of Heat and Mass Transfer", John Wiley & Sons Pvt. Ltd., 2000.
2. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
3. Cengel, Y.A. "Heat Transfer: A Practical Approach", Tata McGraw, Hill. Second edition 2002.
4. Nag P.K, "Heat Transfer", Tata McGraw-Hill, New Delhi, 2002.

COURSE CODE   U19ME502   L T P C

COURSE NAME   DYNAMICS OF MACHINERY   3 0 0 3

Pre-Requisites Subject: Kinematics of Machinery

Course Outcomes

Upon completion of this course the students will be able to

CO1   Explain the force-motion relationship in components subjected to external forces.

CO2   Analyze balancing problems in rotating and reciprocating machinery

CO3   Analyze the principles in mechanisms used for governing of machines and gyroscopes.

CO4   Analyze the free and forced vibrations of single degree freedom systems.

CO5   Calculate the effect of Dynamics of undesirable vibrations.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	3	2	3	3	3	2	2	1	2	3	-	3	2
CO – 2	3	3	1	3	3	3	1	-	1	-	3	2	2	2
CO – 3	3	3	3	3	3	3	-	2	2	2	3	1	2	2
CO – 4	3	3	3	3	3	3	2	1	-	2	3	2	2	3
CO - 5	3	3	3	3	3	3	1	2	2	-	3	2	3	3

CO / PO, PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)

Unit – I   FORCE ANALYSIS   L 9 T 0

D Alembert's principle -Applied and constraint forces – Free body diagrams – Static equilibrium conditions – Two, three & four members – Static force analysis of simple mechanisms – Dynamic equivalent system-correction couple – Inertia force and Inertia torque -Dynamic Analysis in reciprocating engines – Bearing loads – Crank shaft torque- Equivalent masses. Turning moment diagrams – Single and multi-cylinder engines &double acting engines – Maximum fluctuation of energy and its determination- Coefficient of fluctuation of speed – Fly Wheel Analysis.

Unit – II   BALANCING   L 9 T 0

Balancing and its types- Rotor balancing- Single plane and two plane balancing. Unbalanced forces and couples-Static and dynamic balancing of rotating masses – Balancing of reciprocating masses-Balancing of locomotives - Balancing of Multi-cylinder engines.

Unit – III   MECHANISM FOR CONTROL   L 9 T 0

Necessity of governor- Types of governors- Working principle of centrifugal governors- Gravity controlled and spring controlled governors - Control force diagram- Characteristics of governors.

Gyroscopic couple – Gyroscopic effects on the movement of air planes and ships – Stability of two wheel drive and four wheel drive – Gyroscope stabilization.

Unit – IV   LONGITUDINAL VIBRATIONS   L 9 T 0

Introduction to vibration – Terminology – Classification of vibrations – Undamped and Damped free vibration of single degree of freedom systems-springs in series springs in parallel and combinations-concepts of critical damping coefficient and damping factor- under damping-critical damping and over damping - Forced vibration of single degree of freedom system- Logarithmic decrement-Vibrations of spring mass damper system under harmonic excitation-magnification factor, vibration isolation and transmissibility-Phase difference between excitation and motion – Estimation of natural frequencies for simple longitudinal vibration systems using python programming.

Unit – V   TRANSVERSE AND TORSIONAL VIBRATIONS   L 9 T 0

Transverse vibrations of shafts and beams-natural frequency- whirling of shafts-Application of Dunkerley's method and Rayleigh's method for estimating the critical speed of shafts – Estimation of Natural frequencies for simple transverse vibration systems using python programming.

Torsional vibrations -equivalent shafts- natural frequencies-mode shapes, nodes-single rotor, two rotor and three rotor systems.

Total Number of hours: 45

Learning Resources
Text Books
1. Rattan .S.S, "Theory of Machines", Fifth Edition, Tata McGraw-Hill Publishing Company Ltd, 2019.
2. Sadhu Singh "Theory of Machines", Pearson Education, 3rd edition, 2019.

Reference Books
1. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", 4th edition, oxford university press, 2018.
2. Thomas Bevan, "Theory of Machines" CBS Publishers and Distributers, 3rd edition, 2018.
3. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", New Age International, New Delhi, 2018.
4. Dr.V.P.Singh, Mechanical Vibrations, PHI, 2018.
5. Python - A Beginners Complete Reference Guide to Learn the Python Programming Language, Nexcod publishing, 2019.

COURSE CODE   **U19ME503**   L T P C

COURSE NAME   **COMPUTER AIDED DESIGN AND ANALYSIS**   3 0 0 3

Pre-Requisites Subject: Engineering graphics,   Strength of material, Python programming

Course Outcomes

Upon completion of this course the students will be able to

CO1   Find 2D and 3D transformation matrix also Construct the 2D and 3D model for the product by using CAD.

CO2   Solve the problem using the potential energy and weighted residual method.

CO3   Analyze one dimensional bar element and heat transfer element and find the solution.

CO4   Solve the two dimensional elements problems like scalar variable problems and vector variable problems.

CO5   Solve the integration using gauss quadrature and write the python program for finding the solution of Finite Element problems.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	1	-	2	3	1	1	2	1	3	3	3	2	2
CO – 2	3	3	2	3	2	2	-	-	1	2	2	3	2	2
CO – 3	3	3	1	3	1	3	1	-	2	1	1	3	3	3
CO – 4	3	3	-	3	-	3	2	1	-	1	-	3	2	3
CO - 5	3	3	2	3	2	3	-	2	1	2	-	3	3	3

Unit – I   COMPUTER AIDED DESIGN   L 9 T 0

Introduction and overview. Need and Scope of Computer Aided Machine Design, CAD design process, Graphic standards, 2D and 3D geometric Transformation- Scaling, Translation and Rotation. Geometric Modeling- Role of Geometric Modeling, Wire Frame Modeling, Surface Modeling, Solid Modeling-Constructive solid geometry (CSG), Boundary Representation (B-Rep). Importance of Finite element mesh, Automatic meshing techniques.

Unit – II   INTRODUCTION TO FEM   L 9 T 0

Finite element modeling procedure - mathematical modeling- Application to the continuum-Discretization - Matrix algebra - Gaussian elimination - Governing equations for continuum-Classical Techniques in FEM – Potential energy methods -Ritz method ,Weighted residual methods, engineering applications of FEA.

Unit – III   ONE DIMENSIONAL PROBLEMS   L 9 T 0

One dimensional element Coordinates and shapes functions- Potential energy approach -Galarkin approach- Assembly of stiffness matrix and load vector- linear 1D bar element - nodal approximation- development of shape functions- quadratic shape functions - element matrices and vectors-. One dimensional heat transfer element – Assembly of stiffness matrix and load vector, one-dimensional heat transfer problems.

Unit – IV   TWO DIMENSIONAL PROBLEMS   L 9 T 0

Scalar Variable Problems- Finite element modeling- CST element- Element equations, Load vectors and boundary conditions – Assembly - Vector Variable problems- Elasticity equations, Plane Stress, Plane Strain, Axisymmetric problems- Formulation- element matrices- Assembly - boundary conditions and solutions.

Unit – V   ISOPARAMETRIC ELEMENT   L 9 T 0

Natural coordinates, Iso parametric elements, Four node quadrilateral element– Shape functions- Element stiffness matrix and force vector – Numerical integration – Gauss quadrature

Application of python programming for 1D bar and heat transfer element.

                                                   Total Number of hours: 45

Learning Resources
Text Books
1. Ibrahim Zeid. & R. Sivasubramanian" CAD-CAM Theory and Practice", Tata McGraw-Hill Publishing Co. Ltd. 2nd edition, 2009. ISBN-13:978-0070151345
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", Prentice-Hall of India, Eastern Economy Editions, 4th Edition, 2015, ISBN-13: 978-9332551824.

Reference Books
1. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition, 2005, ISBN: 9780070601222.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions, 2006, 3rd Edition, ISBN: 9780070607415.
3. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., NewDelhi, 2007. ISBN-978-203-2315-5
4. Mikell P. Groover and Emory W. Zimmers, Jr, "CAD/CAM Computer Aided and Manufacturing". Eastern Economy Edition, PHI publishers 2008.ISBN 13: 978-8120304024.
5. Rao S.S., "The Finite Element Method in Engineering", Fourth Edition, Published by Elsevier, 5th Edition, 2010, Hardcover ISBN: 9781856176613.
6. P.N. Rao, "CAD/CAM Principles and Applications". Tata McGraw Hill Publications, 3rd Edition 2010. ISBN-13 : 978-0070583733.
7. Logan D.L., "A First course in the Finite Element Method", Fourth Edition, Cengage Learning, 5th Edition, 2012, ISBN-13: 9788131517307.
8. Python - A Beginners Complete Reference Guide to Learn the Python Programming Language, Nexcod publishing, 2019.

COURSE CODE   **noc21-me115**   L T P C

COURSE NAME   **ELECTIVE NPTEL FUNDAMENTALS OF ADDITIVE**

                      MANUFACTURING TECHNOLOGIES   3 0 0 3

Prerequisites- subject: Engineering materials & Metallurgy, Manufacturing Process

Course Outcomes

Upon completion of this course the students will be able to

CO1   Identify the usages of computer aided process in additive manufacturing and write the necessary programs and algorithms.

CO2   Describe the various Liquid and sheet-based additive manufacturing technologies and give their applications.

CO3   Apply the principles of wire Deposition and doing the mathematic modeling process of additive manufacturing technologies.

CO4   Discuss the types of metal wire Additive Manufacturing technologies and design instruments to apply the processes.

CO5   Analyze the working principles of the different types of Powder Additive Manufacturing technologies and use them in real life situations.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	1	3	1	3	1	-	3	3	3	3	3
CO – 2	3	3	-	3	3	-	1	3	3	1	3	3	3	2
CO – 3	3	3	2	3	3	3	1	-	1	-	2	3	2	3
CO – 4	3	3	2	3	2	3	-	2	2	2	3	3	3	3
CO - 5	3	3	1	3	1	3	2	3	1	3	3	3	3	3

Unit – I   INTRODUCTION TO ADDITIVE MANUFACTURING   L 9 T 0

Introduction to Additive Manufacturing, Capabilities of Additive Manufacturing, Classification of Additive Manufacturing. CAD formats for AM, STL Format, Errors in STL Format, Manipulation of STL Files, Calculation of Support Structure, Slicing Methods, Area-filling Algorithms, Guidelines for Programing, Demonstration in the CAD/CAM package.

Unit – II   LIQUID & SHEET ADDITIVE MANUFACTURING   L 9 T 0

Working principle, Classification of Liquid Additive Manufacturing, Introduction to photo-polymerization based AM systems, Layer scanning methods, Principle of laser curing, Recoating methods, Other Liquid Additive Manufacturing. Classification of sheet AM processes, Introduction to paper & plastic sheet-based AM processes, Introduction to metallic sheet-based AM processes.

Unit – III   WIRE ADDITIVE MANUFACTURING   L 9 T 0

Working principle, Classification of wire-based AM processes. Fused Deposition Modeling- Wire feeding mechanism, Liquefier dynamics, Die swelling and bead cooling, Bead deposition, spreading and bonding, Mathematical modeling of Single-bead (Start, Stop and Turns), Multi-bead, multi-layer deposition in FDM.

Unit – IV   METAL WIRE ADDITIVE MANUFACTURING   L 9 T 0

Classification, Wire Arc Additive Manufacturing: WAAM: Architecture of MIG, TIG, and Plasma cladding based AM, Mathematical modeling of single-bead multi-bead and multi-layer deposition. Wire Beam Additive Manufacturing - Wire Laser Additive Manufacturing, Wire Electron-Beam Additive Manufacturing.

Unit – V   POWDER ADDITIVE MANUFACTURING   L 9 T 0

Powder-feed Additive Manufacturing: Laser cladding based Additive Manufacturing- Fundamentals of laser cladding, Introduction to powder handling system, Applications: FGMs, Repair. Binder based Powder-bed Additive Manufacturing- Working principle, Classification of powder/ink combinations, Mechanism of powder-droplet interaction, Applications: Time Delivery Drugs, Sand Molds. Energy Beam based Powder-bed Additive Manufacturing- Introduction to laser-based powder-bed AM, Layer fusion mechanism in indirect & direct routes, Introduction to Electron Beam based powder-bed AM.

Total Number of hours: 45

Learning Resources

Text Books
1. Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.
2. Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
3. Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
4. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.

Reference Books
1. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapidmanufacturing, Hanser Publishers, 2011.
2. LiouW. Liou, Frank W. Liou, "Rapid Prototyping and Engineering applications: A Tool Box for Prototype development",CRC Press, 2013.
3. DongdongGu, (2014), Laser Additive Manufacturing of High-Performance Materials, Springer Publ.
4. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: 4th Edition of Rapid Prototyping, World Scientific Publishers, 2014.
5. Mahamood R.M., Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes, Springer International Publishing AG 2018.

COURSE CODE   **noc21-cs63**   L T P C

COURSE NAME   **ELECTIVE NPTEL INTRODUCTION TO**
                   INTERNET OF THINGS   3 0 0 3

Course Outcomes

Upon completion of this course the students will be able to

CO1   Assess the characteristics of IoT and Analyze the difference between M2M and IoT.

CO2   Incorporate the digital devices in mechanical engineering projects using Arduino board.

CO3   Construct the logical design for IoT using Python and Raspberry Pi.

CO4   Identify the architecture and infrastructure of cloud computing.

CO5   Design and develop the automation system with inventory management & quality control.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	3	3	3	3	-	-	1	-	3	2	2	2	2
CO – 2	3	3	3	3	3	1	-	-	1	3	1	-	2	2
CO – 3	3	3	3	3	3	-	2	1	1	3	2	3	2	3
CO – 4	3	3	3	3	3	2	-	-	2	3	-	3	3	3
CO - 5	3	3	3	3	3	1	3	2	2	3	1	3	3	3

Unit – I   INTRODUCTION TO IOT   L 9 T 0

Introduction to IoT: characteristics of IoT, levels & deployment templates, Sensing, Actuation, Communication Protocols, Machine-to-Machine Communications, Difference between IoT and M2M, Communication modules - RFID, Bluetooth, WiFi, Zigbee.

Unit – II   IOT USING ARDUINO   L 9 T 0

Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Uno architecture, setup the IDE, writing Arduino software, basics of embedded c programming for Arduino, Introduction of python programming for Arduino.

Unit – III   IOT WITH PYTHON PROGRAMMING & RASPBERRY PI   L 9 T 0

Logical design using Python, installing python, python data types and data structures, control flow, functions, modules, Introduction to Raspberry, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics.

Unit – IV   CLOUD PLATFORMS FOR IOT   L 9 T 0

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud-Cloud architecture, Fog Computing.

Unit – V   INDUSTRIAL IOT   L 9 T 0

IoT vs IIoT, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Case Study: Agriculture, Healthcare, Activity Monitoring, power plants, inventory management & quality control, plant safety and security (including AR and VR safety applications).

<p align="center">Total Number of hours: 45</p>

Learning Resources

Text Books
1. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, VPT, 1st edition, 2014.
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press, 2020.
3. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.

Reference Books
1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things – Key applications and Protocols, Wiley, 2012.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, and David Boyle, From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence, Elsevier, 2014.
3. Marco Schwatrz, Internet of Things with Arduino Cookbook, Packt Publication Ltd, 2016.
4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.

COURSE CODE   **U19ME901**   L T P C

COURSE NAME   **ELECTIVE MACHINE LEARNING WITH PYTHON**
                     PROGRAMMING   3 0 0 3

Prerequisites- subject: Problem solving in Python Programming

Course Outcomes

Upon completion of this course the students will be able to

CO1   Cognize the basic concepts and techniques of Machine Learning.

CO2   Develop data analytics and visualization skills for machine learning algorithms.

CO3   Analyze the various machine learning algorithms.

CO4   Assess the complexity of Machine Learning algorithms and their limitations.

CO5   Develop python programs for various machine learning algorithms.

CO / PO, PSO Mapping														
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs **PSOs Mapping**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	3	3	3	2	1	2	2	1	2	3	2	3	2
CO – 2	3	3	3	2	1	-	-	-	1	3	3	1	2	2
CO – 3	2	1	3	3	2	2	2	1	-	3	3	3	3	3
CO – 4	-	2	3	3	3	2	-	1	2	3	2	3	3	3
CO - 5	1	2	2	3	3	1	1	2	2	3	3	3	2	3

Unit – I   INTRODUCTION   L 9 T 0

History of Artificial Intelligence – overview of machine learning – Linear algebra – scalars, vectors and tensors –Matrix operations – special matrices –Matrix decomposition – labeled data – un-labeled data – supervised learning – unsupervised learning – semi-supervised learning – reinforced learning – data science & analytics – Artificial Intelligence and deep learning in Engineering applications.

Unit – II   DATA ANALYTICS & VISUALIZATION   L 9 T 0

Data exploration (histograms, bar chart, box plot, line graph, scatter plot) - Qualitative and Quantitative Data - Measure of Central Tendency (Mean, Median and Mode) - Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles) - Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation) - Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs – Burn charts.

Unit – III   MACHINE LEARNING ALGORITHMS – I   L 9 T 0

Probability & Bayes' learning – Linear regression – Logistic regression – least squares gradient descent – goodness of fit – bias-variance tradeoff – multinomial regression –polynomial regression – ridge regression - lasso regression – k nearest neighbor (kNN) algorithm – Support vector machine. (Qualitative treatment only).

Unit – IV   MACHINE LEARNING ALGORITHMS – II   L 9 T 0

Clustering – Hierarchical – divisive, agglomerative, dendrograms, K-means – identification of centroids and location near centroids – clustering large applications (CLARA) – dimension reduction – Density based spatial clustering of applications with noise (DBSCAN) - Decision tree – binary decision tress, recursive binary split, pruning – Introduction to Artificial neural networks (Qualitative treatment only).

Unit – V   PYTHON PROGRAMMING FOR MACHINE LEARNING   L 9 T 0

Basic commands & syntax – packages and libraries – Construction of bar plots, line plot, scatter plot & histograms – Computation of mean, median & mode – construction of Box and Whisker Plot - development of machine learning programs using Scikit learn library– Linear regression – polynomial regression – kNN Algorithm – k-Means clustering – Support vector machine.

                              Total Number of hours: 45

Learning Resources

Text Books
   1. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2009.
   2. Harrington, Peter. Machine learning in action. Manning Publications Co., 2012.

Reference Books
   1. Witten, Ian H., et al. Data Mining: Practical machine learning tools and techniques. Morgan Kaufmann, 2016.
   2. Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. MIT press, 2017.
   3. Hackeling, Gavin. Mastering Machine Learning with scikit-learn. Packt Publishing Ltd, 2017.
   4. Kelleher, John D., Brian Mac Namee, and Aoife D'arcy. Fundamentals of machine learning for predictive data analytics: algorithms, worked examples, and case studies. MIT press, 2020.

COURSE CODE   **U19ME504**   L T P C

COURSE NAME   **HEAT POWER LABORATORY**   0 0 2 1

Pre-requisites subject: Thermal engineering and Heat and mass transfer.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Apply the fundamental theory and equations of one-dimensional steady state heat conduction systems.

CO2   Analyze the convective heat transfer in forced and free convection systems by applying the concepts of thermodynamics, heat transfer, and fluid mechanics.

CO3   Compare the heat exchangers with LMTD method and Effectiveness NTU method.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	3	3	2	3	3	3	-	3	2	3	3	2	2
CO – 2	3	2	3	3	3	2	-	3	3	3	3	3	2	3
CO – 3	3	3	3	3	-	3	3	2	3	-	3	3	3	3

List of Experiments:

1. Thermal conductivity measurements by guarded plate method.
2. Thermal conductivity of metal bar.
3. Natural convection heat transfer from a vertical cylinder.
4. Forced convection inside tube.
5. Heat Transfer from Pin-fin (Natural & Forced convection modes).
6. Determination of Stefan- Boltzman constant.
7. Determination of Emissivity of a grey surface.
8. Effectiveness of parallel/ Counter flow heat Exchanger.
9. Thermal conductivity of insulating powder.
10. Thermal conductivity of composite wall material.

List of Equipment's: (for a batch of 30 students)

1. Heat transfer through guarded plate apparatus.
2. Heat transfer through metal bar apparatus.
3. Heat transfer through Natural convection apparatus.
4. Heat transfer through Forced convection apparatus.
5. Heat Transfer through Pin-fin apparatus.
6. Heat transfer through Stefan- Boltzman constant apparatus.
7. Heat transfer through Emissivity apparatus.
8. Heat transfer through parallel/ Counter flow heat Exchanger.
9. Thermal conductivity of insulating powder.
10. Thermal conductivity of composite wall material.

Total Number of hours: 30

COURSE CODE   **U19ME505**   L T P C

COURSE NAME   **DYNAMICS OF MACHINERY LABORATORY**   0 0 2 1

Pre-requisites subject: Dynamics of Machinery.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Demonstrate the kinematics of 4bar, Slider crank and Crank Rocker mechanisms, Universal joints and Gear trains.

CO2   Determine the sensitivity, effort of Governors and determine the gyroscopic couple of Gyroscope and determination of Critical speed of shaft.

CO3   Calculate the moment of Inertia by oscillation method and determine the damping co-efficient of spring mass system.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	3	3	3	3	3	1	2	3	-	3	3	2	2
CO – 2	3	3	3	3	3	3	2	-	3	1	3	3	3	3
CO – 3	3	3	3	3	3	3	-	1	3	2	3	3	3	3

List of Experiments:

1. Kinematics of 4 bar mechanisms – Slider crank and Crank Rocker Mechanism - Determination of velocity and acceleration.

2. Kinematics of Universal Joints – Determination of velocity and acceleration

3. Kinematics of Gear Trains – Simple, Compound and differential: Determination of velocity ratio and Torque

4. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring controlled Governors

5. Cam – Determination of jump speed and profile of the cam.

6. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.

7. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.

8. Balancing of rotating and reciprocating masses.

9. Determination of moment of inertia by Oscillation method for connecting rod and flywheel.

10. Vibrating system - spring mass system - Determination of damping co-efficient of single degree of freedom system

11. Determination of torsional frequencies for compound pendulum and flywheel   system with lumped Moment of inertia.

12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

List of Equipment's: (for a batch of 30 students)

1. Four bar Mechanism
2. Slider Crank Mechanism
3. Universal Joint
4. Compound Gear Train
5. Universal Governor
6. Cam Analysis Machine
7. Motorized Gyroscope
8. Whirling of shafts
9. Balancing of rotating masses Apparatus.
10. Balancing of reciprocating masses Apparatus.
11. Moment of Inertia by Oscillation
12. Vibrating Table
13. Compound Pendulum
14. Transverse Vibration Apparatus

Total Number of hours: 30

COURSE CODE   U19ME506   L T P C

COURSE NAME   COMPUTER AIDED DESIGN AND ANALYSIS LABORATORY   0 0 2 1

Pre-requisites subject: Engineering Graphics, Computer aided drafting laboratory, Strength of material Laboratory.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Construct the 2D views of standard machine components.

CO2   Create 3D model for the engineering components using solid works software.

CO3   Solve real time analysis of 1D, 2D and 3D engineering problems using ANSYS.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	1	3	1	-	3	1	-	2	-	3	3	3	2	3
CO – 2	2	3	3	3	3	2	-	-	2	3	3	3	3	2
CO – 3	3	3	3	3	3	3	2	3	1	3	3	2	3	3

List of Experiments:

PART-A-CAD

1. Introduction

Introduction to Code of practice for Engineering Drawing, BIS specifications – Welding symbols, Riveted joints, keys, Fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. Introduction to Drafting Software, Editing, Dimensioning and Plotting Commands-Layering concepts-Limits, Fits and Tolerances.

2. Preparation of 2-D Drawings

Orthographic views of standard machine components:

Brackets, V Blocks, Stop Block, Screw threads and Threaded fasteners.

3. Assembly Drawing (Preparation of assembled view)

1. Solid Modeling & assembly
2. Surface modeling & assembly
3. Sheet metal & assembly
4. Weldments & assembly and BOM.
5. 3D printing of simple machine parts.

PART B – **Finite ElementAnalysis using ANSYS Software:**

6. Analysis of ID element such as bar, rod and truss
7. Analysis of beams (cantilever, simply supported and fixed beam)
8. Analysis of an axis-symmetric element
9. Mode frequency analysis of beams (cantilever, simply supported and fixed beam)
10. 2D heat transfer analysis (conduction and convection)
11. Harmonic analysis
12. Analysis of 3D components

List of Equipment's:

1. Computer systems configuration: i7 – 7th GEN-8GB RAM-1TB HDD 22" LED DISPY
2. 3D printer

List of Equipment's: (for a batch of 30 students)

1. Solid Works 2019 -100 users.
2. ANSYS 12.00

Total Number of hours: 30

Semester –V	U19GE501 : SOFT SKILLS AND APTITUDE - III	L	T	P	C	Marks
		0	0	2	1	100

Course Outcomes

At the end of the course the student will be able to:

1. Demonstrate capabilities in supplementary areas of soft-skills and job-related selection processes using hands-on and/or case-study approaches

2. Solve problems of advanced levels than those in SSA-II in specified areas of quantitative aptitude and logical reasoning and score 70-75% marks in company-specific internal tests

3. Demonstrate greater than SSA-II level of verbal aptitude skills in English with regard to given topics and score 70-75% marks in company-specific internal tests

	Demonstrating soft-skill capabilities with reference to the following topics:
1.SOFT SKILLS	a. **Career planning:** Importance; Exploring various career options, Field research, Social media management; Process, benefits and limitations of career planning; Mapping SWOT and GOALS to career planning; Self-evaluation
	b. **Resume writing :** Build credentials and resume, Positioning yourself and your career, JD mapping, Video resume, Relevant resume phrases and components; Cover letter; Portfolio management and Social media cover
	c. **Group discussion :** Skills needed for GD; Frequently Asked topics and Practice; Types of topics; Various framework and tools to handle GD; Practice and assessment
	d. **Teamwork :** Definition and importance of team-building; Stages of team-building; Communication within a team; Various styles of teams and their analysis; Activities demonstrating a team
	e. **Leadership skills :** Role of a leader; Difference between a manager and a leader; Various Leadership styles; Compelling qualities of a leader; Famous leaders and their impact to the world; Self-assessment
	f. **Interview skills :** Process and types of interview; Appearance and grooming etiquette; Do's and Don'ts (Before – During interview); Brainstorming interview possible questions; Hot seat; Transactional Analysis for effective communication and handling interviewers; mock interviews and assessment parameters discussion
	g. **Mock interviews :** Frequently Asked Questions practice and assessment; Discussion and demonstrations on Stress and Technical interviews; Group interview
	h. **Mock GDs :** Frequently Asked Topics Practice; Assessment and feedback

	Solving problems with reference to the following topics :
2. QUANTITATIVE APTITUDE AND LOGICAL REASONING	a. **Geometry:** 2D, 3D, Coordinate Geometry, and Height & Distance.
	b. **Permutation & Combinations :** Principles of counting, Circular Arrangements and Derangements.
	c. **Probability:** Addition & Multiplication Theorems, Conditional Probability and Bayes Theorem.
	d. **Statistics :** Mean Median, Mode, Range and Standard Deviation.
	e. **Interest Calculation :** Simple Interest and Compound Interest
	f. **Crypto arithmetic:** Addition and Multiplication based problem.
	g. **Logical Reasoning :** Blood Relations, Directions Test, Series, Odd man out, Analogy, Coding & Decoding, Problems and Input – Output Reasoning.
	h. Statement & Assumptions, Statements & Arguments, Inference.
	i. **Company Specific Pattern :** Infosys and TCS company specific problems
3. VERBAL APTITUDE	Demonstrating English language skills with reference to the following topics:
	a. Subject verb agreement
	b. Selecting the best alternative for the stated parts of given sentences
	c. Reading comprehension
	d. Contextual synonyms
	e. Sentence fillers
	f. Writing a story for a given picture
	g. Company specific aptitude questions

Dr.S.Anita

Head/Training

Department of Placement Training
Sona College of Technology,
Salem-636 005.

Open Elective Courses
MECH

COURSE CODE   U19ME1004   L   T   P   C

COURSE NAME   RENEWABLE ENERGY SOURCES   3   0   0   3

Prerequisites- subject: Power plant Engineering**,** Environmental Sciences.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Discuss the power demand scenario in world level and impact of various renewable energy sources in satisfying power demand.

CO2   Explain the different components and the principle of operation and the application of solar PV system and Bio Mass power generation system.

CO3   Outline in the components and to find the suitability based on the performance of wind energy conversion system, geothermal and hydel power system.

CO4   Describe the components of tidal power generation scheme and wave energy scheme and to discuss the performance of two schemes.

CO5   Compare and contrast the various components and methods of Ocean Energy Conversion Systems.

CO / PO, PSO Mapping													
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs **PSOs Mapping**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	2	2	3	2	2	3	3	3	3	2	3	3	2	3
CO – 2	3	3	3	3	3	2	3	3	2	2	3	3	3	3
CO – 3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
CO – 4	3	3	3	3	3	3	3	2	2	2	2	3	3	3
CO - 5	3	3	3	3	3	2	2	2	2	2	3	3	3	3

Unit I   **INTRODUCTION**   L 9 T 0

World energy use – reserves of energy resources – energy cycle of the earth – environmental aspects of energy Utilization – renewable energy resources and their importance.

15-06-2021   Regulations 2019

Unit II   SOLAR & BIO ENERGY   L 9 T 0

Introduction – extra-terrestrial solar radiation – radiation at ground level – collectors – solar cells – applications of solar energy – Biomass Energy – Introduction – Biomass Conversion – Biogas Production – Ethanol Production – Pyrolysis and Gasification – Direct Combustion – Applications.

Unit III   GEO THERMAL AND HYDRO ENERGY SOURCES   L 9 T 0

Geothermal energy – types of geothermal energy sites, site selection, and geothermal power plants, Hydro energy – Feasibility of small, mini and micro hydro plants: scheme, layout and economics.

Unit IV   WIND AND TIDAL ENERGY   L 9 T 0

Introduction – Wind Energy – Wind speed and power relation – Power extracted from wind – wind distribution and wind speed predictions – types of Wind power systems.

Introduction – origin of tides – power generation schemes – Wave Energy – basic theory – wave power Devices.

Unit V   OTHER RENEWABLE ENERGY SOURCES   L 9 T 0

Introduction – Open and Closed OTEC cycles – Ocean Currents – Salinity Gradient Devices – Potential impacts of harnessing the different renewable energy resources.

Total Number of hours: 45

Learning Resources

Text Books

1. Twidell John; Weir, Tony, "Renewable energy resources", Taylor & Francis, 2010
2. Godfrey Boyle, "Renewable energy – power for a sustainable future", Oxford University Press, 2010
3. Kothari DP, Singal KC and Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies' PHI Learning Pvt. Ltd.2011.
4. S.A. Abbasi and Naseema Abbasi, "Renewable energy sources and their environmental impact", Prentice- Hall of India, 2001.

Reference Books

1. T.N.Veziroglu, Alternative Energy Sources, Vol 5 and 6, McGraw Hill, 1978.
2. G D Rai, "Non-conventional sources of energy", Khanna Publishers, 2002.
3. G D Rai, "Solar energy utilization", Khanna Publishers, 2005.
4. MukundR.Patel, "Wind and Solar Power Systems", CRC Press, Taylor and Francis, 2005.
5. Yogi Goswami, 'Principles of Solar Engineering' CRC Press, 2015, ISBN 10: 1466563788

COURSE CODE   U19ME1006   L T P C

COURSE NAME   3D PRINTING   3 0 0 3

Prerequisites- subject: CAD / CAM & Engineering Materials.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Explain the principles of various Additive Manufacturing Technologies for application to various industrial needs.

CO2   Familiarize the various Liquid based additive manufacturing technologies.

CO3   Explain the different Solid based additive manufacturing technologies.

CO4   Discuss the different Powder based additive manufacturing technologies.

CO5   Discuss the post processing and tooling methods of additive manufacturing technologies.

CO / PO, PSO Mapping													
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	3	3	3	1	3	3	2	3	1	1	2
CO – 2	2	3	1	-	3	1	3	-	2	1	3	1	2	3
CO – 3	2	3	-	-	3	2	3	-	1	3	3	1	2	3
CO – 4	2	2	2	2	3	3	3	-	2	2	3	3	2	3
CO - 5	3	1	3	3	3	3	2	-	3	3	2	3	3	2

Unit I   INTRODUCTION   L 9 T 0

Introduction to 3D Printing (Additive Manufacturing) - Impact of AM and Rapid Tooling on Product Development – Historical development, Advantages of AMT, commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields - Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data.

Unit II   LIQUID BASED SYSTEMS   L 9 T 0

Stereo lithography apparatus (SLA), Digital Light Projection (DLP), Continuous Liquid Interface Production (CLIP), Solid ground curing (SGC) - models and specifications, process, working, principle, materials, applications, advantages and disadvantages.

Unit III   SOLID BASED SYSTEMS   L 9 T 0

Fused Deposition Modeling (FDM, Laminated Object Manufacturing (LOM) and MULTI-JET MODELING SYSTEM (MJM) - models and specifications, process variables, working principle, materials, applications, advantages and disadvantages.

Unit IV   POWDER BASED SYSTEMS   L 9 T 0

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Direct Metal Deposition (DMD), Ballistic Particle Manufacturing (BPM), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - working principle, construction, process variables, materials and applications.

**Unit V   TOOLING, APPLICATIONS AND FUTURE
               DIRECTIONS OF 3D PRINTING**   L 9 T 0

Rapid tooling: Classification of Tooling, Direct and Indirect tooling methods, Soft and Hard tooling methods, Silicone rubber molding, Epoxy tooling, Spray Metal Coating. Applications of AM: Aerospace, Automotive, Biomedical, Product Development, Commercialization, Trends and Future Directions in 3D printing technology.

Total Number of hours: 45

Learning Resources
Text Books
1. Chua C.K., Leong K.F., and Lim C.S., "Rapid Prototyping: Principles and Applications", Second Edition, World scientific Publishers, 2005.
2. Ian Gibson, David Rosen and Brent Stucker, Additive Manufacturing Technologies, Springer Publications, 2015.

Reference Books
1. D. T. Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
2. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.
3. Andreas Gebhardt, Understanding Additive Manufacturing, Hanser Publishers, 2011.
4. LiouW. Liou, Frank W. Liou, "Rapid Prototyping and Engineering applications: A Tool Box for Prototype development", CRC Press, 2013.
5. DongdongGu, Laser Additive Manufacturing of High-Performance Materials, Springer Publications, 2014.
6. Yang, L., Hsu, K., Baughman, B., Godfrey, D., Medina, F., Menon, M., and Wiener, S., Additive Manufacturing of Metals: The Technology, Materials, Design and Production, Springer, 2017.

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory					
1	U19ME601	Design of Machine Elements	3	1	0	4	60
2	U19ME602	Mechatronics System Design	3	0	0	3	45
3	U19ME603	Operations Research	3	1	0	4	60
4	U19ME902	**Professional Elective -** Data Analytics	3	0	0	3	45
5	U19ME903	**Professional Elective -** Data Structures using Python					
6	U19ME904	**Professional Elective -** Heating Ventilation and Air Conditioning Design	3	0	0	3	45
7	U19ME905	**Professional Elective -** Modern Vehicle Technology and Automotive Testing					
8		***Open Elective - I**	3	0	0	3	45
		Practical					
7	U19ME604	Mechatronics and Simulation Laboratory	0	0	4	2	60
8	U19ME605	Computer Aided Manufacturing and Measurements Laboratory	0	0	4	2	60
9	U19GE601	Soft Skills and Aptitude - IV	0	0	2	1	30
					Total Credits	**25**	

Approved By

Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.D.Senthilkumar	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-
    HOD/Mechanical Engineering, Sixth Semester BE Mechanical Students and Staff, COE

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		*Open Elective - I					
1	U19BM1001	Hospital Management	3	0	0	3	45
2	U19CE1001	Building Services and Safety Regulations	3	0	0	3	45
3	U19CE1003	Energy Efficiency and Green Building	3	0	0	3	45
4	U19CS1001	Big Data Analytics	3	0	0	3	45
5	U19CS1002	Cloud Computing	3	0	0	3	45
6	U19CS1006	Data Science	3	0	0	3	45
7	U19EC1003	Sensors and Smart Structures Technologies	3	0	0	3	45
8	U19EC1006	Mobile Technology and Its Applications	3	0	0	3	45
9	U19EE1001	Electric Mobility	3	0	0	3	45
10	U19EE1002	Energy Conservation and Management	3	0	0	3	45
11	U19EE1003	Innovation, IPR and Entrepreneurship Development	3	0	0	3	45
12	U19EE1004	Renewable Energy Systems	3	0	0	3	45
13	U19FT1001	Fundamentals of Fashion Design	3	0	0	3	45
14	U19FT1002	Garment Manufacturing Technology	3	0	0	3	45
15	U19IT1001	Problem Solving Techniques using Java Programming	3	0	0	3	45

Approved By

Chairperson, Mechanical Engineering BoS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**
　　Dr.D.Senthilkumar   Dr.R.Shivakumar   Dr.S.R.R.Senthil Kumar

Copy to:-
　　　HOD/Mechanical Engineering, Sixth Semester BE Mechanical Students and Staff, COE

COURSE CODE	U19ME601	L T P C
COURSE NAME	DESIGN OF MACHINE ELEMENTS	3 1 0 4

Pre-Requisites Subject: Engineering Mechanics, Kinematics of Machinery, Dynamics of Machinery and Strength of Materials

Course Outcomes

Upon completion of this course the students will be able to

CO1 Select the materials based on Mechanical properties, different types of loading and explain simple, steady and variable stresses.

CO2 Illustrate the design procedure for various types of shafts, keys and couplings.

CO3 Design the threaded fasteners, bolted joints including eccentric loading & welded joints and riveted joints for pressure vessels and structures.

CO4 Design the various types of springs like helical, leaf and torsional springs under constant loads and varying loads.

CO5 Develop the design procedure for various types of bearings like sliding contact and rolling contact bearing.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	2	2	3	2	3	2	3	2	3	2	2
CO – 2	3	2	3	3	3	3	2	3	2	2	2	3	3	3
CO – 3	3	2	3	3	3	3	3	3	3	2	3	3	3	3
CO – 4	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO - 5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Unit I   STEADY AND VARIABLE STRESSES   L 9 T 3

Fundamentals of machine design - Introduction to the design process - Factor influencing machine design, selection of materials based on mechanical properties, fits and tolerances -Direct, bending and torsional stress equations – Role of factor of safety - Theories of failure – Design for variable loading – Soderberg, Goodman and Gerber relations - Design of curved beams.

Unit II   DESIGN OF SHAFTS AND COUPLINGS   L 9 T 3

Design of solid and hollow shafts based on strength and rigidity - Design of rigid couplings – Flange, Box and clamp - Introduction of flexible couplings - Bushed pin type.

Unit III   DESIGN OF FASTENERS AND WELDED JOINTS   L   9   T   3

Threaded fasteners - Design of bolted joints including eccentric loading - Design of welded joints - Eccentric loaded welded joints- Introduction of riveted joints-Types of failure of riveted joints for structures and pressure vessel/cylinders.

Unit IV   DESIGN OF SPRINGS AND ENGINE COMPONENTS   L 9 T 3

Design of helical, leaf and torsional springs under constant loads and varying loads – Introduction of concentric springs – Design of Flywheels for engines and punching machines.

Unit V   DESIGN OF BEARINGS   L 9 T 3

Design and Selection of sliding and rolling contact bearings - Cubic mean load - Design of journal bearings - Mckees equation -Lubrication in journal bearings – Bearing materials for various applications.

Total Number of hours: 60

Note: Use of P S G Design Data Book is permitted

Learning Resources

Text Books

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2020.
2. R.S.Khurmi, "Machine Design", 25th edition, S Chand Publisher, 2020.
3. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2021.

Reference Books

1. Ansel Ugural, "Mechanical Design – An Integral Approach", First Edition, Tata McGraw-Hill Book Co, 2010.
2. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" Eight Edition, Printice Hall, 2012.
3. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2015.
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", Second Edition, Tata McGraw-Hill Book Co., 2017.
5. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill Book Co. (Schaum's Outline), 2018.
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2019.
7. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", Fouth Edition, Wiley, 2020.

COURSE CODE	U19ME602		L T P C
COURSE NAME	MECHATRONICS SYSTEM DESIGN		3 0 0 3

Pre-Requisites Subject: Electrical Drives and ARM processor, Instrumentation and Control Systems.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Analyze open loop and closed loop system in Mechatronics system.

CO2 Select the suitable actuator for Mechatronics system Product.

CO3 Design the hydraulic and pneumatic circuit for the given application.

CO4 Identify the controller and construct a PLC ladder program for the given application.

CO5 Apply the concepts of AI in mechatronics and suggest suitable solution for the industrial requirement.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	3	3	3	1	2	1	2	3	1	2	1	3	3
CO – 2	3	3	3	2	1	2	1	1	1	1	1	2	3	2
CO – 3	3	3	3	3	3	2	1	1	2	1	3	2	3	3
CO – 4	3	3	3	3	3	3	2	1	2	1	3	2	2	3
CO - 5	3	3	3	3	3	3	1	1	2	1	3	3	3	3

Unit I   **INTRODUCTION TO MECHATRONICS SYSTEMS**   L 9

Introduction to Mechatronics: Mechatronics– elements – mechatronics approach to modern engineering. Mechatronics system – Measurement systems – control systems- automatic control, sequential controllers - Microprocessor based controllers-examples.

Advanced Sensors: Performance terminology and Characteristics of Sensors-Advanced sensors-RFID sensor, Sniff Sensor, Smart sensor-types and Properties.

Unit II   **ACTUATION SYSTEM FOR MECHATRONICS**   L 9

Hydraulic and Pneumatic Actuation Systems: linear and rotary actuator –hydraulic and pneumatic motors, control valves -Directional control valves, flow control, Mechanical Actuation systems – Cams- Gear Trains – Ratchet and pawl.

Electrical actuation- Solenoids, BLDC motor, stepper motor and servomotors-application and selection of motor.

Unit III   HYDRAULIC AND PNEUMATIC CIRCUIT DESIGN   L 9

Hydraulic circuits design- Symbol, Reciprocating–quick return-pressure sequencing circuit, regeneration and synchronizing circuit, speed control-meter in, meter out and bleed off circuit, accumulator and safety circuits, clamping and drilling circuit.

Pneumatic circuits design: pneumatic circuits- hydro pneumatic circuits - logic circuits, cylinder sequencing circuit-cascade circuit and its applications.

Unit IV   CONTROLLERS AND PROGRAMMABLE LOGIC CONTROLLERS   L 9

Controller : Modes of Controller- On – Off mode, Proportional mode, Derivative mode, Integral Mode, PI Mode, PD mode –PID Controllers.

Programmable Logic Controllers: Introduction -basic structure, Relay logic, Input/output processing, ladder diagram and programming - timers, counters, latching, internal relays and shift registers, data handling, selection of a PLC, I/O interfacing, simple ladder programming applications for the industrial requirements.

Unit V   ARTIFICIAL INTELLIGENCE IN MECHATRONICS
**   AND CASE STUDIES   L 9**

AI concepts in mechatronics –Perception and Cognition, Neural Networks, Reasoning-Fuzzy logic – Application of AI in mechatronics.

Case studies: Control of Washing machine –Autofocus Camera, exposure control, Engine management systems – Controlling temperature of a hot/cold reservoir using PID – Control of pick and place robot – Part identification and tracking using RFID.

**   Total Number of hours: 45**

Learning Resources

Text Books

1. Nitaigour Premchand Mahalik., "Mechatronics: Principles, Concepts and Applications", Tata Mc Graw Hill,2003.

2. Bolton, N.,"Mechatronics: A Multidisciplinary Approach", 4th edition, Pearson Education, 2013.

Reference Books

1. Ernest O. Doeblin, "Measurement system, Application and design", Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004.

2. Patranabis D.,"Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2005.

3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.

4. Devdas shetty, Richard A. Kolk, "Mechatronics System Design", 2nd Edition, Cengage Learning 2011.

5. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

6. David Allan Bradley, Derek Seward, David Dawson, "Mechatronics and the Design of Intelligent Machines and Systems" CRC press, 2018.

7. Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry. Wiley publisher,2019.

COURSE CODE   **U19ME603**   L T P C

COURSE NAME   **OPERATIONS RESEARCH**   3 1 0 4

Pre-Requisites Subject: Probability and statistics, Multivariable Calculus.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Formulate real life situations into linear programming problems and solve using the algorithms.

CO2   Construct and solve industrial problems using transportation and assignment modeling.

CO3   Analyze various routing issues using network models to solve them and understand game theory.

CO4   Design inventory models to help decision making of purchase and production department.

CO5   Formulate queuing models for service systems and solve them optimally. Simulate exponential and Poisson models and suggest realistic solutions.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	3	2	2	3	2	2	3	3	3	3	3	3	3
CO – 2	3	3	3	2	2	2	3	2	3	2	3	2	3	3
CO – 3	3	2	2	3	3	2	2	2	2	3	2	2	3	3
CO – 4	2	3	2	2	2	3	2	3	2	2	2	2	3	3
CO - 5	2	3	3	3	3	2	2	2	2	3	3	3	3	3

Unit I   LINEAR PROGRAMMING   L 9 T 3

Introduction to operations research- Linear programming, Mathematical formulation of real life problems- Graphical solution - Mathematical formulation of a problem –Simplex Algorithm: Algebraic form, Tabular form, BIG-M, Two phase method. Introduction to dual simplex method, writing the dual of an LP, simple problems.

Unit II   TRANSPORTATION AND ASSIGNMENT MODELS   L 9 T 3

Transportation problems - Introduction – Problem formulation, balancing the transportation problem – North West Corner method – Least cost method – Vogel's method, Assignment problems, Algorithm – Hungarian method, travelling salesman problem, real life problems in finding optimal number of delivery points and the capacity level of service outlets.

Unit III   NETWORK MODELS AND GAME THEORY   L 9 T 3

Network models - Shortest route algorithm - Minimal spanning tree - Maximum flow algorithm – Designing different types of sales networks to minimize resource uses and improve efficiency. Critical path method - PERT networks. Introduction to game theory, two person zero sum games, problem formulation, graphical solutions.

Unit IV   INVENTORY MODELS   L 9 T 3

Introduction to deterministic inventory models - Economic order quantity models –EOQ with price breaks, Quantity discount models – Probabilistic Inventory models – single period models, Multi period models.

Unit V   QUEUEING THEORY AND SIMULATION MODELING   L 9 T 3

Elements of Queuing models – role of exponential and poisson distribution, - Single Server and multi-server models - Poisson input - Exponential service - Constant rate service. Monte carlo simulation, Discrete event simulation, Generation of random numbers and manual simulation of single server model.

Total Number of hours: 60

Learning Resources

Text Books

1. H.A.Taha, "Operations Research ", Prentice Hall of India, 2011, Ninth Edition.
2. Panneerselvam.R , "Operations Research ", Prentice Hall of India, 2009, 2nd edition.
3. Hira and Gupta, "Introduction to Operations Research", S.Chand and Co., 2002.

Reference Books

1. Shenoy,G.V; Srivastava,U.K; Sharma,S.C, "Operation Research for Management ", New Age International (P) Ltd, 2005.
2. Sherali,Hanif.D ; Jarvis,John.J ; Bazaraa,Mokhtar.S, "Linear Programming and Network Flows ", Wiley-Interscience, 2005.
3. Ravindran.A; Phillips,Dow.T; Solberg,James,"Operations Research Principles & Practice ", John Wiley, 2004.

COURSE CODE   **U19ME902**   L T P C

COURSE NAME   **DATA ANALYTICS**   3 0 0 3

Pre-Requisites Subject: Probability and statistics, Machine learning with python programming

Course Outcomes

Upon completion of this course, the students will be able to

CO1   Construct the basic data search and set from real world scenarios.

CO2   Design the techniques for data mining.

CO3   Design and develop various model evaluation techniques.

CO4   Compare and contrast different paradigms for learning.

CO5   Analyze various data's using python.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	2	3	1	2	3	1	-	-	2	-	1	2	3
CO – 2	2	-	3	1	2	3	2	1	2	1	2	3	3	1
CO – 3	3	2	3	-	2	-	1	-	-	2	-	3	2	3
CO – 4	2	2	-	1	2	3	2	1	3	1	2	3	3	2
CO - 5	3	2	3	1	-	3	1	-	-	2	-	1	2	3

Unit I   **INTRODUCTION TO DATA ANALYTICS**   L 9

Introduction to data- data vs noise- Data normalization- Data Summarization and Visualization – Challenges of conventional systems - Web data – Evolution of Analytic scalability – Data sorting- Synchronous Data values- Data traffic regulation through web- Data storage.

Unit II   **DATA MINING**   L 9

Gathering and selecting data-Data cleansing and preparation-Outputs of Data Mining-Evaluating Data Mining Results-Data Mining Techniques-Tools and Platforms for Data Mining-Data Mining Best Practices-Myths about data mining-Data Mining Mistakes.

Unit III   **DECISION TREES & REGRESSION**   L 9

Decision Tree problem-Decision Tree Construction-Lessons from constructing trees-Decision Tree Algorithms. Correlations and Relationships-Visual look at relationships-Regression Exercise-Non-linear regression exercise-Logistic Regression-Advantages and Disadvantages of Regression Models.

Unit IV   **SUPERVISED VERSUS UNSUPERVISED ALGORITHMS**   L 9

Introduction - Supervised and unsupervised learning- Supervised learning: predict, predict and predict -Unsupervised learning: go to profiles search - Regression versus classification –Regression- Classification- Clustering gathers-What good could it serve-Principle of clustering algorithms- Partitioning your data by using the K-means algorithm.

Unit V   PYTHON FOR DATA ANALYTICS   L 9

Python libraries – Jupiter & Spider module – pandas – data handling, slicing & repair – plotting – variables and data types – operators – NumPy – sequence data – exploratory data analysis – dealing with missing data – data visualization.

Total Number of hours: 45

Learning Resources

Text Books

1. "Data Analytics" - Anil Maheshwari – McGraw Hill Publication – 2017.
2. "Data Analytics using Python" - Bharti Motwani – Wiley Publication.
3. "Data Analytics using Python" - Bharti Motwani – Wiley Publication.
4. McKinney, W. (2012). "Python for data analysis: Data wrangling with Pandas, NumPy, and IPython". " O'Reilly Media, Inc Montgomery, Douglas C., and George C. Runger.
5. "Probability and Statistics for Engineers and Scientists", 9th Edition, Walpole, Myers, Myers & Ye
6. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

Reference Books

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics", John Wiley & sons, 2012.
2. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
4. "Applied statistics and probability for engineers", John Wiley & Sons, 2010

COURSE CODE   **U19ME903**   L T P C

COURSE NAME   **DATA STRUCTURES USING PYTHON**   3 0 0 3

Pre-Requisites Subject: Python programming

Course Outcomes

Upon completion of this course, the students will be able to

CO1   Discuss the concept of abstract data structure.

CO2   Apply linear data structure and the concept of queues in python.

CO3   Compare trees, queues and heaps in non-linear data structure.

CO4   Discuss the concept of non-hierarchical data structures.

CO5   Explain various sorting and accessing techniques.

<table>
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<tr><td>CO – 1</td><td>3</td><td>3</td><td>3</td><td>2</td><td>1</td><td>1</td><td>-</td><td>-</td><td>2</td><td>1</td><td>1</td><td>3</td><td>3</td><td>2</td></tr>
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<tr><td>CO – 3</td><td>3</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>-</td><td>-</td><td>3</td><td>2</td><td>1</td><td>3</td><td>3</td><td>2</td></tr>
<tr><td>CO – 4</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>1</td><td>-</td><td>-</td><td>2</td><td>1</td><td>1</td><td>3</td><td>3</td><td>2</td></tr>
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</table>

Unit I   **INTRODUCTION**   L   9

Introduction to programming, algorithms and data structure **-** need of data structure – types of data structure – implementation – real life scenarios – difference between data structure and data base management – Abstract data type and classes – Introduction to OOP - classes in Python **-** complexity – asymptotic notations – recursion – application of recursion.

Unit II   **LINEAR DATA STRUCTURES**   L 9

Introduction to Arrays – declaration of arrays – implementation – applications – python sequences**.** Continues memory based linear data structure – stack – implementation of stack using pointer – complex operations – applications – queues – single ended queues – double ended queues.

Unit III   **NON LINEAR DATA STRUCTURES**   L   9

Introduction to non-linear data structure – Trees – binary trees – implementation – traversal – basic operations – applications of trees – Search trees – binary trees – AVL trees– B-trees – applications – Heaps **-** binary heap – leftist heaps – priority queues using heaps – applications.

Unit IV NON HIERARCHICAL DATA STRUCTURES L 9

Introduction to non-hierarchical data structures – trie – dictionary – hash tables – sets – counter and multisets. Memory management – data structure in memory management – B+ trees – memory hierarchy – caching.

Unit V SORTING AND SEARCHING L 9

Introduction to sorting – importance of sorting algorithms – exchange sort – insertion sort – divide and conquer - distribution sort – comparison of sorts.

Introduction to searching – linear search – binary search – tree based search - hashing.

Total Number of hours: 45

Learning Resources

Text Books

1. Shriram K Vasudevan, Abhishek S Nagarajan, Karthick Nanmaran, "Data structures using python", Oxford university press, New Delhi, 2021.

2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015.

Reference Books

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, 2021.

2. Benjamin Baka, " Python Data Structures and Algorithms", Packt, 2nd Edition, 2017.

3. Narasimha Karumanchi, "Data Structure and Algorithmic Thinking with Python", Careermonk, 2015.

4. Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011.

COURSE CODE   **U19ME904**   L T P C

COURSE NAME   **HEATING VENTILATION AND**

                        AIR CONDITIONING DESIGN   3 0 0 3

Pre-Requisites Subject: Engineering Thermodynamics, Thermal Engineering, Heat and Mass Transfer.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Develop an understanding of basic physical principles of refrigerants, air and efforts of heat transfer through materials.

CO2   Estimate the heating and cooling load for various buildings.

CO3   Design simple duct layouts and estimate the pressure drop in simple duct layouts.

CO4   Select the suitable fan for the air distribution systems.

CO5   Suggest an appropriate Air Conditioning system for specific applications.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	3	2	1	3	1	2	1	2	1	3	2	3	3
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CO – 4	2	3	3	1	3	1	1	1	3	1	1	2	3	3
CO - 5	3	3	3	1	1	1	1	-	3	-	1	1	3	3

Unit I   **INTRODUCTION**   L   9

Introduction to HVAC- scope - modes of Heat transfer in building – Refrigerants- types properties of refrigerants, properties of air, psychrometric processes, psychrometric chart – basic components of air conditioning – RTU, AHU etc. - functions of HVAC systems – Codes and standards – ASHRAE, ISHRAE, IMC.

Unit II   **LOAD CALCULATIONS**   L 9

Heating and Cooling Load calculation – Room types – load sources – internal and external – infiltration, ventilation (Restaurant, kitchen, parking area and Toilet)- case study of various buildings.

Unit III   **DUCT DESIGN**   L 9

Ducts and its types, Duct materials, fittings, dampers, Pressure losses in ducts, Equivalent diameter, Duct designing methods (manual calculations) using Equal friction/Velocity reduction method.

Unit IV   AIR DISTRIBUTION SYSTEMS   L 9

Principles of air distribution systems – types, Diffusers – grills – selection – fans – types – performance characteristics.

Unit V   AIR CONDITIONING SYSTEMS & HVAC COMMISSIONING   L 9

Air conditioning systems – Unitary Air Conditioning Systems - Central Air Conditioning Systems - Chilled water system.

HVAC Commissioning- Cost / Benefit Analysis - Testing and Commissioning Procedures for HVAC Systems.

Total Number of hours: 45

Note: (Use of "Refrigeration and Air-Conditioning" data book, Domkundwar, Dhanpat Rai & co, and Approved HVAC data book are permitted in the University examination).

Learning Resources

Text Books

1. R.K.Rajput, "A Textbook of Refrigeration and Air-Conditioning", S.K. Kataria & Sons,2014.
2. Faye C.McQuiston, Jerald D.Parker & Jeffrey D.Spitler "Heating, Ventilating, and Air Conditioning analysis and Design", sixth edition, Wiley, Reprint 2016.

Reference Books

1. Ali vedavarz, Sunil kumar and Muhammed iqbal hussain, "The Handbook of Heating, Ventilation and Air Conditioning for Design and Implementation", Industrial press inc, new york, 2007.
2. Edward G.Pita "Air conditioning Principles and systems", PHI learning Private Limited, Fourth edition, Reprint 2012.
3. P.L.Ballaney, "Refrigeration and Air Conditioning", Khanna Publishers, 2013.
4. Shan K. Wang, "Handbook Of Air Conditioning And Refrigeration", Second Edition, McGraw-Hill
5. Arthur A. Bell Jr, "HVAC Equations, Data, and Rules of Thumb", McGraw-Hill.

COURSE CODE   **U19ME905**   L T P C

COURSE NAME   **MODERN VEHICLE TECHNOLOGY AND**

                    AUTOMOTIVE TESTING   3 0 0 3

Course Outcomes

Upon completion of this course the students will be able to

CO1   Discuss the vehicle control, geographical information and autonomous safety
          systems.

CO2   Design and implement the comfort and security systems for autonomous
          vehicles.

CO3   Discuss the various vibration measurement test, Vehicle roof strength test and
          Fuel consumption test for autonomous vehicles.

CO4   Analysis the performance of suspension, shock absorber and Steering control system.

CO5   Evaluate the performance of wheels and braking system.

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Unit I   DRIVER ASSISTANCE, TELEMATICS AND SAFETY SYSTEM   L 9

Driver information - driver perception - driver monitoring, general vehicle control - longitudinal and lateral control, collision avoidance, vehicle monitoring. Global positioning system, geographical information systems, navigation system, automotive vision system, road recognition. Active and passive safety, forward collision warning systems, Autonomous Vehicle System, Lane departure warning system, Adaptive headlight system, Day time running lights (DRL), Automatic wiper system, Traffic Sign Identification.

Unit II   COMFORT SYSTEMS AND SECURITY SYSTEMS   L 9 Adaptive cruise control system - Active suspension system- collapsible and climate control system. Anti theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system, number plate coding, Bio metric systems.

Unit III   RIDE VIBRATION AND BODY TEST   L 9

Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, vehicle acceleration measurement. Dolly roll over test - dolly role over fixture, Vehicle roof strength test – test procedure and test measurements. Door system crush test –procedure and measurements. Fuel consumption test - test route selection, vehicle test speeds, cargo weights, driver selection, simple calculations.

Unit IV   SUSPENSION AND STABILITY FOR

**   DIRECTIONAL CONTROL TEST   L 9**

Measurement of dimensional and geometric characteristics - measurement of centre of gravity position, suspension elastic and coulomb friction characteristics, measurement of shock absorber characteristics. Steering control system directional control test **-** Analysis of constant radius test, constant steer angle test, constant speed variable radius test, constant speed variable steer angle test, response gain test and simple design calculation.

Unit V   WHEELS AND BRAKING PERFORMANCE TEST   L 9

Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test and performance calculations.

Total Number of hours: 45

Learning Resources

Text Books

1. Crouse W.H.and Anglin D.L., "Automotive Mechanics" Tata McGraw Hill Publishing Company, 2004.
2. Rangan, Mani and Sharma, "Instrumentation", Tata McGraw Hill Publishers, New Delhi, 2004.
3. Ronald K Jurgen, "Navigation and Intelligent Transportation Systems – Progress in Technology", Automotive Electronics Series. SAE, USA, 2001.

Reference Books

1. Beckwith TG. and Buck N L., "Mechanical Measurements", Addition Wesley Publishing Company Limited, 2004.
2. Tim Gilles, "Automotive Service"" Delmar Publishers, 2005.
3. Jain R K. "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 2004.
4. LjuboVlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann Publications, Oxford, 2001.
5. Robert Bosch GmbH, "Safety, Comfort and Convenience Systems", Wiley, 2007.

COURSE CODE   **U19ME604**   L T P C

COURSE NAME   **MECHATRONICS AND SIMULATION LABORATORY**   0 0 4 2

Pre- requisites Subject: Electrical Drives and ARM processor Laboratory

Course Outcomes

Upon completion of this course the students will be able to

CO1   Design the fluid power circuits to control the direction and speed of actuators.

CO2   Analyze the performance of ON-OFF/P/PI/PD/PID controllers on Temperature Process, Flow Process and Pressure Process.

CO3   Solve the real-time problem using fluid sim, Lab view and MATLAB in automation industry.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO – 3	3	3	3	3	3	3	1	1	3	1	3	1	3	3

LIST OF EXPERIMENTS

1. Design the fluid power circuits to control the direction and speed of actuators.

2. Design of fluid power circuits to control the speed of actuators.

   a. Meter in circuit

   b. Meter out circuit

3. Design of circuits for the logic sequence using Electro pneumatic trainer kits.

4. Simulation of basic Hydraulic and Pneumatic circuits using software.

5. Design of circuits with Programmable logic controller in Electro pneumatic trainer.

6. Servo controller interfacing for open loop and closed loop.

7. PID controller interfacing of DC motor for the speed control.

8. Stepper motor interfacing with 8051 Micro controllers

   a. Full step resolution

   b. Half step resolution

9. Analyzing the performance of ON-OFF/P/PI/PD/PID controllers on Temperature Process, Flow Process and Pressure Process.

10. Simulation using Lab VIEW and Data acquisition using NI Hardware

11. Simulation using MATLAB software

    a. Simulation of Cam and follower mechanism to find the displacement

    b. Simulation of air conditioning with condenser and evaporator temperatures as input to estimate the COP

    c. Simulation of heat exchanger to find the LMTD

    d. Simulation of spring mass system by varying mass to find the frequency

List of Equipment (for a batch of 30 students)

1. Basic Pneumatic Trainer Kit with manual and electrical controls - 1 each
2. Basic Pneumatic Trainer Kit with PLC controls - 1 No.
3. Fluid sim- hydro & Pneumo Software - 2 sets.
4. LabVIEW software   - 40 users.
5. Data acquisition setup - 1 each.
6. MATLAB Software- 20 users.

Total Number of Hours: 60

COURSE CODE	**U19ME605**	L T P C
COURSE NAME	**COMPUTER AIDED MANUFACTURING AND MEASUREMENTS LABORATORY**	0 0 4 2

Pre-requisites subject: Manufacturing process, Instrumentation and Control Systems.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Write a CNC part program by using G & M Codes for turning machine.

CO2   Measure the taper angle, cutting tool parameters, temperature, straightness, flatness, and gear tooth parameters.

CO3   Simulate a CNC part program for manufacturing real time component applications.

CO / PO, PSO Mapping														
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	3	3	2	2	2	1	2	3	1	3	2	2	3
CO – 2	3	2	3	3	3	2	1	1	1	1	1	1	3	2
CO – 3	3	3	2	3	2	3	1	1	3	1	3	1	3	3

LIST OF EXPERIMENTS

PART–A- CAM

1. CNC lathe - Introduction to G-Code and M- code programming & operations.
2. CNC Part Programming for facing cycle.
3. CNC Part Programming for turning cycle.
4. CNC Part Programming for threading cycle.
5. CNC Part Programming for Taper Turning operation.
6. Circular Interpolation - CCW & CW operations.
7. Part Programming for Grooving, Drilling and Boring operations.
8. Multiple profile turning & boring canned cycle.
9. Manufacturing of tapped nozzle for hydraulic and pneumatic systems.

PART-B-Measurements
1. Checking Linear dimensions of a part using slip gauges.
2. Measurement of Taper Angle using sine bar / bevel protractor.
3. Measurement of cutting tool parameters using tool makers microscope.
4. Measurement of straightness and flatness using auto-collimator.
5. Measurement of thread parameters using Profile projector / Floating carriage micrometer.
6. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic).
7. Measurement of Temperature using Thermocouple system.
8. Measurement of Force using load cell.
9. Measurement of Gear tooth dimensions using Gear Tooth Vernier.

List of Equipment's (for a batch of 30 students)

1. CNC Lathe
2. Simulation software - CADEM
3. Micrometer and Dial Gauge
4. Vernier Caliper, Vernier Height Gauge, Vernier Depth Gauge
5. Sine Bar and Slip Gauge Set
6. Bevel Protractor
7. Tool Makers Microscope
8. Autocollimator
9. Profile Projector
10. Floating Carriage Micrometer
11. Mechanical and Pneumatic Comparator
12. Temperature Measuring Setup
13. LVDT-Displacement Measuring Setup
14. Load cell -Force Measuring Setup
15. Gear Teeth Vernier

Total Number of Hours: 60

COURSE CODE   **U19GE601**   L T P C

COURSE NAME   **SOFT SKILLS AND APTITUDE –IV**   0 0 2 1

Course Outcomes

Upon completion of this course the students will be able to

CO1   Demonstrate capabilities in job-oriented company selection processes using the hands-on approach.

CO2   Solve problems of any given level of complexity in all areas of quantitative aptitude and logical reasoning and score 70-75% marks in company-specific internal tests.

CO3   Put-to-use their proficiency in language skills to arrange the jumbled sentences, write captions for given pictures and attempt the company specific verbal ability questions with commendable aptitude.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
CO – 1	1	1	1	1	1	2	2	3	3	3	1	3	1	1
CO – 2	3	3	3	2	2	2	1	3	3	2	1	3	3	3
CO – 3	1	1	1	1	1	1	1	3	3	3	1	3	1	1

1. **SOFTSKILLS**

Demonstrating Soft -Skills capabilities with reference to the following topics:

   a. Mock group discussions
   b. Mock interviews
   c. Mock stress interviews

2. **QUANTITATIVE APTITUDE AND LOGICAL REASONING**

Solving problems with reference to the following topics:

   a. Functions and Polynomials
   b. Clocks and Calendars
   c. Data Sufficiency: Introductions, 3 Options Data Sufficiency, 4 Options Data Sufficiency and 5 Options Data Sufficiency
   d. Logical reasoning: Cubes, Non Verbal reasoning and Symbol based Reasoning.
   e. Decision making table and Flowchart
   f. Campus recruitment papers: Discussion of previous year questions paper of all major recruiters
   g. Miscellaneous: Cognitive gaming Puzzles-(Picture, Word and Number based), IQ Puzzles, Calculation Techniques and Time Management Strategies.
   h. Trigonometry.-Concepts.

3. QUANTITATIVE APTITUDE AND LOGICAL REASONING

Demonstrating English language skills with reference to the following topics:
   a. Writing captions for given pictures
   b. Reading comprehension
   c. Critical reasoning
   d. Theme detection
   e. Jumbled sentences
   f. Writing a story on given pictures
   g. Company specific verbal questions

Total Number of Hours: 30

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory						
1	U19ME701	Design of Transmission Systems		3	1	0	4	60
2	U19ME702	Design of Jigs, Fixtures and Press Tools		3	1	0	4	60
3	U19GE701	Professional Ethics and Human Values		3	0	0	3	45
4	U19ME906	**Professional Elective**	Product Life Cycle Management	3	0	0	3	45
5	U19ME907		Quality and Reliability Engineering					
6	U19ME908	**Professional Elective**	Enterprise Resource Planning	3	0	0	3	45
7	U19ME909		Supply Chain Management and Analytics					
8		***Open Elective**		3	0	0	3	45
		Practical						
9	U19ME703	Project Design		0	0	6	3	90
						Total Credits	23	

Approved By

Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.D.Senthilkumar	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

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Page 1

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		*Open Elective					
1	U19CE1004	Disaster Management					
2	U19CS1002	Cloud Computing					
3	U19CS1003	Internet of Things					
4	U19CS1004	Mobile Application Development					
5	U19CS1006	Data Science					
6	U19EC1001	Biomedical Instrumentation and Measurements					
7	U19EC1002	Embedded and Real Time Systems					
8	U19EC1003	Sensors and Smart Structures Technologies					
9	U19EC1005	Signal and Image Processing					
10	U19EC1007	CMOS VLSI Design	3	0	0	3	45
11	U19EE1001	Electric Mobility					
12	U19EE1002	Energy Conservation and Management					
13	U19EE1003	Innovation, IPR and Entrepreneurship Development					
14	U19EE1004	Renewable Energy Systems					
15	U19EE1005	Electrification in Building Construction					
16	U19FT1001	Fundamentals of Fashion Design					
17	U19FT1002	Garment Manufacturing Technology					
18	U19MC1003	Smart Automation					
19	U19MC1004	Fundamentals of Robotics					

Approved By

Chairperson, Mechanical Engineering BoS   **Member Secretary, Academic Council**   **Chairperson, Academic Council & Principal**

    Dr.D.Senthilkumar   **Dr.R.Shivakumar**   **Dr.S.R.R.Senthil Kumar**

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    HOD/Mechanical Engineering, Seventh Semester BE Mechanical Students and Staff, COE

COURSE CODE   **U19ME701**   **L T P C**

COURSE NAME   **DESIGN OF TRANSMISSION SYSTEMS**   **3 1 0 4**

Pre-Requisites Subject: Kinematics of Machinery & Design of Machine elements

Course Outcomes

Upon completion of this course the students will be able to

CO1   Design the various transmission systems and its elements including flexible elements for complex mechanisms.

CO2   Design the spur and helical gear with related concepts and other gear designing terms.

CO3   Design the bevel and worm gear based for industrial applications.

CO4   Design the gear box for both constant speed and variable number of speeds in the transmission systems.

CO5   Design the clutches and Brakes and solving the practical problems.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	3	2	2	2	-	1	2	3	2	2	2	2
CO – 2	3	2	2	2	2	1	1	1	2	3	3	3	3	3
CO – 3	2	3	3	3	3	1	-	2	2	2	3	3	2	2
CO – 4	2	3	3	3	2	2	1	1	1	3	3	2	3	3
CO - 5	2	2	2	3	3	1	1	1	2	2	3	3	2	3

Unit I   **DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS**   L 9 T 3

Design of flat belt, V - Belt and pulleys - Selection of flat belts and pulleys – V belts and pulleys – Selection of transmission chains and sprockets - Introduction to Wire ropes and modern transmission systems.

Unit II   **DESIGN OF SPUR GEARS AND HELICAL GEARS**   L 9 T 3

Design of Spur Gear: Terminology - Speed ratios and number of teeth -Force analysis - Tooth Stresses - Dynamic effects – fatigue strength - factor of safety - gear materials. Design of helical gear :Terminology – Speed ratios and number of teeth – Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and face width – Pressure angle in the normal and transverse plane – Equivalent number of teeth – Forces and stresses – Estimating the size of the helical gears.

Unit III   DESIGN OF BEVEL AND WORM GEARS   L 9 T 3

Design of Straight bevel gears: Tooth terminology- Tooth forces and stresses – Equivalent number of teeth. Worm Gear: Terminology – Thermal capacity – materials - forces and stresses and Efficiency - Design of Worm gear – Estimating the size of the worm gear pair.

Unit IV   DESIGN OF GEAR BOXES   L 9 T 3

Geometric progression – Standard step ratio – Ray diagram – Kinematics layout – Design of sliding mesh gear box – Constant mesh gear box – Design of multi speed gear box.

Unit V   DESIGN OF CLUTCHES AND BRAKES   L 9 T 3

Design of plate clutches – axial clutches - cone clutches - internal expanding rim clutches - internal and external shoe brakes.

Total Number of hours: 60

Note: (Use of standard Design Data Book is permitted in the University examination)

Learning Resources

Text Books

1. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Education, 2020.
2. Kurt M. Marshek; Robert C. Juvinall, "Fundamentals of Machine Component Design", 7th Edition, Wiley 2019.
3. Robert L Norton, "Machine Design - An Integrated Approach", Pearson Education, New Delhi, 10th edition, 2020.

Reference Books

1. Joseph E. Shigley, Charles R. Mischke and Charles R. Mischke "Mechanical Engineering Design", McGraw – Hill International 10th Edition, 2020.
2. Prabhu, T.J., "Design of Transmission Elements", Prabhu publisher, 2020.
3. Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson.," Fundamentals of Machine Elements", CRC Press., 2020.
4. G.M. Maitra. and L.V. Prasad., "Hand book of Mechanical Design", McGraw-Hill Inc., US, New edition 2020.

COURSE CODE   **U19ME702**   **L T P C**

COURSE NAME   **DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**   **3 1 0 4**

Pre-Requisites Subject: Manufacturing process, Design of Machine Elements.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Explain the fundamental concepts and various elements in Tool design and discuss different materials and devices, state the features of Jigs and fixture mechanisms, pneumatic and hydraulic actuators and discuss different forces analyzed in clamping.

CO2   Describe the fundamental components and working principles of Jigs and its types. Outline the working principle and characteristic of various parts with its real time applications.

CO3   Design the fixture for the machines such as lathe, milling machine, Planner, boring and broaching. Also design the fixtures for grinding, shaping, welding and planning operations for a given component.

CO4   Design the fundamental and working principle of press tools, Dies and its accessories.

CO5   Design and develop the progressive dies, compound dies and bending dies for blanking operations. Also develop the drawing of dies.

CO / PO, PSO Mapping														
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	2	2	2	2	2	1	1	2	3	2	2	3	2
CO – 2	2	2	2	2	2	2	1	1	2	3	3	3	2	2
CO – 3	2	3	3	3	2	1	-	2	2	3	3	2	2	3
CO – 4	2	3	3	3	2	2	1	1	1	3	3	3	3	2
CO - 5	2	2	2	3	3	1	1	1	2	2	3	3	2	3

Unit I   PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES   L 9 T 3

Tool design objectives - Production devices - Inspection devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force- Tolerance and error analysis.

Unit II   JIGS   L 9 T 3

Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs- Automatic drill jigs-Rack and pinion operated - Air operated Jigs components - Design and development of Jigs for given components.

Unit III   FIXTURES   L 9 T 3

General principles of boring, lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given component.

Unit IV   PRESS WORKING   L 9 T 3

Press Working Terminologies and Elements of Dies and Strip Layout Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements - Elements of progressive combination and compound dies: Die block-die shoe - Bolster plate-punch holder-guide pins and bushes – strippers – knockouts-stops –pilots.

Unit V   DESIGN AND DEVELOPMENT OF DIES   L 9 T 3

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

Total Number of hours: 60

Learning Resources

Text Books

1. Joshi, P.H. "Jigs and Fixtures", Third Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2. Edward G Hoffman, "Jigs and Fixture Design", 5th Edition Gengage India, 2015.
3. Donaldson, Lecain and Goold "Tool Design", 5th Edition Tata McGraw Hill, 2017.

Reference Books

1. K. Venkataraman, "Design of Jigs Fixtures and Press Tools", 2nd Edition, Springer Nature Switzerland AG, 2022.
2. Hiram E Grant, "Jigs and Fixture" Tata McGraw-Hill, New Delhi, 2003.
3. ASTME Fundamentals of Tool Design, Prentice Hall of India.
4. Design Data Handbook PSG College of Technology, Coimbatore.

COURSE CODE   **U19GE701**   **L T P C**

COURSE NAME   **PROFESSIONAL ETHICS AND HUMAN VALUES**   **3 0 0 3**

Course Outcomes

Upon completion of this course the students will be able to

CO1   Identify the core values that shape the ethical behavior of an engineer.

CO2   Analyze and practice engineering ethics in their profession.

CO3   Apply codes of ethics in the context of social experimentation.

CO4   Explore various safety issues and ethical responsibilities of an engineer.

CO5   Adopt ethical practices pertaining to global issues.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs **PSOs Mapping**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	2	1	1	1	1	2	3	3	3	2	2	3	1	1
CO – 2	2	1	1	1	2	2	3	3	3	3	3	3	1	1
CO – 3	2	1	3	1	2	3	3	3	3	3	3	3	1	1
CO – 4	2	1	3	1	1	3	3	3	3	2	3	3	1	1
CO - 5	2	1	3	1	1	3	3	3	3	3	3	3	1	1

Unit I   HUMAN VALUES   L 9

Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – Caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Introduction to Yoga and meditation for professional excellence and stress management.

Unit II   ENGINEERING ETHICS   L 9

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Profession and Professionalism – Professional Ideals and Virtues –Theories of Right action- Self Interest- Customs and Religion-Uses of Ethical Theories.

Unit III   ENGINEERING AS SOCIAL EXPERIMENTATION   L 9

Engineering as Experimentation – Contrasts with standard experiments- Engineers as Responsible Experimenters – Importance and limitations of Codes of Ethics - Industrial Standards - A Balanced Outlook on Law – Industrial Standards- Case Study: Space shuttle challenger disaster.

Unit IV   SAFETY, RESPONSIBILITIES AND RIGHTS   L 9

Safety and Risk – Types of risk - Assessment of Safety and Risk – Risk Benefit analysis-Reducing Risk – Case Studies - Chernobyl and Bhopal plant disaster.

Collegiality and Loyalty –Respect for Authority- Collective Bargaining – Confidentiality – Conflicts of

Interest – Occupational Crime – Importance and consequences of whistle blowing - Professional Rights – Employee Rights – Intellectual Property Rights (IPR) and its components– Discrimination.

Unit V   **GLOBAL ISSUES**   L 9

Multinational Corporations – Environmental Ethics – Computer Ethics and Internet- Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Participation in professional societies- –Code of Conduct – Corporate Social Responsibility.

Total Number of hours: 45

Learning Resources

Text Books

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, Indian Edition, Tenth reprint, 2017.
2. Professional Ethics and Human values- Sonaversity, Edition 2018.

Reference Books

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 2012.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2016.
3. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
4. R.Subramanian, "Professional Ethics ", Oxford University Press, Second Edition, 2017.

Course Code   **U19ME703**   **L T P C**

Course Name   **PROJECT DESIGN**   **0 0 6 3**

Course Outcomes

Upon completion of this course the students will be able to

CO1   Identify Problem, formulate survey literature and analyze engineering problems.

CO2   Design system component that acquires the needs for public health and environment consideration.

CO3   Ability to form team for carrying the project in multi-disciplinary settings and design documentation with effective presentation.

Total Number of hours: 90

1. The students are expected to get formed into a team of convenient groups of not more than 4 members on a project.
2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of beginning of 7th semester.
3. The group has to identify and select the problem to be addressed as their project work; make through literature survey and finalize a comprehensive aim and scope of their work to be done.
4. A project report has to be submitted by each student group for his project work.
5. Three reviews have to be conducted by a team of faculty (minimum of 3 and maximum of 5) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

COURSE CODE	U19ME906	L T P C
COURSE NAME	PRODUCT LIFE CYCLE MANAGEMENT	3 0 0 3

Course Outcomes

Upon completion of this course the students will be able to

CO1 Explain the history, concepts and terminology of PLM.

CO2 Apply the functions and features of PLM/PDM.

CO3 Apply the different modules offered in commercial PLM/PDM tools.

CO4 Implement the PLM/PDM approaches for industrial applications.

CO5 Integrate the PLM/PDM with legacy data bases, CAx& ERP systems.

CO / PO, PSO Mapping													
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	2	2	1	-	2	2	2	3	3	3	3	2	1	2
CO – 2	2	2	2	2	3	2	2	2	3	3	3	3	1	2
CO – 3	2	2	2	2	3	2	1	2	2	2	3	3	-	3
CO – 4	1	1	2	1	2	2	2	1	3	2	3	2	2	3
CO - 5	2	2	3	3	2	1	2	2	3	2	3	3	2	3

Unit I   INTRODUCTION TO PLM   L 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (CPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

Unit II   PLM/PDM FUNCTIONS AND FEATURES   L 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

Unit III   DETAILS OF MODULES IN A PDM/PLM SOFTWARE   L 9

Mechanical case studies based on top few commercial PLM/PDM tools – Team center, Wind chill, ENOVIA, Aras PLM, SAP PLM, and etc.

Unit IV   ROLE OF PLM IN INDUSTRIES   L 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance.

Unit V   PERIODIC AND PREVENTIVE MAINTENANCE   L 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities. Steps/procedure for periodic and preventive maintenance. Advantages of preventive maintenance. Repair cycle concept and importance.

Total Number of hours: 45

Learning Resources

Text Books

1. L Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2016.
2. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2015.

Reference Books

1. ArieKarniel and Yoram Reich, Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm, Springer, 2011
2. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011.
3. Kevin Roebuck, Product Lifecycle Management (PLM): High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Emereo, 2011.

COURSE CODE   U19ME907   L T P C
COURSE NAME   QUALITY AND RELIABILITY ENGINEERING   3 0 0 3
Course Outcomes
Upon completion of this course the students will be able to

CO1 Apply the 7 QC tools in problem solving for continuous improvement.

CO2 Design online sampling plan for quality control using control charts and perform process capability studies.

CO3 Apply the strategies of acceptance sampling plan to perform quality audit in the customer site.

CO4 Evaluate the different reliability measurements applying the reliability concepts.

CO5 Select the suitable method of improving the reliability and integrate reliability concepts in new product design and development.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	2	2	1	-	-	3	2	3	3	3	3	2	2	2
CO – 2	2	2	2	2	2	2	2	3	3	3	3	3	1	2
CO – 3	2	1	2	2	2	3	1	2	2	2	2	2	-	2
CO – 4	2	1	2	1	2	2	1	3	3	3	3	3	2	3
CO - 5	1	2	2	1	2	2	2	3	3	2	3	3	2	3

Unit I   INTRODUCTION AND STATISTICAL PROCESS CONTROL   L 9

Introduction:-definitions of quality, Evolution of Quality: Inspection, Quality Control, Quality assurance Customer-Orientation: Internal & External Customer Concept, Life cycle approach to quality costs-Prevention; Appraisal and Failure costs. Seven SPC tools -Histogram, Check sheets, Ishikawa diagrams, Pareto, Scatter diagrams, Control charts and flow chart.

Unit II   ONLINE QUALITY CONTROL   L 9

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, Control chart for variables – X chart, R chart andσchart -State of control and process out of control identification in charts, pattern study and process capability studies.

Unit III   OFFLINE QUALITY CONTROL   L 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producers Risk and consumers Risk. AQL, LTPD, AOQL concepts standard sampling plans for AQL and LTPD- uses of standard sampling plans.

Unit IV   RELIABILITY CONCEPTS   L 9

Reliability engineering - fundamentals – failure data analysis, Mean failure rate, Mortality curves concept of burn –in period, useful life and wear out phase of a system, mean time to failure, meantime between failure, hazard rate – failure density and conditional reliability-Maintainability and availability – simple problems.

Unit V   RELIABLITY ESTIMATION   L 9

System reliability: Series, Parallel and Mixed configurations, Reliability improvement techniques, use of Pareto analysis – design for reliability – redundancy unit and standby redundancy- fault tree analysis – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Total Number of hours: 45

Learning Resources

Text Books

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley2016.
2. Srinath. L.S., "Reliability Engineering", 4th edition Affiliated East west press, 2015.

Reference Books

1. Besterfield D.H., "Quality Control", 8th edition, Prentice Hall, 2009.
2. Connor, P.D.T.O., "Practical Reliability Engineering", 5th edition Wiley India, 2012.
3. Grant, Eugene .L "Statistical Quality Control", TMH, 2005.
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai& Sons 2016.

COURSE CODE **U19ME908** **L T P C**

COURSE NAME **ENTERPRISE RESOURCE PLANNING** **3 0 0 3**

Pre-Requisites Subject: Manufacturing technology, CAD/CAM

Course Outcomes

Upon completion of this course the students will be able to

CO1 Identify the suitable parameters to design the ERP system for industries.

CO2 Analyze the modules of ERP system for the real time applications.

CO3 Identify the strategies to be followed during implementation of ERP system.

CO4 Apply the latest trends in ERP systems for modifications of existing systems.

CO5 Apply the latest e-business tools for designing web based ERP systems.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	2	2	1	-	1	3	2	2	3	3	3	2	1	2
CO – 2	2	1	2	2	2	2	2	3	2	3	3	3	2	2
CO – 3	1	1	1	2	1	3	1	2	2	2	2	3	1	3
CO – 4	2	1	2	1	2	2	2	3	3	3	3	3	2	3
CO - 5	1	2	2	1	2	2	2	3	3	3	3	3	2	3

Unit I INTRODUCTION L 9

ERP Architecture - Inventory management- Economic order quantity– Material Requirement Planning (MRP) –Bill of material- Capacity requirement planning- Master production schedule- Manufacturing Resource Planning (MRP II)- CAPP- Cost control – Enterprise Resource Planning.

Unit II MODULES OF ERP L 9

Structure of ERP system – Functions of ERP system – Integrated ERP solutions – ERP sub systems – Key Modules -Modules of ERP – Accounting and Finance, Sales and Distribution, Production & Materials Management – Human Resource management – Plant and Maintenance, Quality Management.

Unit III IMPLEMENTATION OF ERP L 9

Implementation of ERP – Phase, Strategies and Approaches – Implementation Methodologies – Role of vendors, consultants and user in ERP implementation – Critical Success factor – Failure factors of ERP Implementation, Return on investment.

Unit IV EMERGING TRENDS IN ERP L 9 Extended

ERP systems and ERP add-ons, Customer Relationship Management, E- ERP and CRM integration, SCM, Business process Reengineering, Wireless Technology used in ERP, Business analytics & Intelligence, Future trends in ERP.

Unit V   ERP E-BUSINESS   L 9

Making Functional Areas E-Business Enabled, inter and intra organizational business processes, E-Procurement, E-marketing, E-Selling, Security and payment systems, Customer behavior modeling, Design of web-based ERP sites, Small business ERP, Case studies on AMAZON and Flipkart.

Total Number of hours: 45

Learning Resources

Text Books

1. Dimpi Srivastava, Aarti Batra, "ERP systems", I.K. International Publishing House, New Delhi, 2015.

2. Alexis Leon, "Enterprise Resource Planning", second edition, Tata McGraw Hill, Publishing Company Limited, New Delhi. 2017.

Reference Books

1. Marianne Bradford, Modern ERP Select, Implement & Use Today's Advanced Business System, North Carolina state university, 2014.

2. Alexis Leon, ERP Demystified" second edition, Tata McGraw Hill, Publishing Company Limited, New Delhi. 2008.

3. Daniel E. O'Leary, "Enterprise Resource Planning (ERP) Systems", Cambridge University Press, 2000.

4. Mary Summer, "Enterprise Resource Planning", Pearson Education, 2005.

COURSE CODE   **U19ME909**   **L T P C**

COURSE NAME   **SUPPLY CHAIN MANAGEMENT AND ANALYTICS**   **3 0 0 3**

Pre-Requisites Subject: Manufacturing technology.

Course Outcomes

Upon completion of this course the students will be able to

CO1   Construct a good supply chain model based on the demand and strategic fit.

CO2   Design suitable supply chain models based on the major factors of influence.

CO3   Analyze and find out the safe levels of inventory and warehousing facilities needed.

CO4   Adopt suitable methods of purchasing materials and strategies to manage vendors.

CO5   Explain the concept of analytics in supply chain and apply in real situations.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	2	2	1	1	1	2	1	2	3	3	3	2	1	2
CO – 2	2	1	2	2	2	2	2	2	2	3	2	3	2	2
CO – 3	2	2	2	2	2	2	1	2	3	3	3	3	1	3
CO – 4	2	1	2	1	2	2	2	3	3	3	3	3	1	2
CO - 5	1	2	2	1	2	2	2	2	3	3	3	3	2	3

Table caption (header rows): CO / PO, PSO Mapping — (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak — Programme Outcomes (POs) and Programme Specific Outcome (PSOs)

Unit I   SUPPLY CHAIN PLANNING   L 9

Introduction to Supply Chain Management, Types, push/pull and cycle views, Achieving Strategic fit, Drivers of supply chain performance, Demand forecasting, Uncertainty in the supply chain, Bullwhip Effect, SC Restructuring, Shift left and Shift right strategies, Agile Supply Chains.

Unit II   DESIGNING AND MODELING SUPPLY CHAIN NETWORK   L 9

Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, customer service strategic management, Logistics Information system-Operational LIS , Models for Facility Location and Capacity Allocation, Supply Chain Integration.

Unit III   INVENTORY MANAGEMENT, WARE HOUSING AND MATERIAL HANDLING
                                                                              L 9
Concept, types, functions of inventory in logistics, Planning Supply and Demand in a SC, managing uncertainty in a SC: Safety Inventory, Warehousing- Concept, Types, Warehouse Strategies, Material Handling- Concept, Guiding Principles, and Devices. Elements of transportation cost, Multi Model transport.

Unit IV   PURCHASING AND VENDOR MANAGEMENT IN SC   L 9

Impact of strategic purchasing on profitability, Make or Busy Decisions, Subcontracting, Global Quotation and E-Procurement, Vendor selection process, vendor rating techniques. Developing vendor performance measures, Global trends and issues in Sourcing, Dealing with international suppliers.

Introduction to Modeling and Analytics in Supply Chain Network, Prescriptive analytics in network planning in a supply chain, Strategic Performance Improvement, IT enablement of supply chains, Inventory Analytics, Risk Analytics in Supply Network Design. Problem solving using Microsoft Excel and open source software. Supply Chain Analytics Case studies of Swiggy, Zomato and other online vendors.

Total Number of hours: 45

Learning Resources

Text Books

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia, 2016.

2. N. Chandrasekaran, Supply Chain Management- Process, System and Practices, 1st Edition, Oxford, 2014.

Reference Books

1. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2012.

2. Sudalaimuthu and Anthony Raj, Logistics Management for International Business- Text and cases, PHI, 2009 Edition.

3. Ayers.J.B, "Hand book of supply chain management", The St. Lencie press,2000.

4. Joel D. Wisner, Principles of Supply chain management, Cengage Learning, 2007.

U19GE701   PROFESSIONAL ETHICS AND HUMAN VALUES   3 0 0 3

COURSE OUTCOMES:

At the end of the course, the student will be able to
- Identify the core values that shape the ethical behavior of an engineer.
- Analyze and practice engineering ethics in their profession.
- Apply codes of ethics in the context of social experimentation.
- Explore various safety issues and ethical responsibilities of an engineer.
- Adopt ethical practices pertaining to global issues.

COs	CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	2	1	1	1	1	2	3	3	3	2	2	3
CO2	2	1	1	1	2	2	3	3	3	3	3	3
CO3	2	1	3	1	2	3	3	3	3	3	3	3
CO4	2	1	3	1	1	3	3	3	3	2	3	3
CO5	2	1	3	1	1	3	3	3	3	3	3	3

UNIT-I   HUMAN VALUES   9
Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – Caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT -II   ENGINEERING ETHICS   9
Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Profession and Professionalism – Professional Ideals and Virtues –Theories of Right action- Self Interest- Customs and Religion-Uses of Ethical Theories.

UNIT-III   ENGINEERING AS SOCIAL EXPERIMENTATION   9
Engineering as Experimentation – Contrasts with standard experiments- Engineers as Responsible Experimenters – Importance and limitations of Codes of Ethics - Industrial Standards - A Balanced Outlook on Law – Industrial Standards- Case Study: Space shuttle challenger disaster.

UNIT-IV   SAFETY, RESPONSIBILITIES AND RIGHTS   9
Safety and Risk – Types of risk - Assessment of Safety and Risk – Risk Benefit analysis-Reducing Risk – Case Studies - Chernobyl and Bhopal plant disaster.

Collegiality and Loyalty –Respect for Authority- Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Importance and consequences of whistle blowing - Professional Rights – Employee Rights – Intellectual Property Rights (IPR) and its components– Discrimination.

UNIT-V   GLOBAL ISSUES   9
Multinational Corporations – Environmental Ethics – Computer Ethics and Internet- Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Participation in professional societies- –Code of Conduct – Corporate Social Responsibility.

                                    Lecture: 45, Tutorial: 0, TOTAL: 45 Hours

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, Indian Edition, Tenth reprint, 2017.
2. Professional Ethics and Human values- Sonaversity, Edition 2018.

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 2012.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2016.
3. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
4. R.Subramanian, "Professional Ethics ",Oxford University Press , Second Edition, 2017.

Nivakumar
5/7/2022

Member Secretary-Academic Cou----
SONA COLLEGE OF TECHNOLOGY
SALEM - 636 005.

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Practical					
1	U19ME801	Project Work	0	0	24	12	360
					Total Credits	**12**	

Approved By

Chairperson, Mechanical Engineering BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.D.Senthilkumar	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-
    HOD/Mechanical Engineering, Eighth Semester BE Mechanical Students and Staff, COE