SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

B.E-Mechanical Engineering

CURRICULUM and SYLLABI

[For students admitted in 2020-2021]

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	0	0	2	1	HS
11	U19OLE1102	German					
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

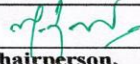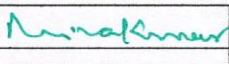| Chairperson, Science and Humanities BoS	Chairperson, Mechanical Engineering BoS	Member Secretary, Academic Council	Chairperson, Academic Council & Principal
Dr.M.Renuga	**Dr.D.Senthilkumar**	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

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

Sona College of Technology, Salem – 636 005
(An Autonomous Institution)
Courses of Study for BE / B Tech Semester II under Regulations 2019 (CBCS)
Branch: Mechanical Engineering

S.N	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
Theory								
1	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BSC	60
2	U19PHY203D	Physics for Mechanical Engineering	3	1	0	4	BSC	60
3	U19PPR205	Problem Solving Using Python Programming	3	0	0	3	ESC	45
4	U19ME201	Manufacturing Process	3	0	2	4	ESC	75 (45L+30P)
5	U19ENG201D	Communication Skills in English for Engineers and Technocrats	2	0	2	3	HSC	60 (30L+30P)
Practical								
7	U19PHL210	Physics Laboratory	0	0	3	1.5	BSC	45
8	U19PPL211	Python Programming Laboratory	0	0	2	1	ESC	30
9	U19GE201	Basic Aptitude-II	0	0	2	0	EEC	30
Total Credits						20.5		
Optional Language Elective*								
10	U19OLE1201	French						
11	U19OLE1202	German	0	0	2	1	HSMC	30
12	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	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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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester III Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory					
1	U19MAT301B	Probability and Statistics	3	1	0	4	60
2	U19ME301	Engineering Mechanics **-** Statics and Dynamics	3	1	0	4	60
3	U19ME302	Engineering Thermodynamics	3	1	0	4	60
4	U19ME303	Fluid Mechanics and Machinery	3	0	0	3	45
5	U19ME304	Conventional and Smart Manufacturing	3	0	0	3	45
6	U19ME305	Instrumentation and Control Systems	3	0	0	3	45
7	U19GE302	**Mandatory course:** Environment and Climate Science	2	0	0	0	30
		Practical					
8	U19ME306	Fluid Mechanics and Machinery Laboratory	0	0	2	1	30
9	U19ME307	Special Machines Laboratory	0	0	2	1	30
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1	30
					Total Credits	**24**	

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

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory					
1	U19ME401	Thermal Engineering	3	0	0	3	45
2	U19ME402	Strength of Materials	3	0	0	3	45
3	U19ME403	Engineering Materials and Metallurgy	3	0	0	3	45
4	U19ME404	Object Oriented Programming for Mechanical Engineering	3	0	0	3	45
5	U19ME405	Kinematics of Machines	3	0	0	3	45
6	U19GE403	**Mandatory Course:** Essence of Indian Traditional Knowledge	2	0	0	0	30
		Practical					
7	U19ME406	Thermal Engineering Laboratory	0	0	2	1	30
8	U19ME407	Strength of Materials Laboratory	0	0	2	1	30
9	U19ME408	Object Oriented Programming Laboratory for Mechanical Engineering	0	0	2	1	30
10	U19GE401	Soft Skills and Aptitude - II	0	0	2	1	30
					Total Credits	**19**	

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester V under 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	noc22_cs95	**NPTEL -** Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3	45
5	U19ME901	**Professional Elective** Machine Learning with Python Programming	3	0	0	3	45
**Practical**							
6	U19ME504	Heat and Mass Transfer Laboratory	0	0	2	1	30
7	U19ME505	Dynamics of Machinery Laboratory	0	0	2	1	30
8	U19ME506	Computer Aided Design and Analysis Laboratory	0	0	2	1	30
9	U19GE501	Soft Skills and Aptitude - III	0	0	2	1	30
					Total Credits	**19**	

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Dr.R.Shivakumar

Chairperson, Academic Council & Principal
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HOD/Mechanical Engineering, Fifth Semester BE Mechanical Students and Staff, COE

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	U19ME910	**Professional Elective** – Robotics and Automation	3	0	0	3	45
5	U19ME911	**Professional Elective** – Product Design and Development					
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**	3	0	0	3	45
		Practical					
9	U19ME604	Mechatronics and Simulation Laboratory	0	0	4	2	60
10	U19ME605	Computer Aided Manufacturing and Measurements Laboratory	0	0	4	2	60
11	U19GE601	Soft Skills and Aptitude – IV	0	0	2	1	30
					Total Credits	**25**	

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

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S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
*Open Elective							
1	U19BM1002	Basic Life Support	3	0	0	3	45
2	U19CE1002	Municipal Solid Waste Management	3	0	0	3	45
3	U19CS1001	Big Data Analytics	3	0	0	3	45
4	U19CS1002	Cloud Computing	3	0	0	3	45
5	U19EC1002	Embedded and Real Time Systems	3	0	0	3	45
6	U19EC1006	Mobile Technology and its Applications	3	0	0	3	45
7	U19EE1002	Energy Conservation and Management	3	0	0	3	45
8	U19EE1003	Innovation, IPR and Entrepreneurship Development	3	0	0	3	45
9	U19EE1004	Renewable Energy Systems	3	0	0	3	45
10	U19FT1001	Fundamentals of Fashion Design	3	0	0	3	45
11	U19IT1001	Problem Solving Techniques Using Java Programming	3	0	0	3	45
12	U19MC1003	Smart Automation	3	0	0	3	45
13	U19MC1004	Fundamentals of Robotics	3	0	0	3	45

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

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
	U19ME907		Quality and Reliability Engineering					
5	U19ME908	**Professional Elective**	Enterprise Resource Planning	3	0	0	3	45
	U19ME909		Supply Chain Management and Analytics					
6		***Open Elective**		3	0	0	3	45
Practical								
7	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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		*Open Elective					
1	U19CE1001	Building Services and Safety Regulations					
2	U19CE1004	Disaster Management					
3	U19CS1003	Internet Of Things					
4	U19CS1001	Big Data Analytics					
5	U19EC1003	Sensors and Smart Structures Technologies					
6	U19EC1007	CMOS VLSI Design	3	0	0	3	45
7	U19EC1006	Mobile Technology and its Applications					
8	U19EE1002	Energy Conservation and Management					
9	U19EE1004	Renewable Energy Systems					
10	U19FT1001	Fundamentals of Fashion Design					
11	U19BM1001	Hospital Management					
12	U19MC1004	Fundamentals of Robotics					

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11.07.2023

Regulations-2019

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII under 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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HOD/Mechanical Engineering, Eight Semester BE Mechanical Students and Staff, COE

21.12.2023

Regulations-2019

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					
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

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

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

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
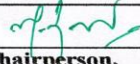- d. Editing passages
- e. Sentence filler words
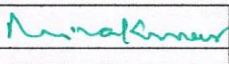
TOTAL: 30 hours

Sona College of Technology, Salem – 636 005
(An Autonomous Institution)
Courses of Study for BE / B Tech Semester II under Regulations 2019 (CBCS)
Branch: Mechanical Engineering

S.N	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
		Theory						
1	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BSC	60
2	U19PHY203D	Physics for Mechanical Engineering	3	1	0	4	BSC	60
3	U19PPR205	Problem Solving Using Python Programming	3	0	0	3	ESC	45
4	U19ME201	Manufacturing Process	3	0	2	4	ESC	75 (45L+30P)
5	U19ENG201D	Communication Skills in English for Engineers and Technocrats	2	0	2	3	HSC	60 (30L+30P)
		Practical						
7	U19PHL210	Physics Laboratory	0	0	3	1.5	BSC	45
8	U19PPL211	Python Programming Laboratory	0	0	2	1	ESC	30
9	U19GE201	Basic Aptitude-II	0	0	2	0	EEC	30
		Total Credits				20.5		
		Optional Language Elective*						
10	U19OLE1201	French						
11	U19OLE1202	German	0	0	2	1	HSMC	30
12	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	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 Engineering, Second Semester BE MECH Students and Staff, COE

04.06.2021   B.E/B. Tech Regulations-2019

B. E. / MECHANICAL ENGINEERING

SEMESTER – II	DIFFERENTIAL EQUATIONS AND	L	T	P	C
U19MAT202A	VECTOR CALCULUS	3	1	0	4

COURSE OUTCOMES

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

1. apply the classical methods to solve linear ordinary differential equations.
2. apply the appropriate numerical methods to solve ordinary differential equations.
3. apply the Laplace transforms technique to solve ordinary differential equations.
4. apply the classical method to solve partial differential equations.
5. apply the concepts of vector differentiation and integration to determine the line, surface and volume integrals.

	CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	3							2	2		3
CO2	3		2	3							2	2		3
CO3	3		2	3							2	2		3
CO4	3		2	3							2	2		3
CO5	3		2	3							2	2		3

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 12 EQUATIONS

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.

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. 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.

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BoS - Chairperson
Science and Humanities
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10. 05. 2019

B. E. / B. Tech. Regulations 2019

Course Code: **U19PHY203D**   **L T P C**
Course Name: **Physics for Mechanical Engineering**   **3 1 0 4 100**

(for Mechanical Engineering)

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

CO1   Explain motion of objects in two dimensions.

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.

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	-	3
CO – 2	3	2	-	-	-	-	-	-	-	-	2	2	-	3
CO – 3	3	2	-	-	-	-	-	-	-	-	2	2	-	3
CO – 4	3	2	-	-	-	-	-	-	-	-	2	2	-	3
CO - 5	3	2	-	-	-	-	-	-	-	-	2	2	-	3

UNIT 1   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 2   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 3   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 4   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 5   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 book

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.

U19PPR205   PROBLEM SOLVING USING PYTHON PROGRAMMING   3 0 0 3

COURSE OUTCOMES

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

1. Develop algorithmic solutions to simple computational problems

2. Write simple Python programs

3. Write programs with the various control statements and handling strings in Python

4. Develop Python programs using functions and files

5. Analyze a problem and use appropriate data structures to solve it.

COs	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)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3									3	3
CO2	2	3	3	3	3								3	2
CO3	2	3	3	3	3								3	2
CO4	2	3	3	3	3								3	2
CO5	2	3	3	3	3								3	2

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, 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

TEXT BOOK

1. Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 2018.

2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

REFERENCES

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

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

3. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.

4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013.

COURSE CODE   U19ME201   L T P C

COURSE NAME   MANUFACTURING PROCESS   3 0 2 4

Course Outcomes

Upon completion of this 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   Discuss 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   Elaborate the various types of moulding processes in manufacturing of plastic components.

<table>
<tr><td colspan="15">CO / PO, PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak</td></tr>
<tr><td colspan="15">Programme Outcomes (POs) and Programme Specific Outcome (PSOs)</td></tr>
<tr><td>COs, POs

PSOs Mapping</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td><td>PSO1</td><td>PSO2</td></tr>
<tr><td>CO 1</td><td>3</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>2</td><td>1</td><td>2</td><td>3</td><td>2</td><td>3</td><td>3</td><td>3</td></tr>
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<tr><td>CO 4</td><td>3</td><td>2</td><td>2</td><td>3</td><td>2</td><td>3</td><td>1</td><td>1</td><td>2</td><td>3</td><td>1</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>CO 5</td><td>3</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>2</td><td>3</td><td>3</td><td>3</td></tr>
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SECTION: A   **THEORY**

Unit – I   THEORY OF METAL CUTTING   L 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   L 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   L 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   L 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   L 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.

Number of hours: 45

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

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

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

Reference Books

1. B.S. Magendranparashar& 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.

U19ENG201C- Communication Skills in English for Engineers and Technocrats

First year II semester

Mechanical

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.

	COURSE OUTCOMES	PROGRAMME OUTCOMES													
		1	2	3	4	5	6	7	8	9	10	11	12	Pso 1	Pso 2
1	Use grammatical components effectively in both written and spoken communication	1	1	1	2	2	2	3	3	3	3	3	3	3	3
2	Read for gathering and understanding information, following directions and giving responses	2	2	1	1	2	3	3	3	3	3	3	3	3	3
3	Develop effective reading skills and reinforce language skills required for using grammar and building vocabulary	2	2	1	1	2	3	3	3	3	3	3	3	3	3
4	Write email, formal letters and descriptions of graphics	1	1	2	2	2	3	2	2	1	3	3	2	3	3
5	Develop skills for writing reports and proposals, and for general purpose and technical writing	1	2	1	2	2	2	2	2	3	3	2	2	2	2

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

Total 60 hours

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.

U19PHL210	PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

	Course Outcomes
	After successful completion of this course, the students should be able to
CO1:	Apply the principles of Thermal Physics and Elasticity to determine the Engineering properties of materials.
CO2:	Apply the principles of Optics and Electricity to determine the Engineering properties of materials.
CO3:	Determine the thickness and resistivity of the given copper turn used for house hold applications.

Pre-requisite: Capable of using Screw gauge, Vernier calliper, Travelling microscope and Spectrometer

	CO/PO, PSO Mapping
	(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3			1		1					1			2
CO2	3			1		1					1			2
CO3	3			1		1					1			2

Course Assessment methods		
Direct		**Indirect**
Mean of 1st half of Experiment (10)	Quiz on 2nd half (5)	Course end survey
Quiz on 1st half (5)	Internal test II (10)	
Internal test I (10)	RTPS (10)	
Mean of 2nd half of Experiment (10)	End semester Examination (40)	

List of Experiments

1	Determination of velocity of ultrasonic waves and compressibility of the given liquid using ultrasonic interferometer.
2	Determination of Young's modulus of the material of the beam by Non-uniform bending method.
3	Determination of the thermal conductivity of a bad conductor using Lee's Disc apparatus.
4	Determination of specific resistance of a given wire using Carey Foster's bridge.
5	Determination of Rigidity Modulus of given wire using Torsion Pendulum.
6	Determination of coefficient of viscosity of liquid by Poiseuille's method.
7	Determination of Young's modulus of the material of the beam by uniform bending method.
8	Determination of laser wavelength using diode laser.
9	Determination of particle size of lycopodium powder using diode laser.
10	Determination of acceptance angle and numerical aperture of an optical fibre using diode laser.

11	Determination of the thickness of a thin wire by forming interference fringes using air wedge apparatus.
12	Determination of dispersive power of the prism for various pairs of colors in the mercury spectrum using a spectrometer.
13	Determination of Wavelength of Mercury spectrum using spectrometer.
14	Determination of band gap of the given semiconductor diode.
	Total Hours: 45 Hrs

U19PPL211   **PYTHON PROGRAMMING LABORATORY**   **0 0 2 1**

COURSE OUTCOMES

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

1. Implement the algorithms using basic control structures in Python

2. Develop Python programs to use functions, strings and data structures to solve different types of problems

3. Implement persistent storing information through file operations

	CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3									3	3
CO2	2	3	3	3	3								3	2
CO3	2	3	3	3	3								3	2

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 Regulations 2019
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
		Theory					
1	U19MAT301B	Probability and Statistics	3	1	0	4	60
2	U19ME301	Engineering Mechanics **-** Statics and Dynamics	3	1	0	4	60
3	U19ME302	Engineering Thermodynamics	3	1	0	4	60
4	U19ME303	Fluid Mechanics and Machinery	3	0	0	3	45
5	U19ME304	Conventional and Smart Manufacturing	3	0	0	3	45
6	U19ME305	Instrumentation and Control Systems	3	0	0	3	45
7	U19GE302	**Mandatory course:** Environment and Climate Science	2	0	0	0	30
		Practical					
8	U19ME306	Fluid Mechanics and Machinery Laboratory	0	0	2	1	30
9	U19ME307	Special Machines Laboratory	0	0	2	1	30
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1	30
					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

B. E / MECHANICAL ENGINEERING

SEMESTER – III			L	T	P	C
U19MAT301B	PROBABILITY AND STATISTICS		3	1	0	4

COURSE OUTCOMES

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

1. apply the concepts of measures of central tendency, dispersion, correlation to the given data and analyze the results.
2. apply the concepts of random variables and their properties to generate the moments.
3. fit the suitable distribution and its properties to the real world problems and interpret the results.
4. apply the concepts of joint probability distribution and its properties to find the covariance.
5. test the hypothesis of the population using sample information.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	3							2	2		3
CO2	3		2	3							2	2		3
CO3	3		2	3							2	2		3
CO4	3		2	3							2	2		3
CO5	3		2	3							2	2		3

UNIT – I   BASIC STATISTICS   12

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   12

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

UNIT – III   THEORETICAL DISTRIBUTIONS   12

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

UNIT – IV   TWO DIMENSIONAL RANDOM VARIABLES   12

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

20. 05. 2020   B. E. / B. Tech. Regulations 2019

UNIT – V   TESTING OF SIGNIFICANCE   12

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.

Theory: 45 Hours   **Tutorial: 15 Hours**   **Total: 60 Hours**

TEXT BOOKS:

1. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons Publishers, 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:

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

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20. 05. 2020

B. E. / B. Tech. Regulations 2019

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

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

Table title: 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   **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   **EQUILLLIBRIUM 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

1. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education.
2. 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.
3. 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 Outcomes

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.

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	1	-	1	2	-	3	-	3	-	3	3	2
CO – 2	3	3	3	2	3	3	2	3	2	3	2	3	3	3
CO – 3	2	3	2	3	3	-	3	1	3	1	3	2	2	2
CO – 4	3	-	3	3	-	3	3	2	1	-	3	2	2	3
CO - 5	2	2	3	3	3	1	3	-	3	3	3	3	3	3

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

Learning Resources

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.

Reference books

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.

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	3	-	3	3	2	-	3	-	3	3	3
CO – 2	3	3	3	-	1	3	3	-	3	1	-	2	3	2
CO – 3	-	2	3	3	3	2	3	1	2	3	3	3	2	3
CO – 4	3	3	3	2	3	1	-	3	3	3	3	2	2	2
CO - 5	2	3	2	3	3	3	2	3	3	2	3	3	3	3

Unit – I   FLUID PROPERTIES AND PRESSURE MEASUREMENT   L 9 T 0

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 T 0

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 T 0

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 T 0

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 T 0

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

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

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

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

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

5. 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.

COs, POs PSOs Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO – 1	3	-	-	-	-	3	2	3	2	3	3	2	3	2
CO – 2	3	2	1	2	3	-	3	1	3	3	-	3	3	3
CO – 3	2	1	3	3	2	3	3	-	3	2	2	3	2	3
CO – 4	2	3	3	3	3	2	2	2	3	1	3	3	2	3
CO - 5	1	3	2	3	3	2	3	3	2	3	3	3	2	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   SPECIAL MACHINE TOOLS   L 9 T 0

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 T 0

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 T 0

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 T 0

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 T 0

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 NAME   INSTRUMENTATION AND CONTROL SYSTEMS   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.

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	1	3	-	3	1	3	3	1	3	2
CO – 2	3	1	2	2	3	-	-	-	-	3	3	3	2	3
CO – 3	2	2	3	3	2	3	1	2	3	2	3	3	3	2
CO – 4	1	3	3	3	2	2	2	3	3	2	2	2	3	3
CO - 5	-	3	3	3	3	1	3	1	3	2	-	3	2	3

Unit – I   MEASURING SYSTEM   L 9 T 0

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 T 0

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 T 0

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 T 0

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 T 0

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).

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	3	3	3	-	3	2	3	3
CO – 2	1	3	3	3	2	3	3	-	3	3	3	3	2	3
CO – 3	2	2	3	3	3	2	1	3	3	3	1	3	2	3

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.

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	3	3	3	3	3	3	2	2	3
CO – 2	3	2	3	3	2	-	3	-	3	3	-	3	2	2
CO – 3	-	3	2	3	3	1	-	2	3	2	3	3	3	3

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

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

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

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)

L	T	P	C
2	0	0	0

Course Outcomes:

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..

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

30.07.2021   Regulations-2019

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.
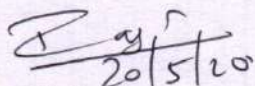
TOTAL: 30 HOURS
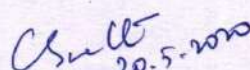
Text Books:
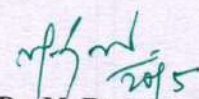
1. Miller, T.G. Jr., "Environmental Science", Wadsworth Pub. Co. 2018
2. Anubha Kaushik and Kaushik, "Environmental Science and Engineering" New Age International Publication, 4th Multicolour Edition, New Delhi, 2014.

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	Total Contact Hours
Theory							
1	U19ME401	Thermal Engineering	3	0	0	3	45
2	U19ME402	Strength of Materials	3	0	0	3	45
3	U19ME403	Engineering Materials and Metallurgy	3	0	0	3	45
4	U19ME404	Object Oriented Programming for Mechanical Engineering	3	0	0	3	45
5	U19ME405	Kinematics of Machines	3	0	0	3	45
6	U19GE403	**Mandatory Course:** Essence of Indian Traditional Knowledge	2	0	0	0	30
Practical							
7	U19ME406	Thermal Engineering Laboratory	0	0	2	1	30
8	U19ME407	Strength of Materials Laboratory	0	0	2	1	30
9	U19ME408	Object Oriented Programming Laboratory for Mechanical Engineering	0	0	2	1	30
10	U19GE401	Soft Skills and Aptitude - II	0	0	2	1	30
		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.

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	1	-	1	2	-	3	-	3	-	3	3	2
CO-2	3	3	3	2	3	3	2	3	2	3	2	3	3	3
CO-3	2	3	2	3	3	-	3	1	3	1	3	2	2	2
CO-4	3	-	3	3	-	3	3	2	1	-	3	2	2	3
CO-5	2	2	3	3	3	1	3	-	3	3	3	3	3	3

Unit – I   GAS POWER CYCLES   L 9

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

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

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

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

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

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

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

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

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

5. 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 Categorize the stresses and strains for various engineering components with different loading conditions.

CO2 Determine the effect of the two-dimensional stresses under various loading combinations on structural parts and thin cylinders.

CO3 Construct the shear force and bending moment diagrams for simply supported, cantilever and over hanging beams.

CO4 Analyze pure torsion on solid and hollow circular shafts and Design of Leaf and closed coil helical springs.

CO5 Evaluate slope and deflection of beams and buckling of columns using analytical methods and python programming.

<table>
<tr><td colspan="15">CO / PO, PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak</td></tr>
<tr><td colspan="15">Programme Outcomes (POs) and Programme Specific Outcome (PSOs)</td></tr>
<tr><td>COs, POs

PSOs Mapping</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td><td>PSO1</td><td>PSO2</td></tr>
<tr><td>CO – 1</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>CO – 2</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>CO – 3</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>CO – 4</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>CO - 5</td><td>3</td><td>3</td><td>2</td><td>2</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
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Unit – I   **STRESS, STRAIN AND DEFORMATION OF SOLIDS**   **L 9**

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**

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

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

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

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

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

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

Reference books

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
2. Singh D.K "Mechanics of Solids" Pearson Education 2002.
3. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.
4. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, Second Edition 2012.
5. Robert L Mott and Joseph A. Untener, ''Applied Strength of Materials'', CRC Press, Sixth Edition, 2016.
6. Nagar Sandeep. Introduction to Python: For Scientists and Engineers, independently published (2016)
7. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016
8. 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: Chemistry for Mechanical Engineering, Physics for mechanical engineering.

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 Discuss the various non-metallic materials with its properties and applications.

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

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	1	2	3	3	1	1	3	2	3	3	3
CO – 2	3	1	2	1	2	3	3	1	1	3	2	3	3	3
CO – 3	3	2	2	1	2	3	3	2	1	3	2	3	3	3
CO – 4	3	2	2	1	2	3	3	2	1	3	2	3	3	3
CO - 5	3	2	2	1	2	3	3	1	2	3	3	3	2	2

Unit I   CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS   L 9

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

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

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

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

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. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2014.
2. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials properties and selection" Pearson India Education Services Pvt ltd, 9 edition, 2017.
3. William D.Callister,Jr and David G.Rethwisch " Materials science and Engineering, An introduction" Wiley, 10th Edition, 2020.

Reference books:

1. R.K.Rajput "Engineering Materials & Metallurgy" S Chand Publications. 2006.
2. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.
3. Zainul Huda, Robert Bulpett "Materials Science and Design for Engineers" Trans Tech Publications Limited, 2012.
4. T. DebRoy, H. K. D. H. Bhadeshia "Innovations in Everyday Engineering Materials" Springer International Publishing. 2021.

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.

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	-	2	1	1	-	-	1	3
CO – 2	3	3	3	3	3	2	1	2	2	3	-	-	2	3
CO – 3	3	3	3	3	3	3	3	3	3	3	1	2	2	3
CO – 4	3	3	3	2	3	2	3	2	2	2	1	2	2	3
CO - 5	3	3	2	1	3	1	1	2	1	1	-	2	1	3

Unit – I   INTRODUCTION TO OOP'S   L 9

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

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

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

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

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:

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

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

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

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

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

6. 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 Mechanics, Problem Solving using 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.

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	3	3	2	1	1	1	1	1	1	3	3
CO – 2	3	3	2	3	3	2	1	1	1	1	1	3	3	3
CO – 3	3	3	3	3	3	2	1	1	1	1	1	2	3	3
CO – 4	3	3	3	3	3	2	1	1	1	1	1	2	3	3
CO - 5	3	3	3	3	3	2	1	2	1	1	1	3	3	3

Unit – I   BASICS OF MECHANISMS   L 9

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

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

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

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

Classification of synthesis – type, dimension, number, Synthesis of four bar mechanism -Chebyshev Method. Robot Arm kinematics – Denavit - Hartenberg Parameters - Forward and inverse kinematics of a two dimensional 2 degree of freedom manipulators (type RR).

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. K.S. Fu, R.C Gonzalez, "Robotics control, sensing, Vision, and Intelligence", Tata McGraw-Hill, 2016, ISBN-13: 978-0-07-026510-3.
3. 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. 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. John Hannah and Stephens R.C, "Mechanics of Machines", Viva Low-Prices, Student Edition, 1999.
6. P.L.Ballaney, "Theory of Machines", Khanna publishers, 23rd Edition, 2003, ISBN 817409122X, 9788174091222.
7. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005, ISBN-13: 978-8123908748.
8. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2008, ISBN-13: 978-8185938936.
9. Ramamurti,V.,'' Mechanism and Machine Theory", Second Edition, Narosa Publishing House, New Delhi, 3rd Edition, 2010, ISBN: 978-81-7319-892-2.

COURSE CODE   **U19GE403**

COURSE NAME   **MANDATORY COURSE: ESSENCE OF INDIAN**   **L T P C**
                                TRADITIONAL KNOWLEDGE   **2 0 0 0**

Course outcome:

Upon completion of this course the students will be able to

CO1   Analyze the basics of Indian traditional knowledge in modern scientific perspectives.

CO2   Explain the basics of Vedic science and its applications in modern days.

CO3   Discuss the introduction and objectives of modern science.

CO4   Describe the contribution of Noble laurates for India's achievements in Science and Technology.

CO5   Analyze the various traditional practices for holistic health care of human beings.

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	2	-	-	2	-	-	-	-	-	-	-	2
CO – 2	2	2	2	-	-	2	-	-	-	-	-	-	-	2
CO – 3	3	2	2	-	-	2	-	-	-	-	-	-	-	2
CO – 4	3	2	2	-	-	2	-	-	-	-	-	-	-	2
CO – 5	2	2	2	-	-	2	-	-	-	-	-	-	-	2

Unit I   **INTRODUCTION TO VEDAS**   L 6
- Introduction to Vedas.
- 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**   L 6
- Basics of Applied Vedic Science.
- Modern day application of Vedas and procedure.
- Ancient Indian Scientific thoughts.
- Introduction to the Vedic language "Sanskrit".

Unit III   **MODERN SCIENCE**   L 6
- Introduction – modern science.
- Objectives – modern science.
- Architecture in ancient India.

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

Unit V   YOGA AND HOLISTIC HEALTH CARE   L 6
- Fundamentals of yoga and holistic health.
- Human biology.
- Diet and nutrition.
- Life management.
- Contemporary yogic models – case study.

Total Number of hours: 30

Learning Resources

Reference Books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.

2. Roshan Dalal The Vedas: An Introduction to Hinduism's Sacred Texts, Penguin Books 2014. ISBN 13: 9780143066385.

3. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.

4. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.

5. Raja Ram Mohan Roy, Vedic Physics, Mount Meru Publication ISBN : 9781988207049

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 Determine the COP of refrigeration and air conditioning systems for the given set of conditions.

<table>
<tr><td colspan="15">CO / PO, PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak</td></tr>
<tr><td colspan="15">Programme Outcomes (POs) and Programme Specific Outcome (PSOs)</td></tr>
<tr><td>COs, POs
PSOs Mapping</td><td>PO1</td><td>PO2</td><td>PO3</td><td>PO4</td><td>PO5</td><td>PO6</td><td>PO7</td><td>PO8</td><td>PO9</td><td>PO10</td><td>PO11</td><td>PO12</td><td>PSO1</td><td>PSO2</td></tr>
<tr><td>CO – 1</td><td>3</td><td>2</td><td>-</td><td>2</td><td>-</td><td>2</td><td>3</td><td>3</td><td>3</td><td>-</td><td>3</td><td>2</td><td>3</td><td>3</td></tr>
<tr><td>CO – 2</td><td>1</td><td>3</td><td>3</td><td>3</td><td>2</td><td>3</td><td>3</td><td>-</td><td>3</td><td>3</td><td>3</td><td>3</td><td>2</td><td>3</td></tr>
<tr><td>CO – 3</td><td>2</td><td>2</td><td>3</td><td>3</td><td>3</td><td>2</td><td>1</td><td>3</td><td>3</td><td>3</td><td>1</td><td>3</td><td>2</td><td>3</td></tr>
</table>

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 real time bending moments for different beams.

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	1	2	2	2	2	3	3	3	3	3
CO – 2	3	3	2	2	1	2	2	2	2	3	3	3	3	3
CO – 3	3	3	2	2	1	2	2	2	2	3	3	3	3	3

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. Study of Fatigue test of metallic materials.
9. Torsion test of metallic materials.
10.   Study of 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.

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	1	3	1	1	1	3	3	-	2	2	3
CO – 2	3	1	3	1	3	3	2	3	3	3	1	3	2	3
CO – 3	3	2	3	1	3	3	2	3	3	3	1	3	2	3

List of Experiments:

1. A projectile is launched at an angle θ and speed of V_0. 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 :

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

2. Write a C++ program to implement the matrix operations using a class. a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices. e) Multiplication of matrices

3. 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 principalstress (Sxx,Syy,Sxy).

4. 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.
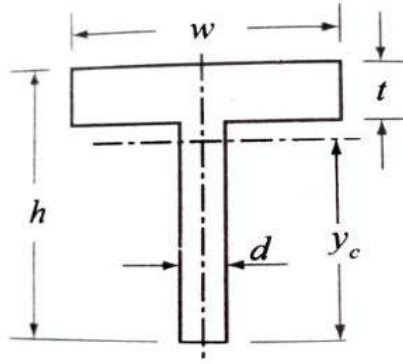
5. Write a C++ program to illustrate the usage of following: Default Constructor, Parameterized Constructor and Copy Constructor.

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

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

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

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

10. 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

COURSE CODE   **U19GE401**   **L T P C**

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

Course Outcomes

Upon completion of this course the students will be able to

CO1   Demonstrate capabilities in additional soft-skill areas using hands-on and/or case-study approaches.

CO2   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.

CO3   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.

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	1	1	2	1	1	3	3	3	3	1	1	3		
CO – 2	3	3	1	1	2	3	2	2	3	2	2	3		
CO – 3	1	2	1	2	1	1	1	1	3	3	1	3		

List of Experiments:

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

Total Number of hours: 30

Semester – IV	U19GE401-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. g. 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

Dr.S.Anita

Head/Training

SEMESTER – IV

MANDATORY COURSE

U19GE403 - ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Common for EEE, CIVIL, MECH and CSE)

	L	T	P	C
	2	0	0	0

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   6

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

Unit II   6

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

UNIT – III- Modern science   6

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

UNIT – IV Technology   6

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

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

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

10.12.2021   Regulations-2019

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester V under 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	noc22_cs95	**NPTEL -** Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3	45
5	U19ME901	**Professional Elective** Machine Learning with Python Programming	3	0	0	3	45
		Practical					
6	U19ME504	Heat and Mass Transfer Laboratory	0	0	2	1	30
7	U19ME505	Dynamics of Machinery Laboratory	0	0	2	1	30
8	U19ME506	Computer Aided Design and Analysis Laboratory	0	0	2	1	30
9	U19GE501	Soft Skills and Aptitude - III	0	0	2	1	30
					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, 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.

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	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

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

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

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

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

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, 2015.
2. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2016.

Reference Books
1. Incropera, Frank.P; Dewitt,David. P "Fundamentals of Heat and Mass Transfer", John Wiley & Sons Pvt. Ltd., 2010.
2. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2012.
3. Cengel, Y.A. "Heat Transfer: A Practical Approach", Tata McGraw, Hill. Second edition 2008.
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.

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	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

Unit – I   FORCE ANALYSIS   L   9   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

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

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

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

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

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

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

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

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

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, 2016. 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   noc22_cs95   L T P C

COURSE NAME   INTRODUCTION TO INDUSTRY

                    4.0 AND INDUSTRIAL INTERNET OF THINGS   3 0 0 3

Week 1: Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-   Part I, Part II

Week 2: Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Week 3: Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Week 4: Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Week 5: IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.

Week 6: Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I

Week 7: Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.

Week 8: Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

Week 9: Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.

Week 10: Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

Week 11: Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Week 12: Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab

Total Number of hours: 45

Learning Resources

Books and References

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress).

2. "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer).

COURSE CODE   **U19ME901**   L T P C

COURSE NAME   **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.

<center>**Total Number of hours: 45**</center>

Learning Resources

Text Books
1. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2017.
2. Harrington, Peter. Machine learning in action. Manning Publications Co., 2016.

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 AND MASS TRANSFER 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.

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	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

COURSE CODE   **U19GE501**   L T P C

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

Course Outcomes

Upon completion of this course the students will be able to

CO1 Demonstrate capabilities in supplementary areas of soft-skills and job-related selection processes using hands-on and/or case-study approaches.

CO2 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.

CO3 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.

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	1	1	2	1	1	3	3	3	3	1	1	3	2	2
CO – 2	3	3	1	1	2	3	2	2	3	2	2	3	2	2
CO – 3	1	2	1	2	1	1	1	1	3	3	1	3	2	3

List of Experiments:

1. SOFT SKILLS

Demonstrating Soft-Skill Capabilities With Reference to the following topics:

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.

2. QUANTITATIVE APTITUDE AND LOGICAL REASONING

Solving problems with reference to the following topics:

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.

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. Display effective language knowledge to construct sentences with subject verb agreement and select the best alternative for the underlined parts of the sentences, and fill in the blanks in the given passages with suitable forms of words and their synonyms.

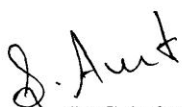|	
1.SOFT SKILLS	**Demonstrating soft-skill capabilities with reference to the following topics:** a. Career planning b. Resume writing c. Group discussion d. Teamwork e. Leadership skills f. Interview skills g. Mock interviews h. Mock GDs
2.QUANTITATIVE APTITUDE AND LOGICAL REASONING	**Solving problems with reference to the following topics :** 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.

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	U19ME910	**Professional Elective** – Robotics and Automation	3	0	0	3	45
5	U19ME911	**Professional Elective** – Product Design and Development					
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**	3	0	0	3	45
Practical							
9	U19ME604	Mechatronics and Simulation Laboratory	0	0	4	2	60
10	U19ME605	Computer Aided Manufacturing and Measurements Laboratory	0	0	4	2	60
11	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					
1	U19BM1002	Basic Life Support	3	0	0	3	45
2	U19CE1002	Municipal Solid Waste Management	3	0	0	3	45
3	U19CS1001	Big Data Analytics	3	0	0	3	45
4	U19CS1002	Cloud Computing	3	0	0	3	45
5	U19EC1002	Embedded and Real Time Systems	3	0	0	3	45
6	U19EC1006	Mobile Technology and its Applications	3	0	0	3	45
7	U19EE1002	Energy Conservation and Management	3	0	0	3	45
8	U19EE1003	Innovation, IPR and Entrepreneurship Development	3	0	0	3	45
9	U19EE1004	Renewable Energy Systems	3	0	0	3	45
10	U19FT1001	Fundamentals of Fashion Design	3	0	0	3	45
11	U19IT1001	Problem Solving Techniques Using Java Programming	3	0	0	3	45
12	U19MC1003	Smart Automation	3	0	0	3	45
13	U19MC1004	Fundamentals of Robotics	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 ofMachinery 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 andexplain 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 & weldedjoints and riveted joints for pressure vessels and structures.

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

CO5 Develop the design procedure for various types of bearings like sliding contact androlling 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	PO 3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
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 curvedbeams.

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 rivetedjoints 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 ResourcesText 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 andshift 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 – Controlof 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	U19ME910					L	T	P	C
COURSE NAME	ROBOTICS AND AUTOMATION					3	0	0	3

Prerequisites- subject: Kinematics of machinery, Engineering Mechanics, Instrumentation and control.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Classify robot configuration and end effectors and Analyze kinematics of robot

CO2 Analyze hydraulic, pneumatic and electrical drives of robot

CO3 Identify robot cell layout and write robot program for industrial application

CO4 Apply mechatronics design process for industrial automation and discuss industry 4.0.

CO5 Recognize various transport system for automation and parts delivery 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	3	3
CO – 2	3	3	3	3	-	3	-	-	-	-	-	3	3	3
CO – 3	3	-	3	3	3	3	-	-	-	-	3	3	3	3
CO – 4	3	-	3	-	3	-	-	-	3	-	3	3	3	3
CO - 5	3	-	-	3	-	-	-	-	-	-	3	3	3	3

Unit I   INTRODUCTION AND ROBOT KINEMATICS   L   9

Definition need and scope of industrial robots – Robot anatomy – Work volume – Precision movement – Classification of robots. Robot Kinematics – Direct and inverse kinematics –Coordinate transformation, Types of end effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

Unit II ROBOT DRIVES AND CONTROL   L   9

Hydraulic and pneumatic drives – Linear and rotary actuators and control valves –Electro hydraulic servo valves, electric drives – Motors ,Design of drive systems Controlling the robot motion –robot control - open loop and closed loop system- Position and velocity sensing devices

Unit III   ROBOT CELL DESIGN AND INDUSTRAIL APPLICATION   L   9

Robot work cell design and control – safety in robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots in Welding - Assembly – inspection- Material handling –pick and place- Loading and unloading. Simple robot programming language for pick and place and loading and unloading.

Unit IV   INTRODUCTION TO AUTOMATION   L   9

Introduction, Integrated design issues in automation systems, the Mechatronics design process- benefits, Architecture of industrial automation system, building blocks of automation systems, Automation in production system, classification of automated manufacturing system- fixed, programmable and flexible automation ,Automation principle and strategies -Fundamentals of industry 4.0

Unit V   TRANSPORT SYSTEM AND ASSEMBELY AUTOMATION   L   9

Material transport system - Principles of material handling, overview of material handling equipment, AGVs, RGVs ASRS-Conveyor system-Types of conveyor system, belt conveyor elements, conveyor operation and features, Assembly automation Equipments-parts delivery system-Hopper Feeders.

Total Number of hours: 45

Learning Resources

Text Books

- Mikell, P.Groover, Mitchell Weis, Roger, N.Nagel, Nicholas G.Odrey, "Industrial robotics Technology, Programming and applications" Mc Graw-Hill 2012.
- K.S.Fu, R.C.Gonzalez and C.S.G lee, "Robotics control, Sensing, Vision and Intelligence" Mc Graw-Hill, 2008.

Reference Books

- Mikell, P.Groover "Automation, Production system and Computer Integrated Manufacturing, Pearson Education. Asia 2001
- Yoram Koren, "Robotics for Engineers" Mc Graw-Hill, 1987.
- Kozyrey, Yu. "Industrial Robotics", MIR Publishers Moscow 1985.
- Richard D, Klafter, Thomas A, Chmielewski, MichealNegin, "Robotics Engineering – An integrated Approach", Prentice-Hall of India Pvt Ltd 1984.
- Deb S.R, "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994
- Ashitava Ghosal," Robotics fundamental concepts and Analysis," oxford university press, 11th compression 2015.
- Khushdeep goyal Deepak Bhandari Industrial automation and robotics S.K.Kataria & Sons. Fitfth Edition 2015.

COURSE CODE   U19ME911   L T P   C

COURSE NAME   PRODUCT DESIGN AND DEVELOPMENT   3 0   0   3

Course Outcomes

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

CO1 Apply the fundamental principles of product design and development for new product development.

CO2 Perform concept generation and select the best one by structured approaches.

CO3 Test the selected concept and develop product architecture.

CO4 Assess the importance of industrial design.

CO5 Apply the principles of design for environment and manufacturing.

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	PO 3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO – 1	3	3	3	3	3	1	-	-	3	3	-	3	3	3
CO – 2	3	3	3	3	3	1	-	-	3	3	-	3	3	3
CO – 3	3	3	3	3	3	1	-	-	3	3	-	3	3	3
CO – 4	3	3	3	3	3	1	-	-	3	3	-	3	3	3
CO – 5	3	-	3	3	3	2	3	3	3	3	-	3	3	3

Unit I INTRODUCTION TO PRODUCT DESIGN AND DEVELOPMENT   L 9

Characteristics of successful product development - Challenges of Product development – phases of generic product development process – opportunity identification process – Identification of customer needs – Establishing product specifications – case study on developing product specification for mountain bike with suspension fork.

Unit II CONCEPT GENERATION AND SELECTION   L 9

Phases of concept generation process - Structured approaches - clarification – search externally and internally-Explore systematically - reflect on the solutions and processes – concept selection – phases – concept screening – concept scoring – case studies on concept generation and selection.

Unit III CONCEPT TESTING AND PRODUCT ARCHITECTURE L 9

Seven step method for concept testing – product architecture – types of modularity – product change – product variety – component standardization – product performance – product development management – Steps involved in establishing product architecture – case study on establishing product architecture of a Deskjet printer - platform planning.

Unit IV INDUSTRIAL DESIGN L 9

Need for industrial design – critical goals of industrial designers – Ergonomic needs – Aesthetic needs – case study on assessing the importance of industrial design for a mobile phone – industrial design and corporate identity – Industrial design process – case studies on assessing the Quality of Industrial Design.

Unit V DESIGN FOR ENVIRONMENT & MANUFACTURING L 9

Stages in natural and product life cycle management – Environmental impacts - The Design for Environment Process – Introduction to Design for manufacturing (DFM) – The five-step process involved in DFM – Case studies – Ethical principles in product design.

Total Number of hours: 45

Learning Resources

Text Books

1. Karl Ulrich, Steven Eppinger, Maria C. Yang, Product Design And Development, 7th Edition, McGraw Hill, 2020

Reference Books

1. Mattson, Christopher A., and Carl D. Sorensen. Product Development: Principles and Tools for Creating Desirable and Transferable Designs. Springer Nature, 2019.

2. Jamnia, Ali. Introduction to product design and development for engineers. CRC Press, 2018.

3. Desai, Anoop, and Anil Mital. Sustainable Product Design and Development. CRC Press, 2020.

4. Boothroyd, Geoffrey, Peter Dewhurst, and Winston A. Knight. Product design for manufacture and assembly. CRC press, 2010.

5. Morris, Richard. The fundamentals of product design. Bloomsbury Publishing, 2016.

COURSE CODE   U19ME904   **L T P C**
COURSE NAME   **HEATING VENTILATION AND**   **3 0 0 3**
                AIR CONDITIONING DESIGN

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**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO – 1	3	3	2	1	3	1	2	1	2	1	3	2	3	3
CO – 2	3	1	3	1	1	1	1	1	3	1	1	1	2	2
CO – 3	3	3	1	1	3	1	1	-	3	1	3	1	3	3
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.

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**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
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   **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 overfixture, 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 PublishingCompany, 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	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO – 1	3	3	3	3	2	2	1	2	3	1	3	2	3	3
CO – 2	3	3	3	3	3	2	1	1	1	1	1	1	3	2
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 LabVIEW 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	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
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 EXPERIMENTSPART–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 carriagemicrometer.
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

Semester –VI	U19GE601-SOFT SKILLS AND APTITUDE – IV (Common to All except Civil)	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 job-oriented company selection processes using the hands-on approach
2. 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
3. Demonstrate advanced-level verbal aptitude skills in English and score 70-75% marks in company-specific internal tests

1. Soft Skills	**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 Campus recruitment papers: Solving of previous year questions paper of all major recruiters f. Miscellaneous: Cognitive gaming Puzzles-(Picture, Word and Number based), IQ Puzzles, Calculation Techniques and Time Management Strategies. g. Trigonometry.- Concepts
3. Verbal Aptitude	**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

Dr.S.Anita

06/01/2023

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

Course Code	U19ME1004	L	T	P	C
Course Name	**RENEWABLE ENERGY SOURCES**	3	0	0	3

Pre-Requisite Subject: Environmental Sciences

Course Outcomes

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

CO 1 Discuss the power demand scenario in world level and impact of various renewable energy sources in satisfying power demand.

CO 2 Explain the different components and the principle of operation and the application of solar PV system and Bio Mass power generation system.

CO 3 Outline in the components and to find the suitability based on the performance of wind energy conversion system, geothermal and hydel power system.

CO 4 Describe the components of tidal power generation scheme and wave energy scheme and to discuss the performance of two schemes.

CO 5 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	3	3	3	-	3	3	3	2	3	3	2	3	3	3
CO – 2	3	-	3	3	3	3	3	-	3	3	3	3	3	3
CO – 3	3	3	3	2	3	3	3	-	3	3	3	3	3	3
CO – 4	3	3	3	2	3	3	3	-	3	3	2	3	3	3
CO – 5	3	2	3	3	3	3	3	2	3	3	2	3	3	3

UNIT – I INTRODUCTION   9

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

UNIT – II SOLAR & BIO ENERGY   9

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   9

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   **9**

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   **9**

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

Total: 45 Hrs

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

REFERENCES:

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

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

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
	U19ME907		Quality and Reliability Engineering					
5	U19ME908	**Professional Elective**	Enterprise Resource Planning	3	0	0	3	45
	U19ME909		Supply Chain Management and Analytics					
6		***Open Elective**		3	0	0	3	45
		Practical						
7	U19ME703	Project Design		0	0	6	3	90
			Total Credits				23	

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, Seventh Semester BE Mechanical Students and Staff, COE

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
*Open Elective							
1	U19CE1001	Building Services and Safety Regulations					
2	U19CE1004	Disaster Management					
3	U19CS1003	Internet Of Things					
4	U19CS1001	Big Data Analytics					
5	U19EC1003	Sensors and Smart Structures Technologies					
6	U19EC1007	CMOS VLSI Design	3	0	0	3	45
7	U19EC1006	Mobile Technology and its Applications					
8	U19EE1002	Energy Conservation and Management					
9	U19EE1004	Renewable Energy Systems					
10	U19FT1001	Fundamentals of Fashion Design					
11	U19BM1001	Hospital Management					
12	U19MC1004	Fundamentals of Robotics					

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, Seventh Semester BE Mechanical Students and Staff, COE

11.07.2023

Regulations-2019

SONA COLLEGE OF TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
Regulation – 2019
CHOICE BASED CREDIT SYSTEM

VII-SEMESTER

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1	U19ME701	Design of Transmission Systems	3	1	0	4
2	U19ME702	Design of Jigs, Fixtures and Press Tools	3	1	0	4
3	U19GE701	Professional Ethics and Human Values	3	0	0	3
4		*Professional Elective - V	3	0	0	3
5		*Professional Elective - VI	3	0	0	3
6		**Open Elective - II	3	0	0	3
PRACTICAL						
7	U19ME703	Project Design	0	0	6	3
Total						23

Dr. D. SENTHIL KUMAR, M.E.,Ph.D
PROFESSOR & HEAD
DEPT. OF MECHANICAL ENGG.
SONA COLLEGE OF TECHNOLOGY
JUNCTION MAIN ROAD, SALEM-5.

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.

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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.

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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.

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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.

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	3	3	3	3	3	3	3	3
CO – 2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO – 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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).

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*PROFESSIONAL ELECTIVES

		PROFESSIONAL ELECTIVE - V				
1	U19ME906	Product Life Cycle Management	3	0	0	3
2	U19ME907	Quality and Reliability Engineering	3	0	0	3
		PROFESSIONAL ELECTIVE - VI				
1	U19ME908	Enterprise Resource Planning	3	0	0	3
2	U19ME909	Supply Chain Management and Analytics	3	0	0	3

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COURSE CODE	U19ME906									LTPC			
COURSE NAME	PRODUCT LIFE CYCLE MANAGEMENT									3003			

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. ArieKarniei 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.

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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
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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.

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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
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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.

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.

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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.

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 – 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

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.

Unit V   SUPPLY CHAIN ANALYTICS   L 9

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.

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PREAMBLE
To
Building Services and Safety Regulations

- Building services engineers are responsible for the design, installation, operation and monitoring of the mechanical, electrical and public health systems required for the safe, comfortable and environmentally friendly operation of modern buildings.

- Building services engineers work closely with other construction professionals such as architects, structural engineers and quantity surveyors. They influence the architecture of a building and play a significant role on the sustainability and energy demand of a building.

- Within building services engineering, new roles are emerging, for example in the areas of renewable energy, sustainability, low carbon technologies and energy management.

- With buildings accounting for around 50% of all carbon emissions, building services engineers play a significant role in combating climate change.

COURSE CODE	COURSE NAME	L	T	P	C
U19CE1001	BUILDING SERVICES AND SAFETY REGULATIONS	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:	
1.	Provide knowledge on the building electrification systems.
2.	Impart the basic knowledge in the design of lighting systems in the buildings.
3.	Provide the basic knowledge of providing air conditioning systems in the various types of buildings.
4.	Aware the students about fire safety regulations and installation systems in the building.
5.	Provide basic knowledge in the water supply and sewerage systems for the buildings.

Course Outcome (s) (COs): At the end of this course, the students will be able to:	
CO1	Acquire the basics knowledge in electrical and wiring systems for the buildings. (K1)
CO2	Design the lighting system for the various buildings and disabled peoples. (K3)
CO3	Know the basic provisions for air conditioning systems for various types of buildings. (K4)
CO4	Plan to install the fire safety equipment system in the buildings by obeying the regulations. (K3)
CO5	Explain the various plumbing fittings in the water supply and rainwater harvesting system for buildings. (K2)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

Cos	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS
CO1	3	1	3	1	1	1	3	1	1	-	-	2	1	2
CO2	3	2	3	1	2	1	3	-	1	-	-	2	1	2
CO3	3	2	3	1	2	1	3	-	1	-	-	2	1	2
CO4	1	2	3	2	2	2	3	3	2	-	-	2	2	2
CO5	1	3	3	2	2	2	3	1	2	-	-	2	2	2
CO (Avg)	2.2	2	3	1.4	1.8	1.4	3	1	1.4	-	-	2	1.4	2

Correlation Level:	1:Slight (Low)	2:Moderate (Medium)	3:Substantial (High)

UNIT-I	ELECTRICAL SYSTEMS IN BUILDINGS	9 Hours

Basics of electricity- Single / Three-phase supply- Protective devices in electrical installations- Earthing for safety- Types of earthing- ISI specifications- Types of wires, wiring systems, and their choice- Planning electrical wiring for building- Main and distribution boards- Transformers and switch-gears- Layout of substations.

UNIT-II	PRINCIPLES OF ILLUMINATION & DESIGN	9 Hours

Visual tasks- Factors affecting visual tasks- Modern theory of light and colour- Synthesis of light- Additive and subtractive synthesis of colour- Luminous flux- Candela- Solid angle illumination- Utilisation factor- Depreciation factor- MSCP- MHCP- Lans of illumination- Classification of lighting- Artificial light sources- Spectral energy distribution- Luminous efficiency- Colour temperature- Colour rendering. Design of modern lighting- Lighting for stores, offices, schools, hospitals, and house lighting. Elementary idea of special features required and minimum level of illumination required for

physically handicapped and elderly in building types.

UNIT-III	REFRIGERATION PRINCIPLES & APPLICATIONS	9 Hours

Thermodynamics- Heat- Temperature, measurement transfer- Change of state- Sensible heat- Latent heat of fusion, evaporation, sublimation- saturation temperature- Superheated vapour- Subcooled liquid- Pressure temperature relationship for liquids- Refrigerants- Vapour compression cycle- Compressors- Evaporators- Refrigerant control devices- Electric motors- Starters- Air handling units- Cooling towers- Window type and packaged air-conditioners- Chilled water plant- Fan coil systems- Water piping- Cooling load- Air conditioning systems for different types of buildings- Protection against fire to be caused by A.C. Systems

UNIT-IV	FIRE SAFETY REGULATIONS AND INSTALLATION	9 Hours

Causes of fire in buildings- Safety regulations- NBC- Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes, and A.C. systems. Special features required for physically handicapped and elderly in building types- Heat and smoke detectors- Fire alarm system, snorkel ladder- Fire lighting pump and water storage- Dry and wet risers- Automatic sprinklers

UNIT-V	WATER SUPPLY AND SEWERAGE SYSTEM FOR BUILDINGS	9 Hours

Plumbing fixtures and fixture fittings- Water-conserving fittings- Overflows- Strainers and connectors- Prohibited fixtures- Special fixtures- Installation of water closet- Urinals - Flushing devices- Floor drains- Shower stall- Bathtub- Bidets- Minimum plumbing facilities- Rainwater harvesting systems- Necessity- Construction- Different types

	TOTAL: 45 Hours

TEXT BOOKS:

1.	R. Udaykumar, "A text book on Building Services", Eswar Press, Chennai, ISBN13, 9788178740638. ISBN-10, 817874063X
2.	David V. Chadderton , Building Services Engineering Taylor & Francis, 2000.

REFERENCES:

1.	Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2011.
2.	Philips Lighting in Architectural Design, McGraw-Hill, New York, Latest edition.
3.	R.G.Hopkinson and J.D.Kay, "The Lighting of buildings", Faber and Faber, London, 1972.
4.	William H.Severns and Julian R.Fellows, "Air-conditioning and Refrigeration", John Wiley and Sons, London, 1988.
5.	A.F.C. Sherratt, "Air-conditioning and Energy Conservation", The Architectural Press, London, 2007.

PREAMBLE
To
Disaster Management

We observe that during the last three decades, disaster both natural and man-made occur frequently and their impact on life, live hoods, natural resources, property, infrastructure and facilities is very severe. Though hazards and disasters could not be prevents, by taking preparedness activities, we can minimize their harmful effects.

This course on disaster management emphasizes the need for disaster preparedness rather than emergency response. It throws light on risk assessments, risk resolution and risk sharing and transfer. The importance of community participation, building self-reliant resilient communities and awareness creation is highlights in this course. Application of modern communication tools, remote sensing and GIS technologies in search and resource operations and stream lining activities is elaborated. Way and means of financial arrangements to carry out disaster management activities are discussed.

The physics of earthquake and tsunamis is explained. Safety measures against tsunamis are described. The functioning and tsunamis warning system is described.

COURSE CODE	COURSE NAME	L	T	P	C
U19CE1004	DISASTER MANAGEMENT	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

1.	Provide knowledge on the types and effects of disasters.
2.	Impart basic knowledge to reduce the impact of disasters.
3.	Understand the relationship and impact of development projects on environment and society.
4.	Disseminate the National policy and role played by our country during disasters.
5.	Provide basic knowledge in assessment of disasters with case study.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Distinguish various types of disasters, their causes and impacts on environment and society (K2)
CO2	Explain different phases of disaster management cycle (K3)
CO3	Assess vulnerability and prepare disaster risk reduction measures (K4)
CO4	Explain the vulnerability profile of India(K5)
CO5	Prepare hazard zonation maps for all types of hazards (K4)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

Cos	Pos												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS
CO1	3	2	3	3	1	2	3	3	3	3	2	3	2	2
CO2	3	2	3	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	2	3	3	3	2	2	2	3	3	3	3
CO (Avg)	3	2.6	3	2.6	2.6	2.8	3	2.8	2.8	2.8	2.8	3	2.8	2.8

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	INTRODUCTION TO DISASTERS	9 Hours
	Definitions: Disaster, Hazard, Vulnerability, Resilience, Disaster Preparedness - Classification of Disasters - Causes for Disasters - Impacts of Disasters on Society, Environment, Economics, Politics, Health, etc. - Types of Vulnerability - The Sphere Project	

UNIT-II	APPROACHES TO DISASTER RISK REDUCTION	9 Hours
	Phases of Disaster Management Cycle - Culture of safety, prevention, mitigation, and preparedness - Community-based Disaster Risk Reduction - Structural and Non-structural mitigation measures	

UNIT-III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9 Hours

Linkage between Development and Disasters -Impact of Development Projects on Environment and Society - Climate Change Adaptation - IPCC - India's Participation - Relevance of Indigenous Knowledge, Appropriate Technology, and Local Resources

UNIT-IV	DISASTER RISK MANAGEMENT IN INDIA	9 Hours

Hazards-Vulnerability Profile of India - Components of Disaster Relief: Water, Sanitation, Food, Shelter, Health, etc. - National Policy and Disaster Management - Institutional Framework for Disaster Management in India - Role of NGOs in Disaster Risk Reduction - Role of Armed Forces during Disasters

UNIT-V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS	9 Hours

Application of Information Technology, Remote Sensing Technology, and Geographic Information System in Disaster Risk Reduction - Case Studies on Landslide Hazard Zonation, Seismic Assessment of Buildings and Infrastructures, Drought Assessment, Coastal Flooding Assessment, Storm Surge Assessment, Fluvial and Pluvial Floods Assessment, Forest Fires Assessment

	TOTAL: 45 Hours

TEXT BOOKS:

1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
3.	Pardeep Sahni and Madhavi Malalgoda Ariyabandu, "Disaster Risk Reduction in South Asia", PHI Learning Private Limited, Delhi- 110092, 2017
4.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
5.	Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1.	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2.	Government of India, National Disaster Management Policy,2009.
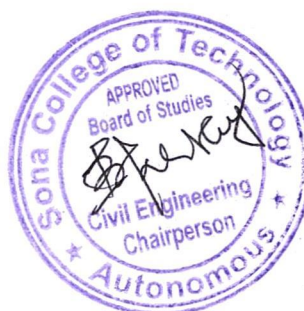
COURSE OUTCOMES:

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

- Compare and analyze different types of digital data characteristics of Big Data
- Implement programs using Hadoop open source software framework
- Design and develop programs using NoSQL Databases like Mongo DB and Cassandra
- Apply MapReduce programming for various big data based problems
- Implement programs using Hive and Pig Databases

	CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	2	0	1	0	2	1	2	2	2
CO2	2	1	2	2	3	2	0	1	1	2	2	2	2	2
CO3	2	1	2	3	3	2	1	1	1	2	3	2	2	3
CO4	3	1	2	3	3	2	0	1	0	2	3	2	2	3
CO5	2	2	3	3	3	1	0	1	0	2	3	2	3	3

UNIT I INTRODUCTION TO BIG DATA   9

Types of Digital Data: Classification of Digital Data Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Characteristics of Big Data ,Traditional Business Intelligence (BI) versus Big Data, A Typical Data Warehouse Environment , A Typical Hadoop Environment.

UNIT II BIG DATA ANALYTICS   9

Introduction -Big Data Analytics, Classification of Analytics, Challenges in Big Data, Technologies to handle Challenges Posed by Big Data- Data Science- Data Scientist, Terminologies Used in Big Data Environments, Basically Available Soft State Eventual Consistency (BASE), Few Top Analytics Tools.

UNIT III HADOOP   9

Introduction Hadoop, RDBMS versus Hadoop, Distributed Computing Challenges ,History of Hadoop , Hadoop Overview, Use Case of Hadoop ,Hadoop Distributors ,HDFS (Hadoop Distributed File System),Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator),Interacting with Hadoop Ecosystem, MapReduce Programming -Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression

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UNIT IV NO SQL DATABASES   9

Cassandra :Apache Cassandra - An Introduction , Features of Cassandra, CQL Data types, CQLSH, Keyspaces, CRUD (Create, Read, Update and Delete) Operations, Collections, Using a Counter, Time to Live (TTL), Alter Commands, Import and Export, Querying System Tables, Practice Examples- MongoDB, Terms Used in RDBMS and MongoDB, Data Types in MongoDB , MongoDB Query Language

UNIT V HIVE AND PIG   9

Hive: Introduction to Hive, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), RCFile Implementation, SerDe, User-defined Function(UDF).
Pig: Introduction to Pig, The Anatomy of Pig, Pig on Hadoop , Pig Philosophy, Use Case for Pig: ETL Processing, Pig Latin Overview , Data Types in Pig ,Running Pig , Execution Modes of Pig ,HDFS Commands ,Relational Operators ,Eval Function ,Complex Data Types ,Piggy Bank, User-Defined Functions (UDF) ,Parameter Substitution , Diagnostic Operator , Word Count Example using Pig,Pig versus Hive

Total: 45 hours

TEXT BOOKS:

1. **Big Data and Analytics**, Seema Acharya, Subhashini Chellappan, Infosys Limited, Publication: Wiley India Private Limited,1st Edition 2015(Chapters 1,2,3,4,5,6,7,8,9,10)

REFERENCE BOOKS:

1. **Hadoop in Practice**, Alex Holmes, Manning Publications Co., September 2014, Second Edition.
2. **Programming Pig,** Alan Gates, O'Reilly, Kindle Publication.
3. **Programming Hive,** Dean Wampler, O'Reilly, Kindle Publication.

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PREAMBLE

The "Internet of Things" (IoT) is the network of physical objects or "things" embedded with sensors, actuators, software, electronics and network connectivity to enable it to achieve greater value and service by exchanging data between the physical world and computer systems over existing network infrastructure. By connecting everyday real world objects such as transports, buildings and industrial equipments, IoT guarantees to revolutionize how we live and work. In the year 2020, it is estimated that approximately 30 billion devices will be connected in IoT. IoT will drive new consumer and business behavior that will demand increasingly intelligent industry solutions. It can also help various industries like agriculture, health services, energy, security, disaster management etc., which need to automate solutions to problems faced through remotely connected devices.

The Internet of Things involves three distinct stages:

1. The sensors which collect data (including identification and addressing the sensor/device)

2. An application which collects and analyzes this data for further consolidation

3. Decision making and the transmission of data to the decision-making server. Analytical engines, actuators and Big data may be used for the decision making process.

After completing the course the students will attain the following,

> Ability to build real time IoT applications by interfacing the sensors with minimal programming.

> Ability to associate sensor networks and communication modules for building IoT systems.

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U19CS1003   INTERNET OF THINGS   3 0 0 3

COURSE OUTCOMES:

At the end of the course the students will be able to
- Recall characteristics, physical and logical designs, domains.
- Differentiate IoT and M2M and explain IoT design methodology.
- Describe the various IoT components.
- Design a portable IoT system using Arduino/Raspberry Pi.
- Discuss the various applications of IoT.

UNIT I   FUNDAMENTALS OF IOT   9

Introduction-Definition and Characteristics of IoT- Physical design- IoT Protocols-Logical design - IoT communication models, Iot Communication APIs- Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs.

UNIT II   M2M AND IOT DESIGN METHODOLOGY   9

IoT and M2M- difference between IoT and M2M - Software defined networks, network function virtualization– Needs- IoT design methodology

UNIT III   IOT COMPONENTS   9

Sensors and actuators - Communication modules - Zigbee- RFID-Wi-Fi-Power sources.

UNIT IV   BUILDING IOT WITH HARDWARE PLATFORMS   9

Platform - Arduino/Raspberry Pi- Physical devices - Interfaces - Programming - APIs/Packages

UNIT V   CASE STUDY   9

Various Real time applications of IoT- Home automation-Automatic lighting-Home intrusion detection- Cities-Smart parking-Environment-Weather monitoring system- Agriculture-Smart irrigation.

                                          TOTAL: 45 PERIODS

TEXT BOOK:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015.

REFERENCES:

1. Manoel Carlos Ramon, ―Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmersǁ, Apress, 2014.

2. Marco Schwartz, ―Internet of Things with the Arduino Yunǁ, Packt Publishing, 2014.

3. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2012.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key applications and Protocols", Wiley Publications 2nd edition , 2013.

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U10EC1003   SENSORS AND SMART STRUCTURES TECHNOLOGIES   3 0 0 3

Course Outcomes

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

1) Insight into the basic concept regarding smart materials and their use in structures.
2) Analyze the use of measuring techniques in smart materials and structures.
3) Identify the suitable sensors for smart materials.
4) Apply the techniques of actuators in smart structures.
5) Relate the data acquisition techniques, signal processing and control for smart structures.

COs	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)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	1						3	2	1
CO2	2	1	2	1	2	1	2					3	2	1
CO3	2	1	2	1	2	1						3	2	1
CO4	2	1	2	1	2	1	2					3	2	1
CO5	2	1	2	1	2	1						3	2	1

Unit I   INTRODUCTION TO SMART MATERIALS AND STRUCTURES   9

Introduction to Smart Materials and Structures – Instrumented Structures Functions and Response –Sensing Systems – Smart Bridge – Self Diagnosis – Signal Processing Consideration for bridges – Actuation Systems and Effectors.

Unit II   MEASURING TECHNIQUES   9

Strain Measuring Techniques using Electrical Strain Gauges, Types – Resistance – Capacitance – Inductance – Wheatstone Bridges – Pressure Transducers – Load Cells – Temperature Compensation – Strain Rosettes.

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Unit III   SENSORS

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain Measurement – Inductively Read Transducers – The LVDT – Fiber Optic Techniques. Chemical and Bio-Chemical Sensing in Structural Assessment – Absorptive Chemical Sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed Measurement –Fire Sensor –Emergency Fire Alarm –Humidity Sensor – Accelerometers – Motion Sensors and Pressure Sensors

Unit IV   ACTUATORS

Actuator Techniques – Actuator and Actuator Materials – Piezoelectric and Electrostrictive Material – Magnetostrictive Material – Shape Memory Alloys – Electro Rheological Fluids– Electro Magnetic Actuation – Role of Actuators and Actuator Materials.

Unit V   SIGNAL PROCESSING AND CONTROL SYSTEMS

Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors : Signal Processing – Control System – Linear and Non-Linear systems.

TOTAL : 45 HOURS

Text Book

1) A.K. Sawhney, "A Course in Electical and Electronic and Measurements and Instrumentation",Dhanpat rai and co pvt limited, 2015.
2) Brain Culshaw , "Smart Structure and Materials", Artech House, Borton. London, 1996.

References

1) L. S. Srinath , "Experimental Stress Analysis", Tata McGraw,1998.
2) J. W. Dally & W. F. Riley, "Experimental Stress Analysis", Tata McGraw, 1998.
3) Srinivasan, A.V and Michael McFarland. D, "Smart Structures -Analysis and Design", Cambridge University Press, 2001

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Course Outcomes

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

1) Analyze the 1G and 2G Technologies.
2) Explain the 2.5G evolutions
3) Analyze the principles of 3G and UMTS
4) Analyze the evolutions of 4G.
5) Summarize the various wireless security applications and solve the mobile phone faults.

COs	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)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3		1		1	1	3		
CO2	3	3	3	3	3	3		1		1	1	3		
CO3	3	3	3	3	3	3		1		1	1	3		
CO4	3	3	3	3	3	3		1		1	1	3		
CO5	3	3	3	3	3	3		1		1	1	3		

Unit I   1G and 2G   9

First Generation (1G): 1G Systems – General 1G System Architecture – Generic MTSO Configuration – Generic Cell Site Configuration – Call Setup Scenarios – Handoff – Frequency Reuse – Spectrum Allocation – Channel Band Plan
Second generation (2G): Enhancements over 1G Systems – Integration with Existing 1G Systems – GSM - iDEN – CDPD

Unit II   2.5G Generation   9

Enhancements over 2G – Technology Platforms – General Packet Radio Service (GPRS) – Enhanced Data Rates for Global Evolution (EDGE) – High-Speed Circuit Switched Data (HSCSD) – CDMA2000 (1XRTT) – WAP-Migration Path from 2G to 2.5G to 3G..

05.07.2023   Regulations 2019

Unit III   3G Generation   9

Introduction – Universal Mobile Telecommunications Service (UMTS), UMTS Basics, The UTRAN Architecture, Handover, UMTS Services – The UMTS Air Interface – Overview of the 3GPP Network Architecture – Overview CDMA2000 – Commonality Between WCDMA/CDMA2000/CDM

Unit IV   4G and Beyond   9

Introduction to LTE - Network architectures – EPC – E-UTRAN architecture – Mobility management – Resource management – Services – Channel – logical and transport channel mapping – downlink/uplink data transfer – MAC control element – PDU packet formats – scheduling services – random access procedure – Objectives of 5G-Architecture – Features and benefits.

Unit V   Wireless Security and Mobile Phone service   9

Introduction – Fingerprint – Classification of major security attacks against RFID systems – GSM Security – Barcode scanner technology features and applications – QR code – BAR code – OTP – AirDrop.
Mobile phone Service: Parts in the mobile phones -Mobile phones assembling and disassembling –motherboard - Mobile Operating Systems - Fault finding - Advanced troubleshooting techniques.

TOTAL : 45 HOURS

Text Book

1) Clint Smith,P.E, Dannel Collins, "3G Wireless Networks" 2nd edition, Tata McGraw-Hill, 2008.
2) Vijay K.Garg, "Wireless Network Evolution- 2G & 3G" Pearson, 2013.

References

1) T.S Rapp port, "Wireless Communications" Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint, 2013.
2) JochenH.Schiller, "Mobile Communications", 2/e, Pearson, 2014
3) SassanAhmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014

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Course Outcomes

After successful completion of this course, the students should be able to

1) Design HDL code for combinational circuits and sequential circuits
2) Analyze MOS transistor theory
3) Illustrate the fabrication processes of CMOS
4) Design combinational circuit design.
5) Architectural choices and performance tradeoffs involved in designing

Pre-requisite

Digital Electronics

	CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	1	3	3	1	1	2	1	3	3
CO2	1	2	2	2	2		2	3		1	2	1	3	3
CO3	2	2	3	3	2		2	2		2	1	1	3	3
CO4	2	2	2	3	2		2	3		2	2	1	3	3
CO5	1	2	3	3	2	1	3	2	1	2	1	2	3	3

Unit I   VERILOG HDL   **9**

Overview of Digital Design with Verilog HDL – Hierarchical Modeling Concepts – Basic Concepts –Modules and Ports – Gate-Level Modeling – Dataflow Modeling – Behavioral Modeling – Test Benches

Unit II   MOS TRANSISTOR THEORY   **9**

Introduction – MOS Transistors – CMOS Logic – Inverter – NAND gate – CMOS Logic Gates – Compound - MOS Transistor Theory – MOS Structure - nMOS and pMOS Transistor Operation –Long Channel V-I Characteristics – C-V Characteristics – Non-ideal I-V Effects

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Unit III	CMOS INVERTER AND ITS TECHNOLOGY	9

DC Transfer Characteristics CMOS Inverter – CMOS Technologies – nMOS Fabrication – n-well Process – SOI – Twin Well Process - Layout Design Rules – CMOS Process Enhancement - Stick Diagram – Inverter – CMOS NAND – CMOS NOR.

Unit IV	COMBINATIONAL CIRCUIT DESIGN	9

Static CMOS – Pseudo logic– Dynamic Circuits – Pass-Transistor Circuits – CMOS with Transmission Gates – Source of Power Dissipation.

Unit V	DESIGNING ARITHMETIC BUILDING BLOCKS AND FPGA	9

Data path circuits, architectures for ripple carry adders (RCA), high speed adders, carry look ahead adder (CLA), Accumulators, Multipliers, Barrel shifters – Introduction to FPGA - FPGA Architecture – FPGA implementation

TOTAL : 45 HOURS

Text Book

1) Neil H. E Weste and David Money Harris, "CMOS VLSI Design a circuits and systems perspective", 4th Edition, Pearson, 2015..
2) Ciletti, "Advanced Digital Design with the Verilog HDL, 2nd Edition ", Pearson Education, Second Edition, 2011

References

1) Jan M. Rabaey, Anantha Chandrakasan ,Borivoje Nikolic, "Digital Integrated Circuits a design perspective", Pearson Education, 2nd edition, 2016
2) Charles H. Roth, Jr., Lizy Kurian John,"Digital System Design using VHDL", Cengage, 3rd edition, 2018
3) Pucknell D.A and Eshraghian K., "Basic VLSI Design", Third Edition, PHI, 2003.

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05.07.2023

Regulations 2019

PREAMBLE
TO
ENERGY CONSERVATION AND MANAGEMENT

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development. In this situation Energy Conservation (EC) is the critical needs in any countries in the world.

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

Energy costs are often treated as a fixed overhead by organisations. But, by taking the right approach to energy management it is possible to make considerable savings. Successful energy management must combine an effective strategy with the right practical interventions. Many organisations would like to save energy, but they need to make energy management an integral part of running the organisation to ensure success. Energy Management is very important for the management of factories/companies, and Energy Conservation is one of its major topics.

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COURSE OUTCOMES

At the end of the course the students will be able to
1. Assess role of energy in global economic development.
2. Explain methodology of energy audit and concept of instruments used.
3. Discuss various lamps and design energy efficient illumination schemes.
4. Apply energy conservation concepts in buildings.
5. Identify the energy conserving opportunities in utilities.

	CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	3		2			2	3	3	3	2
CO2	2	2	3	3	3				2			3	3	2
CO3	2	2	3	3	3	3			3		2	3	3	2
CO4	2	2	3	3	3	2		3				3	3	2
CO5	2	2	3	3	3		3			3		3	3	2

UNIT- I   ENERGY SCENARIO AND BASICS   9

Classification of Energy – Purchasing Power Parity – Energy Security – Strategy to meet future energy requirements – Objectives and features for electricity act 2003 – Energy efficiency standards and labeling – Study of Global and Indian primary energy reserves – Study of energy scenario for India – Energy and environment – Global environmental issues – Types of Energy – Electrical and Thermal energy basics – Energy units and conversions.

UNIT- II   ENERGY MANAGEMENT AND AUDIT   9

Definition and objectives of energy management and audit – Need for energy audit – Types of energy audit – Methodology for conducting detailed energy audit – ENCON opportunities and measures – Energy audit report. Energy costs – Benchmarking – Energy performance – Fuel and Energy substitution – Instruments and metering for energy audit – Basic principles, components of material and energy balance – Sankey diagram – Financial analysis terms – Payback period, ROI, NPV, IRR.

UNIT- III   LIGHTING SYSTEMS   9

Introduction – Terms in Lighting and Illumination – Light sources - Lamp types – Arc Lamps, Vapour lamps – Incandescent lamp, Fluorescent lamp – Energy saving lamps – CFL, LED – Lighting design for interiors – Indoor and outdoor lighting schemes – Energy saving opportunities – Energy efficient lighting controls.

UNIT- IV   ENERGY CONSERVATION IN BUILDINGS   9

Energy conservation building code (ECBC) – Compliance approaches – ECBC guidelines on Building envelope, HVAC system, Service hot water, Water pumps – Energy consumption in Escalators and Elevators – Building Energy Management Systems – Star ratings – Energy Efficiency Measures in AC and Lighting system.

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Introduction to Compressed air system components – Heat transfer loops in refrigeration systems – Standards and labelling of room air conditioners – Introduction to Fans, Blowers and Compressors – Types of pumps, Pump curves – Efficient operation of pumps – Components of cooling towers and its efficient operation - Introduction to DG set system.

Energy Efficiency and energy savings in Compressed Air System, HVAC system, Fans and Blowers, Pumping system, Cooling towers, and DG sets.

Lecture: 45; Tutorial: 00; Total: 45

TEXT BOOKS:
1. "General Aspects of Energy Management and Energy Audit", Bureau of Energy Efficiency, Fourth Edition, 2015.
2. "Energy Efficiency in Electrical Utilities", Bureau of Energy Efficiency, Fourth Edition, 2015.

REFERENCE BOOKS:
1. Chakrabarti A, "Energy Engineering and Management", PHI, 2011.
2. Murphy W R, McKay G, "Energy management", Elsevier, 2009.
3. Rajput R K, "Utilization of Electrical Power", Lakshmi Publications, 2006.

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PREAMBLE
TO
RENEWABLE ENERGY SYSTEMS

Energy is an important source of all technological developments as well as for all basic needs. The usage of renewable energy sources are the only way for sustainable development and future energy requirements. Renewable energy encourages the generation of electricity without any environmental impact and improves the economic growth of the country.

By choosing this elective the students will be able to know the importance of renewable energy sources for power generation. And also they could understand how the fossil fuels are made an impact on environmental issues. They will be familiar with the following

1. Concept of solar energy power production and solar photovoltaic cells and the application of solar PV system and Bio Mass power generation system.
2. Principle of conversion of wind energy in to electric energy
3. Working of geothermal and hydro power stations.
4. Principle of the conversion of tidal and wave energy in to electric energy.
5. The emerging technology of power generation.

After completion of this subject students will know how the energy can be produced locally. This knowledge would provide an opportunity to install small capacity power generation units independently for their needs.

COURSE OUTCOMES

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

1. Describe the power demand scenario in world level and impact of various renewable energy sources in satisfying power demand.
2. Explain the principle of operation and the application of solar system.
3. Outline in the components and to find the suitability based on the performance of wind energy and Conversion system, biomass energy system
4. Describe the principle of operation and the application of geo thermal power tidal power generation scheme, wave energy and OTEC scheme.
5. Illustrate the emerging energy generation systems of MHD, Thermal and fuel cells applications.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2					2		2	3	3	3
CO2	3	3	3	2	1	3	3	1	2		3	3	3	3
CO3	3	3	3	2	2	3	3	1	2		3	3	3	3
CO4	3	3	3	2	2	3	3	1	2		3	3	3	3
CO5	3	3	3	2	2	3	3	1	2		3	3	3	3

UNIT I   INTRODUCTION   9

World energy futures–Energy sources and their availability – Energy cycle of the earth – environmental aspects of energy utilization – Energy plantation- Renewable energy resources and their importance-Prospects of Renewable energy sources.

UNIT II   SOLAR ENERGY SYSTEMS   9

Introduction –Solar radiation and measurements-Solar energy collectors-solar energy storage systems- Solar pond and applications- Applications of solar energy: solar pumping, solar cooking, solar distillation and solar greenhouse.

UNIT III   WIND AND BIOMASS ENERGY SYSTEMS   9

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

Bio mass conversion technologies-Biogas generation-Types of biogas plants-Bio gas from plant wastes-Utilization of Bio gas and applications.

UNIT IV   GEO THERMAL, TIDAL AND OCEAN ENERGY SYSTEMS   9

Geothermal energy – Estimates of Geothermal power- site selection for geothermal power plant-Applications of Geothermal energy.

Origin of tides – Basic principle of Tidal power- Operation of a Tidal power plant. Ocean Thermal Energy conversion system- Open and closed OTEC cycles- Prospects of ocean thermal energy conversion in India.

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Magneto Hydro Dynamic (MHD) Power Generation- MHD systems and its operation. Thermo Electric power generation- Basic principle- Thermo electric power generator.

Thermonuclear fusion energy-Nuclear fusion and reactions- Advantages. Fuel cell- classification of fuel cells- Fuel cell based electrical power generation scheme- Applications.

Lecture: 45; Tutorial: 0; Total: 45 Hours

TEXT BOOKS:

1. Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers, Sixth Edition 2017.
2. Khan, B.H, Non- Conventional Energy Resources", Mc. Graw Hill Education Ltd, third reprint 2017.

REFERENCE BOOK

1. Rao S. Paruklekar,B.B, "Energy Technology – Non Conventional, Renewable and Conventional", KhannaPublishers,1994.
2. F.Kreith and J.F.Kreider, "Principles of Solar Engineering", McGraw Hill.
3. T.N.Veziroglu, "Alternative Energy Sources", Vol 5 and 6, McGraw Hill.
4. Mukund R.Patel, "Wind and Solar Power Systems", CRC Press LLC.

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COURSE OUTCOMES

At the end of the study of this course the students will be able to,
1. Define and discuss the fashion and related terms and reason for change in fashion and the classification
2. Describe clothing and its purpose, Role of clothing and its status.
3. Describe the selection of clothing for various age groups, Fashion apparel and wardrobe planning.
4. Explain the elements and principles of the design, with the effects in the apparel
5. Bounce out the theme and development of portfolio.

CO/PO, PSO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO12	PSO1	PSO2	PSO3
CO1	3	3	3							3	3	3	3	3
CO2	3	3	3									3	3	3
CO3	3	3	3								3	3	3	3
CO4	3	3	3								3	3	3	3
CO5	3	3	3							3	3	3	3	3

UNIT I   Introduction to Fashion   9
Origin of fashion - terms and definitions - reasons for change in fashion - classification of fashion – Style, Classic, FAD, Trend – theories of fashion – movement of fashion - fashion cycle.

UNIT II   Introduction to Clothing   9
Understanding clothing - Purpose of clothing: protection, modesty, attraction etc - Importance of clothing - Clothing Culture, Men and Women clothing and ornamentation - Role and status of clothing - Clothing according to climatic conditions – factors to be considered in the selection of clothing

UNIT III   Selection of clothes   9
Clothes for children, middle-aged and adults. Types of clothes according to different types of human figure, Different materials for different clothes, Fabrics and colours suitable for different garments.
Planning for clothing needs: Formal clothing, Clothes for parties, Clothes for sports,
Casual Clothes for casualwear. Wardrobe Planning: Wardrobe for men and women

UNIT IV   Elements and Principles of Design   9
Elements of Design: Introduction on basics Elements of design - Silhouette, Details, Texture, Color, Lines,

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Principle of design: Introduction to principles of Elements of design - Proportion, Balance, Rhythm, Center of Interest, Harmony

UNIT 5   Design and Development   **9**
Boards: Mood board, fabric board, colour board, accessory board. Fashion illustration – head theories, Illustration techniques – strokes, hatching, shading; Colouring techniques – Medias for colouring. Portfolio presentation – styles of presentation - Fashion shows.

TOTAL: 45 hours

TEXT BOOKS
1. Munslow, Janine, McKelvey, Kathryn "**Fashion Design Process Innovation and Practice**", 2nd Edition , wiley , 2012.
2. Nicola White, Ian Griffiths, "**The Fashion Business Theory, Practice, Image**", Berg, 2000.

REFERENCE
1. Sumathi, G. J. **Elements of fashion and apparel design**. New Age International, 2007.
2. Kathryn McKelvey "**Fashion Source Book**" Balckwell Publishing New Delhi.
3. Mills, Jane, and Janet K. Smith. **Design concepts**. Fairchild Books, 1985.
4. Rasband J. **Wardrobe strategies for women**. Fairchild Publications; 2002.
5. Jarnow JA, Judelle B, Guerreiro M. **Inside the fashion business**. Wiley; 1981.

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U19BM1001   **HOSPITAL MANAGEMENT**   L T P C
                                                       3 0 0 3

COURSE OUTCOMES:

At the end of the course, the students will be able to,
- Describe the basics of Hospital Management.
- Illustrate the knowledge of Human resource management and marketing in hospitals.
- Apply various Quantitative methods in healthcare management.
- Amalgamate their knowledge in Hospital information system and supportive services.
- Explain the quality and safety aspects in Hospital.

	CO/PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	3	-	2	3	3	-	-	-	-	1	-	-	3
CO2	-	-	3	-	2	3	3	-	-	-	-	1	-	-	3
CO3	-	-	3	-		3	3	-	-	-	-	1	-	-	3
CO4	-	-	3	-	3	2	-	-	-	-	-	1	-	-	3
CO5	-	-	3	-	-	3	3	3	-	-	-	1	-	-	3

UNIT I   INTRODUCTION TO HOSPITAL ADMINISTRATION   9

Distinction between Hospital and Industry, Challenges in Hospital Administration, HospitalPlanning, Equipment Planning, Functional Planning, Current Issues in Hospital Management, Role of Manager, Leadership, Motivation, Organizational behaviour, Strategic planning, Ethics and Law, Fraud and abuse.

UNIT II   HUMAN RESOURCE MANAGEMENT AND MARKETING   9

Principles of HRM, Functions of HRM, Profile of HRD Manager, Tools of HRD, Human Resource Inventory, Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines, Methods of Training, Leadership grooming and Training, Promotion, Transfer.

UNIT III   QUANTITATIVE METHODS IN HEALTHCARE MANAGEMENT   9

Introduction to quantitative decision-making methods in healthcare management, Forecasting, Decision making in healthcare facilities, Facility location, Facility layout, Reengineering, Staffing, Scheduling, Productivity, Resource allocation, Supply chain and inventory management, Quality Control, Project Management, Queuing models and capacity planning.

UNIT IV   HOSPITAL INFORMATION SYSTEM AND SUPPORTIVE SERVICES   9

Clinical Information Systems, Administrative Information Systems, Support Service Technical Information Systems, Medical Records Department, Central Sterilization and Supply Department – Pharmacy, Food Services, Laundry Services, Telemedicine.

UNIT V   QUALITY AND SAFETY ASPECTS IN HOSPITAL MANAGEMENT   9

Quality system, Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004. Features of ISO 9001, ISO 14000, Environment Management Systems. NABA, JCI, NABL. Security, Loss Prevention, Fire Safety, Alarm System, Safety Rules.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.C. Goyal, Hospital Administration and Human Resource Management, PHI, 4th Edition, 2006.
2. G.D. Kunders, Hospitals – Facilities Planning and Management, TMH, New Delhi, 5th Reprint, 2007.

REFERENCE BOOKS:

1. Sharon B. Buchbinder and Nancy H. Shanks, Introduction to Healthcare Management, Jones and Bartlett Learning, 2017
2. Blane, David, Brunner, Health and SOCIAL Organization: Towards a Health Policy for the 21st Century, Eric Calrendon Press, 2002.
3. Yasar A. Ozcan, Quantitative Methods in Healthcare management, Jossey Bass- John Wiley and Sons, 2009.

Chairperson

BOS-BME

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Department of Mechatronics Engineering

Open Elective

U19MC1004	FUNDAMENTALS OF ROBOTICS	L	T	P	C
		3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1:	Understand the basic robotic concepts
CO2:	Select the suitable drive system for robot application
CO3:	Select the suitable sensors and grippers for the respective application
CO4:	Develop VAL Programming for simple applications
CO5:	Illustrate the robotic application in various sectors

Pre-requisite

NIL

CO/PO, PSO Mapping

(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2			3	2		3		3	3	3	3
CO2	2	2	2		3				3		2	3	2	3
CO3	3	2	2		3				3		2	3	3	3
CO4	3	3	3	3	3				3		2	3	3	2
CO5	3	3	3	3	3	3	3		3		2	3	3	

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO ROBOTICS	9 Hours

Introduction to Robotics – History of Robotics – Laws of Robotics - Anatomy of a Robot – Classification of Robots – Robot Configurations - Robot subsystems: Motion subsystem, Recognition subsystem, Control subsystem – Robot Links – Joints in robot –Robot Specifications.

Unit 02: ROBOT MOTIONS AND DRIVE SYSTEMS	9 Hours

Degrees of freedom – DOF associated with arm and body - DOF associated with wrist –Joint Notation scheme- Robot Kinematics – Robot Drive systems – Hydraulic Actuators – Pneumatic actuators – Electrical actuators: Stepper motors, DC motors, Servomotor.

Unit 03: ROBOT SENSORS AND END EFFECTORS	9 Hours

Classification of Robotic sensors and their functions – Tactile sensors – Inductive Proximity sensor – Hall effect sensor – Range sensor –Force ant Torque sensors- Types of end effectors – Mechanical grippers – Vacuum cups – Magnetic grippers – Adhesive grippers – Tools as end effectors.

Unit 04: ROBOT PROGRAMMING	9 Hours

Methods of Robot Programming: Lead through methods, Textual robot Languages – Robot language structure – First generation Languages – Second generation Languages – VAL Programming – Simple Programming examples.

Unit 05: ROBOT APPLICATIONS	9 Hours

Robotics Applications in Manufacturing: Welding Robot, AGVs– Healthcare: Surgery Robot, Therapeutic Robot – Agriculture: Crop Harvesting & Fruit Picking Robot – Defence & Space: Exoskeleton Robot, Telerobotics.

Theory: 45 Hrs	Tutorial: --	Practical: --	Total Hours: 45 Hrs

TEXT BOOKS

1. M.P.Groover, M.Weiss,R.N. Nagal,N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata McGraw-Hill Publication, 2012.

REFERENCES

1. Richard D.Klafter, "Robotics Engineering" PHI Learning Private Limited, 2009.

2. Ganesh S.Hedge, "A text book in Industrial Robotics", Laxmi Publications, 2006.

3. S K Saha, "Introduction to Robotics", Tata McGraw-Hill Publication, 2012.

4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

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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.

CO / PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak											
COs	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.

5/7/2022

Member Secretary-Academic Council
SONA COLLEGE OF TECHNOLOGY
SALEM - 636 005.

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VIII

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII under 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
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, Eight Semester BE Mechanical Students and Staff, COE

21.12.2023

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