SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

B.E- Mechanical Engineering

CURRICULUM and SYLLABI

[For students admitted in 2018-2019]

B.E / B.Tech Regulation 2015R

Approved by BOS and Academic Council meetings

SONA COLLEGE OF TECHNOLOGY, SALEM – 636 005
(An Autonomous Institution)

Courses of Study for BE/BTech Semester I under Regulations 2015R (CBCS)

Branch: MECH

S.No.	Course Code	Course Title	L	T	P	C	Group code
Theory							
1	U15ENG101AR	Technical English – I	2	0	2	3	HS
2	U15MAT102AR	Mathematics – I	3	2	0	4	BS
3	U15PHY103AR	Engineering Physics	3	0	0	3	BS
4	U15CHE104AR	Engineering Chemistry	3	0	0	3	BS
5	U15CPR105AR	Programming in C	3	0	0	3	ES
6	U15EGR106AR	Engineering Graphics[1]	2	2	0	3	ES
Practical							
7	U15PCL107AR	Physics and Chemistry Laboratory-I[2]	0	0	2	1	BS
8	U15CPL108AR	C Programming Laboratory	0	0	2	1	ES
9	U15EPL109R	Engineering Practices Laboratory[3]	0	0	2	1	ES
Total Credits						**22**	
Optional Language Elective*							
10	U15OLE1101	French	0	0	2	1	HS
11	U15OLE1102	German					
12	U15OLE1103	Japanese					

* Students may opt for foreign languages viz., German/French/Japanese with additional one credit (over and above the CGPA calculation).

[1] The examination will be conducted for 3 hours through written and practical modes.

[2] Laboratory classes on alternate weeks for Physics and Chemistry. The lab examination will be conducted separately for 50 marks each with 2 hours duration.

[3] The lab examination will be conducted separately for Group A (Civil & Mechanical) and Group B (Electrical & Electronics) with 50 marks each with 1 ½ hours duration.

Approved by

HOD-First Year Dr. M. Renuga	**Chairperson BOS/Civil & HOD-Civil** Dr. R. Malathy	**Chairperson BOS/EEE & HOD-EEE** Dr. S. Padma	**Chairperson BOS/ Mechanical & Mechatronics HOD-Mechanical** Dr. D. Senthilkumar	**Chairperson BOS/ FT & HOD-FT** Dr. G. Gunasekaran

Member Secretary, Academic Council
Dr. R. Shivakumar

Chairperson, Academic Council & Principal
Dr. S.R.R. Senthilkumar

SONA COLLEGE OF TECHNOLOGY, SALEM – 636 005
(An Autonomous Institution)

Courses of Study for BE / B Tech Semester II under Regulations 2015R (CBCS)
Branch: MECH

S.No.	Course Code	Course Title	L	T	P	C	Group code
Theory							
1	U15ENG201AR	Technical English –II	2	0	2	3	HS
2	U15MAT202AR	Mathematics – II	3	2	0	4	BS
3	U15PHY203DR	Physics For Mechanical Engineering	3	0	0	3	BS
4	U15CHE205CR	Chemistry For Mechanical Engineering	3	0	0	3	BS
5	U15MEC206R	Manufacturing Technology – I	3	0	0	3	ES
6	U15GE207R	Engineering Mechanics	2	2	0	3	ES
Practical							
7	U15PCL208AR	Physics and Chemistry Laboratory – II[#]	0	0	2	1	BS
8	U15MEC209R	Manufacturing Technology Laboratory – I	0	0	2	1	ES
9	U15CDL210R	Computer Aided Drafting Laboratory	0	0	2	1	ES
Total Credits						**22**	
Optional Language Elective*							
10	U15OLE1201	French	0	0	2	1	HS
11	U15OLE1202	German					
12	U15OLE1203	Japanese					

*Students may opt for foreign languages viz., German/French/Japanese with additional one credit (over and above the CGPA calculation).

[#]Laboratory classes on alternate weeks for Physics and Chemistry. The lab examination will be conducted separately for 50 marks each with 2 hours duration.

Approved by

HOD-First Year Dr. M. Renuga	**Chairperson BOS/ Mechanical & HOD-Mechanical** Dr. D. Senthilkumar	**Member Secretary, Academic Council** Dr. R. Shivakumar	**Chairperson, Academic Council & Principal** Dr. S.R.R. Senthilkumar

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester III under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT301DR	Transforms and Boundary value problems	3	2	0	4
2	U15ME301R	Engineering Thermodynamics	3	0	0	3
3	U15ME302R	Strength of Materials	3	0	0	3
4	U15ME303R	Fluid Mechanics	3	0	0	3
5	U15ME304R	Manufacturing Technology-II	3	0	0	3
6	U15CHE304R	Environmental Science and Engineering	3	0	0	3
Practical						
7	U15ME305R	Strength of Materials Laboratory	0	0	2	1
8	U15ME306R	Fluid Mechanics Laboratory	0	0	2	1
9	U15ME307R	Manufacturing Technology Laboratory-II	0	0	4	2
10	U15GE301R	Soft Skills and Aptitude-I	0	2	0	1
					Total Credits	**24**

Approved By

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Copy to:-
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 under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT401DR	Statistics and Numerical Methods	3	2	0	4
2	U15ME401R	Kinematics of Machinery	3	0	0	3
3	U15ME402R	Thermal Engineering	3	0	0	3
4	U15EE409R	Electrical Drives and Microprocessor	3	0	0	3
5	U15ME403R	Applied Hydraulics and Pneumatics Systems	3	0	0	3
6	U15ME404R	Engineering Materials and Metallurgy	3	0	0	3
Practical						
7	U15GE401R	Soft Skills and Aptitude-II	0	0	2	1
8	U15ME405R	Thermal Engineering Laboratory	0	0	4	2
9	U15EE410R	Electrical Drives and Microprocessor Laboratory	0	0	4	2
10	U15ENG401R	Communications Skills Laboratory	0	0	2	1
					Total Credits	**25**

Approved By

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Member Secretary, Academic Council Dr.R.Shivakumar

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

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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 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15ME501R	Heat and Mass Transfer	3	0	0	3
2	U15ME502R	Dynamics of Machinery	3	0	0	3
3	U15ME503R	Design of Machine Elements	3	0	0	3
4	U15ME504R	Computer Aided Design and Manufacturing	3	0	0	3
5	U15ME505R	Automobile Engineering	3	0	0	3
6	U15ME904R	**Professional Elective:** Python :Programming and Problem Solving	3	0	0	3
	U15ME920R	**Professional Elective:** IOT for Manufacturing				
	U15ME903R	**Professional Elective:** Heating, Ventilation and Air Conditioning				
Practical						
7	U15ME506R	Heat Power Laboratory	0	0	4	2
8	U15ME507R	Dynamics Laboratory	0	0	4	2
9	U15ME508R	CAD and CAM Laboratory	0	0	4	2
10	U15GE501R	Soft Skills and Aptitude-III	0	0	2	1
					Total Credits	**25**

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VI under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15ME601R	Finite Element Method	3	0	0	3
2	U15ME602R	Turbo machines	3	0	0	3
3	U15ME603R	Design of Transmission System	3	0	0	3
4	U15ME604R	Metrology and Measurements	3	0	0	3
5		**Professional Elective ***	3	0	0	3
6		**Open Elective ****	3	0	0	3
Practical						
7	U15GE601BR	Soft Skills and Aptitude-IV	0	0	2	1
8	U15ME605R	Computer Aided Analysis Laboratory	0	0	4	2
9	U15ME606R	Metrology and Measurements Laboratory	0	0	4	2
10	U15ME607R	Turbo Machines Laboratory	0	0	4	2
					Total Credits	**25**

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S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
***Professional Elective - NPTEL**						
1	noc21-cs45	Data Analytics with Python	3	0	0	3
2	noc21-cs20	Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3
3	noc21-me32	Introduction to Robotics	3	0	0	3

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
****Open Elective**						
1	U15CE1002R	Disaster Management	3	0	0	3
2	U15CE1003R	Energy Efficiency And Green Building	3	0	0	3
3	U15CE1004R	Municipal Solid Waste Management	3	0	0	3
4	U15CS1001R	Big Data Analytics	3	0	0	3
5	U15CS1002R	Cloud Computing	3	0	0	3
6	U15CS1003R	Internet Of Things	3	0	0	3
7	U15CS1004R-	Mobile Application Development	3	0	0	3
8	U15EE1006R	Renewable Energy Systems	3	0	0	3
9	U15IT1003R	Problem Solving Techniques Using Java Programming	3	0	0	3
10	U15IT1004R	Python Programming	3	0	0	3

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VII 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U15GE701R	Professional Ethics And Human Values	3	0	0	3	45
2	U15ME701R	Power Plant Engineering	3	0	0	3	45
3	U15ME702R	Mechatronics System Design	3	0	0	3	45
4	U15ME910R	Enterprise Resource Planning	3	0	0	3	45
	U15ME921R	Supply Chain Management and Analytics					
5	U15ME919R	Robotics and Industrial Automation	3	0	0	3	45
	U15ME922R	Manufacturing System Design					
6		***Open Elective	3	0	0	3	
Practical							
7	U15ME703R	Mechatronics and Simulation Laboratory	0	0	4	2	60
8	U15ME704R	Project Design	0	0	8	4	120
9	U15ME705R	In Plant Training	0	0	2	1	30
					Total Credits	**25**	

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VII 2015R (CBCS)
Branch: Mechanical Engineering
*****Open Elective**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U15CE1002R	Disaster Management	3	0	0	3	45
2	U15CE1003R	Energy Efficiency and Green Building					
3	U15CS1004R	Mobile Application Development					
4	U15CS1005R	Object Oriented Programming and Data Structures					
5	U15EC1008R	Mobile Technology and its Applications					
6	U15EE1004R	Energy Conservation and Management					
7	U15EE1006R	Renewable Energy Systems					
8	U15EE1007R	Innovation, IPR and Entrepreneurship Development					
9	U15IT1003R	Problem Solving Techniques using Java Programming					
10	U15MC1002R	3D Printing Technology					

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	U15ME801R	Project Work	0	0	24	12	360
					Total Credits	**12**	

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

SONA COLLEGE OF TECHNOLOGY, SALEM – 636 005
(An Autonomous Institution)

Courses of Study for BE/BTech Semester I under Regulations 2015R (CBCS)

Branch: MECH

S.No.	Course Code	Course Title	L	T	P	C	Group code
Theory							
1	U15ENG101AR	Technical English – I	2	0	2	3	HS
2	U15MAT102AR	Mathematics – I	3	2	0	4	BS
3	U15PHY103AR	Engineering Physics	3	0	0	3	BS
4	U15CHE104AR	Engineering Chemistry	3	0	0	3	BS
5	U15CPR105AR	Programming in C	3	0	0	3	ES
6	U15EGR106AR	Engineering Graphics[1]	2	2	0	3	ES
Practical							
7	U15PCL107AR	Physics and Chemistry Laboratory-I[2]	0	0	2	1	BS
8	U15CPL108AR	C Programming Laboratory	0	0	2	1	ES
9	U15EPL109R	Engineering Practices Laboratory[3]	0	0	2	1	ES
Total Credits						**22**	
Optional Language Elective*							
10	U15OLE1101	French	0	0	2	1	HS
11	U15OLE1102	German					
12	U15OLE1103	Japanese					

* Students may opt for foreign languages viz., German/French/Japanese with additional one credit (over and above the CGPA calculation).

[1] The examination will be conducted for 3 hours through written and practical modes.

[2] Laboratory classes on alternate weeks for Physics and Chemistry. The lab examination will be conducted separately for 50 marks each with 2 hours duration.

[3] The lab examination will be conducted separately for Group A (Civil & Mechanical) and Group B (Electrical & Electronics) with 50 marks each with 1 ½ hours duration.

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U15ENG101AR - TECHNICAL ENGLISH I

L	T	P	C	M
2	0	2	3	100

Course Outcomes

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

1. frame sentences correctly, both in written and spoken forms of language with accuracy and fluency.
2. develop and demonstrate listening skills for academic and professional purposes.
3. draw conclusions on explicit and implicit oral information.
4. develop effective reading skills and reinforce language skills required for using grammar and building vocabulary.
5. read for gathering and understanding information, following directions and giving responses.

UNIT I – FOCUS ON LANGUAGE

- General Vocabulary
- Prefixes and Suffixes
- Active and Passive Voices
- Adjectives, Comparative Adjectives
- Prepositions and Dependent Prepositions
- Collocations
- Tenses
- Modal Verbs and Probability

UNIT II – LISTENING -I

- Listening to conversations, welcome speeches, lectures and description of equipment.
- Listening to different kinds of interviews (face-to-face, radio, TV and telephone interviews).
- Understanding short conversations or monologues.
- Taking down phone messages, orders, notes etc.
- Listening for gist, identifying topic, context or function.

UNIT III – LISTENING – II

- Listening comprehension, entering information in tabular form.
- Intensive listening exercises and completing the steps of a process.
- Listening exercises to categorise data in tables.
- Listening to extended speech for detail and inference.

UNIT IV – READING -I

- Understanding notices, messages, timetables, advertisements, graphs, etc.
- Reading passages for specific information transfer.
- Reading documents for business and general contexts and interpreting graphical representations.
- Error correction, editing mistakes in grammar, vocabulary, spelling, etc.
- Oral reading – poetry and prose excerpts, general and technical articles, and anecdotes.

UNIT V – READING -II

- Reading passage with multiple choice questions, reading for gist and reading for specific information, skimming for comprehending the general idea, meaning and contents of the whole text.
- Short reading passage: gap-filling exercise related to grammar, testing the understanding of prepositions, articles, auxiliary verbs, modal verbs, pronouns, relative pronouns and adverbs.
- Short reading passage with multiple choice questions, gap-filling exercise testing the knowledge of vocabulary, collocations, dependent prepositions, grammatical structures.
- Short reading passages for sentence matching exercises, picking out specific information in a short text.

Total: 45 Hours

Listening test will be conducted for 20 marks internally and evaluated along with Technical English – I in the End Semester Valuation.
Reading test will be conducted for 20 marks internally and evaluated by internal examiners.

TEXTBOOK

1. Technical English – I & II, Dr. M. Renuga, et al. Sonaversity, Sona College of Technology, Salem, Revised edition, 2016.

EXTENSIVE READING

1. The Story of Amazon.com- Sara Gilbert, published by Jaico
2. The Story of Google – Sara Gilbert, published by Jaico

REFERENCE BOOKS

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.

U15MAT102AR - MATHEMATICS – I

(Common to Civil, Mech, Mechatronics, EEE, IT and FT Branches)

L	T	P	C	M
3	2	0	4	100

Course Outcomes

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

1. find the Eigen values and Eigen vectors of a real matrix and discuss their properties, reduce a real symmetric matrix from quadratic form to canonical form.
2. explain the three dimensional Cartesian coordinates and discuss the problems in straight line, plane and sphere.
3. describe curvature and find the radius of curvature, circle of curvature, evolutes, involutes and envelope of curves.
4. explain functions of several variables and find the Taylor's series expansion, Jacobians, maximum and minimum values of function of several variables.
5. describe the double and triple integrals, discuss the change of order of integration and find the area and volume by multiple integrals.

UNIT I – MATRICES **9+6**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – properties – statement of Cayley – Hamilton theorem and its applications – orthogonal transformation of symmetric matrix to diagonal form – quadratic form – reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II – THREE DIMENSIONAL ANALYTICAL GEOMETRY **9+6**

Direction cosines and ratios, angle between two lines – equation of plane, angle between two planes – equation of the straight line, coplanar lines, skew lines – equation of a sphere, plane section of a sphere, tangent plane, orthogonal spheres.

UNIT III – DIFFERENTIAL CALCULUS AND ITS APPLICATIONS **9+6**

Curvature in Cartesian coordinates, centre and radius of curvature, circle of curvature – evolutes, envelopes, evolute as the envelope of normals.

UNIT IV – FUNCTIONS OF SEVERAL VARIABLES **9+6**

Partial derivatives, total differentiation – differentiation of implicit functions – Taylor's expansion – maxima and minima, constrained maxima and minima by Lagrange's multiplier method – Jacobians – properties.

UNIT V – MULTIPLE INTEGRALS **9+6**

Evaluation of double integrals in Cartesian and polar coordinates – change of order of integration – change of variables from Cartesian to polar coordinates – area as double integral – evaluation of triple integrals in Cartesian coordinates – volume as triple integral in Cartesian coordinates.

Total: 75 Hours

TEXT BOOKS

1. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. T.Veerarajan,"Engineering Mathematics" (I Year), Tata McGraw Hill, 4th Edition, 2011.

REFERENCE BOOKS

1. P.Kandasamy, K.Thilagavathy and K.Gunavathy, "Engineering Mathematics", (for first year), S. Chand and Co., Ltd., Revised Edition 2011.
2. E.Kreyszig, "Advanced Engineering Mathematics", International Student Version, Wiley, 10th Edition, 2015.
3. S. Jayabharathi, "Mathematics - I", Sonaversity, Revised Edition, 2017.
4. N. P. Bali and M. Goyal, "Engineering Mathematics", University Science Press, New Delhi, 9th Edition, 2011.

U15PHY103AR - ENGINEERING PHYSICS

(Common to B.E. Mech, Mechatronics, Civil, EEE, CSE & B.Tech. IT, FT Branches)

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

1. design acoustically good buildings and describe the applications of ultrasonic waves in the field of non-destructive testing
2. classify lasers and explain its applications in the field of medicine, engineering and technology.
3. elucidate the principle of optical fibre communication, applications and the devices involved in the transmission and reception of data.
4. illustrate the dual nature of matter and radiation and its applications.
5. analyze crystal structures and the significance of defects in crystals.

UNIT I – ACOUSTICS AND ULTRASONICS 9

Classification of sound, Pitch, Loudness, Intensity level, Phon, Timbre, Reverberation, Reverberation time – Sabine's formula and its importance (no derivation) – Sound absorbing materials - Absorption Coefficient and its determination – Factors affecting acoustics of buildings and their remedies –- Production of ultrasonic waves by magnetostriction and piezoelectric methods – acoustic grating – Acoustic impedance - Non Destructive Testing – Ultrasonic flaw detector – A scan display - Sonogram (block diagram).

UNIT II – LASERS 9

Principle of spontaneous and stimulated emission – Population inversion - Pumping – Einstein's A and B coefficients derivation – Basic requirements of a laser - Types of lasers – Nd:YAG laser, CO_2 and Semiconductor lasers (homojunction & heterojunction) – Qualitative applications – Lasers in welding, heat treatment and cutting – Medical applications (qualitative) – holography construction and reconstruction.

UNIT III – FIBRE OPTICS AND APPLICATIONS 9

Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibres (material, refractive index, mode) – Double Crucible Technique of fibre drawing – Splicing – Loss in optical fibre – attenuation, dispersion

and bending - Fibre optic communication system (Block diagram) – Fibre optic sensors - temperature and displacement sensor - Endoscope.

UNIT IV – QUANTUM PHYSICS **9**

Introduction – Compton Effect theory and experimental verification – Matter waves – Schrodinger's time independent and time dependent wave equation - Physical significance of the wave function – Particle in a one dimensional box – Evolution of microscope - Electron microscope – Comparison of optical and electron microscope - Scanning electron microscope.

UNIT V – CRYSTALLOGRAPHY **9**

Crystalline Solids – Amorphous solids – Space Lattice - Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number and atomic packing factor for SC, BCC, FCC and HCP Structures – Polymorphism and allotropy – Crystal imperfections: point , line and surface defects – burger vector.

Total: 45 Hours

TEXT BOOKS

1. B. K. Pandey and S. Chaturvedi, Engineering Physics , Cengage Learning India Pvt. Ltd., Delhi, 2012.
2. M. Arumugam, 'Engineering Physics' Anuradha Publications, Kumbakonam, 2006.

REFERENCE BOOKS

1. C. Shanthi et al., Engineering Physics, Sonaversity, Sona College of Technology, Salem (Revised edition, 2016).
2. R. K. Gaur and S.C. Gupta, Engineering Physics, Dhanpat Rai Publications, New Delhi, 2003.
3. V. Rajendran and A. Marikani, Engineering Physics, Tata Mc Graw Hill Publications Ltd, III Edition, New Delhi, 2004.
4. M.N. Avadhanulu and PG Kshirsagar, A Text book of Engineering Physics, S.Chand and company, Ltd., New Delhi, 2005.

U15CHE104AR - ENGINEERING CHEMISTRY

(Common to BE - Civil, EEE, Mech, Mechatronics & BTech - FT)

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

1. analyze the types of impurities present in water, their removal methods and explain the conditioning methods for domestic and industrial uses.
2. outline the principles and applications of electrochemistry to engineering and technology.
3. compare the types of corrosion and describe the methods of corrosion control.
4. outline the principle and applications of surface chemistry and catalysis in engineering and technology.
5. illustrate the basics of nano chemistry, synthesis, properties and applications of nano materials in engineering and technology.

UNIT I – WATER TECHNOLOGY 9

Introduction - Characteristics – hardness – estimation of hardness by EDTA method – alkalinity and its estimation - Boiler feed water – requirements – disadvantages of using hard water in boilers – internal conditioning (colloidal – phosphate – calgon and carbonate conditioning methods) – external conditioning – zeolite process, demineralization process – desalination of brackish water by reverse osmosis - Domestic water treatment – screening, sedimentation – coagulation – aeration – sand filtration and disinfection methods – Chlorination – ozonation and UV treatment.

UNIT II – ELECTROCHEMISTRY 9

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).

UNIT III – CORROSION AND CORROSION CONTROL 9

Chemical corrosion - Pilling-Bedworth rule – electrochemical corrosion – mechanism - galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – preliminary treatment - Paints constituents and their functions – surface conversion coatings – Galvanizing and Tinning.

UNIT IV – SURFACE CHEMISTRY AND CATALYSIS 9

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 carbon and powdered activated carbon) – catalysis-types - characteristics of catalysts - autocatalysis - definition and examples.

UNIT V – NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials – size-dependent properties – nanoparticles: nano cluster, nano rod, nanotube (CNT) and nanowire – Synthesis: precipitation – thermolysis – hydrothermal – solvothermal – electrodeposition - chemical vapour deposition - sol-gel technique – properties and applications of nano materials.

Total: 45 Hours

TEXT BOOKS

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi, 2010 (15th Edition).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2008.

REFERENCE BOOKS

1. T. Maruthavanan et al., “Engineering Chemistry”, Sonaversity, Sona College of Technology, Salem, Revised Edition 2018.
2. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd., Chennai, 2009.
3. H.K. Chopra, A. Parmer, “Chemistry for Engineers”, Narosa Publishing House, New Delhi, 110 002, 2016.
4. Ozin G. A. and Arsenault A. C., “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.

U15CPR105AR - PROGRAMMING IN C

(Common to BE - CIVIL, CSE, EEE, Mech, Mechatronics, B.Tech - FT, IT)

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

1. formulate problems, apply logics to solve problems by practice and outline the basics of computer technology
2. write, compile and find errors in simple c programs
3. apply the concepts such as arrays, decision making and looping statements to solve real-time applications
4. examine the power of functions and pointers to become expert programmers in c
5. solve simple scientific and statistical problems using structures and unions

UNIT I – INTRODUCTION TO PROBLEM SOLVING AND COMPUTERS 8

Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart. Need for computer languages, Generation and Classification of Computers- Basic Organization of a Computer

UNIT II – C PROGRAMMING BASICS 10

Structure of a C program – Compiling and Debugging a C program - C Character set, Identifies and Keywords, Data Types, Declarations, Expressions, Statements and Symbolic constants, Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators. Managing Input and Output operations, pre-processor directives and storage classes

UNIT III – CONTROL STATEMENTS, ARRAYS AND STRINGS 9

Unconditional statements, conditional statements, branching and looping statements - Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations and solving simple scientific and statistical problems

UNIT IV – FUNCTIONS AND POINTERS **9**

Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems. Pointers and Functions

UNIT V – STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures. Union - Programs using structures and Unions

Total: 45 Hours

TEXT BOOKS

1. Yashavant P. Kanetkar, “Let Us C”, BPB Publications, 2011.
2. Balagurusamy E, “Programming in ANSI C”, sixth edition, Tata Mcgraw-Hill, 2012.

REFERENCE BOOKS

1. Deitel and Deitel, “C How to Program”, Pearson Education, New Delhi, 2011.
2. Byron S Gottfried, “Programming with C”, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. Kernighan, B.W and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
4. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

U15EGR106AR - ENGINEERING GRAPHICS

L	T	P	C	M
2	2	0	3	100

Course Outcomes

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

1. predict the construction of various curves in civil elevation plan and machine components.
2. draw the projection of three dimensional objects representation of machine structure and explain standards of orthographic views by different methods.
3. analyze the principles of projection of various planes by different angle to project points, lines and planes.
4. draw the principles of projection of simple solid by the axis is inclined to one reference plane by change of position method. understand the interior components of machinery (or) buildings by sectioning the solid,
5. study the development of simple solids for fabrication of sheet metals.

CONCEPTS AND CONVENTIONS (Not for Examination) 12

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) 12

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

UNIT I – PLANE CURVES (Free hand sketching) 12

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 – ISOMETRIC TO ORTHOGRAPHIC VIEWS 12
(Free Hand Sketching)

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.

UNIT III – PROJECTION OF POINTS, LINES AND PLANE SURFACES (Free hand sketching and 2D Software) 12

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 IV – PROJECTION OF SOLIDS 12

(Free hand sketching and 2D Software)

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 V – SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES (Free hand sketching and 2D Software) 12

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.

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.

U15PCL107AR - PHYSICS AND CHEMISTRY LABORATORY I

(Common to CIVIL, EEE, Mech, Mechatronics & FT Branches)

L	T	P	C	M
0	0	2	1	100

Course Outcomes

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

1. apply the principles of optics, thermal physics and elasticity to determine the engineering properties of materials.
2. analyse the given water sample to determine the amount of hardness and alkalinity.
3. determine the thickness of the given copper turn used for house hold applications and evaluate the amount of alkalinity, pH, conductivity and iron content of house hold water sample.

List of Experiments – (PHYSICS PART)

1. Determination of the thickness of a thin wire by forming interference fringes using air wedge apparatus.
2. Determination of the wavelength and velocity of ultrasonic waves and the compressibility of a given liquid using the ultrasonic interferometer.
3. Determination of thermal conductivity of a bad conductor using Lee's disc apparatus.
4. Determination of the angle and dispersive power of a given prism using a spectrometer.
5. Determination of laser wavelength, particle size (lycopodium powder), acceptance angle and numerical aperture of an optical fibre using a diode laser.
6. Determination of the Young's modulus of a given material by non-uniform bending method.

(Any five experiments may be conducted from the above list)

List of Experiments – (CHEMISTRY PART)

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water by indicator method.
3. Estimation of hydrochloric acid by pH metry.
4. Conductometric titration of strong acid vs strong base (HCl vs NaOH).
5. Estimation of ferrous iron by potentiometric titration (Fe^{2+} vs dichromate).
6. Estimation of corrosion in iron sheets by weight loss method.

(Any five experiments may be conducted from the above list)

Total: 30 Hours

U15CPL108AR - C PROGRAMMING LABORATORY

(Common to BE - CIVIL, CSE, EEE, MECH, Mechatronics & BTech FT, IT)

L	T	P	C	M
0	0	2	1	100

Course Outcomes

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

1. design and develop simple programs using branching, looping statements, functions and arrays
2. develop programs using structures, strings, pointers and recursion
3. effectively choose programming components that efficiently solve computing problems in real-world

List of Experiments

1. Programs using Input, Output and assignment statements
2. Programs using Branching statements
3. Programs using Looping statements
4. Programs using Functions
5. Programs using one dimensional and two dimensional arrays
6. Programs using Structures
7. Programs using Strings
8. Programs using Pointers (both data pointers and function pointers)
9. Programs using Recursion

Total: 30 Hours

U15EPL109R - ENGINEERING PRACTICES LABORATORY

(Common to all Branches)

L	T	P	C	M
0	0	2	1	100

Course Outcomes

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

1. plan the pipe connections using PVC, G.I pipes
2. analyze the process of wood separation with proper types of joints using tools and machines
3. demonstrate the method of material removal from metal components and assemble the components using sheet metals
4. demonstrate the working principles of house wiring and Fluorescent lamp wiring
5. analyze the functions of logic gates (AND, OR, NOT, NAND, NOR and Ex-OR)

List of Experiments

GROUP A (CIVIL & MECHANICAL)

1. CIVIL ENGINEERING PRACTICE

PLUMBING WORKS

a. Basic pipe connections (PVC) involving the fittings like Valves, Taps, and Bends.

b. Mixed pipe (PVC and G.I) connections involving the fitting like Valves, Taps, and Bends

CARPENTRY WORKS

a. Planning

b. Lap joint

c. Cross lap joint

II MECHANICAL ENGINEERING PRACTICE

SHEET METAL WORK

a. Square tray

b. Funnel

FITTING WORK

a. L joint

b. V-joint

c. Demonstration of Welding classes

GROUP B (ELECTRICAL & ELECTRONICS)

ELECTRICAL ENGINEERING

1. Study of Resistor, Inductor and capacitor-ratings-colour coding-series and parallel equivalence.
2. House wiring
3. Fluorescent lamp wiring.
4. Stair-case Wiring and Door bell wiring
5. Measurement of circuit parameters for RLC series circuit..
6. Measurement of Energy using Energy meter for Single Phase system.
7. Study of Fan and Iron Box.

ELECTRONICS ENGINEERING

1. Verification of Ohm's Law
2. Measurement of Amplitude and frequency of AC wave forms using CRO.
3. Verification of logic gates (AND, OR, NOT, NAND, NOR and ExOR).
4. Generation of Clock Signal using IC 555 timer.
5. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
6. Study of Multimeter

Total: 45 Hours

SONA COLLEGE OF TECHNOLOGY, SALEM – 636 005
(An Autonomous Institution)

Courses of Study for BE / B Tech Semester II under Regulations 2015R (CBCS)
Branch: MECH

S.No.	Course Code	Course Title	L	T	P	C	Group code
Theory							
1	U15ENG201AR	Technical English –II	2	0	2	3	HS
2	U15MAT202AR	Mathematics – II	3	2	0	4	BS
3	U15PHY203DR	Physics For Mechanical Engineering	3	0	0	3	BS
4	U15CHE205CR	Chemistry For Mechanical Engineering	3	0	0	3	BS
5	U15MEC206R	Manufacturing Technology – I	3	0	0	3	ES
6	U15GE207R	Engineering Mechanics	2	2	0	3	ES
Practical							
7	U15PCL208AR	Physics and Chemistry Laboratory – II[#]	0	0	2	1	BS
8	U15MEC209R	Manufacturing Technology Laboratory – I	0	0	2	1	ES
9	U15CDL210R	Computer Aided Drafting Laboratory	0	0	2	1	ES
Total Credits						**22**	
Optional Language Elective*							
10	U15OLE1201	French	0	0	2	1	HS
11	U15OLE1202	German					
12	U15OLE1203	Japanese					

*Students may opt for foreign languages viz., German/French/Japanese with additional one credit (over and above the CGPA calculation).

[#]Laboratory classes on alternate weeks for Physics and Chemistry. The lab examination will be conducted separately for 50 marks each with 2 hours duration.

Approved by

HOD-First Year Dr. M. Renuga	**Chairperson BOS/ Mechanical & HOD-Mechanical** Dr. D. Senthilkumar	**Member Secretary, Academic Council** Dr. R. Shivakumar	**Chairperson, Academic Council & Principal** Dr. S.R.R. Senthilkumar

U15ENG201AR - TECHNICAL ENGLISH II

L	T	P	C	M
2	0	2	3	100

Course Outcomes

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

1. use grammatical components effectively in both written and spoken communication
2. develop speaking skills for self introduction, delivering speeches and technical presentation.
3. speak effectively in real time and business situations
4. write emails, formal letters and descriptions of graphics
5. develop skills for writing reports and proposals

UNIT I – FOCUS ON LANGUAGE

- Cause and effect expressions
- Concord
- If conditionals
- Articles
- Pronouns
- Adverbs
- Grammatical structures

UNIT II – SPEAKING-I

- Self introduction, personal information, name, home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations, likes and dislikes in food, travel, clothes, special features of home town.
- Welcome address, vote of thanks, special address on specific topics.

UNIT III – SPEAKING – II

- Mini presentation in small groups of two or three regarding, 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, receptionist and appointment seeker, new employee and manager, employee and employee, P.A. and manager, schedule for training, asking for directions, seeking help with office equipment, clarifying an error in the bill, job details, buying a product, selling a product, designing a website, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities.

UNIT IV – WRITING – I

- Email, fixing an appointment, Cancelling appointments, conference details, hotel accommodation, order for equipment, training programme details, paper submission for seminars and conferences
- Letter Writing, Business communication, quotations, placing orders, complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations
- Resume / CV
- Transcoding: Flow Chart, Pie Chart, Graph, Bar Chart, Tabular Column.

UNIT V – WRITING -II

- Technical report writing, feasibility reports, accident reports, survey reports
- General purpose writing specifications of equipment, description of an object, National and International issues, answering general questions with special emphasis on seeking opinions
- Technical Writing: recommendations, checklists, instructions, note making and memo
- Proposal: establishing a lab, introducing a subject in the curriculum, training programme for students

Total: 45 Hours

Speaking test will be conducted for 20 marks externally and evaluated along with Technical English –II in the End Semester Valuation.

TEXTBOOK

Technical English – I & II, Dr. M. Renuga, et al. Sonaversity, Sona College of Technology, Salem, Revised edition, 2016.

EXTENSIVE READING

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

REFERENCE BOOKS

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

U15MAT202AR - MATHEMATICS – II

(Common to Civil, Mech, Mechatronics, EEE, IT and FT Branches)

L	T	P	C	M
3	2	0	4	100

Course Outcomes

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

1. explain the different types of ordinary differential equations and describe the various methods to solve ordinary differential equations.
2. define and explain the vector functions, operators and discuss the methods of solving line, surface and volume integrals.
3. state the special features of function of a complex variable, properties and discuss the problems involving conformal mapping.
4. describe the power series expansion of a complex function and the procedures of evaluating the complex integral.
5. define laplace transform, its inverse, properties and solve an ordinary differential equation using laplace transform.

UNIT I – ORDINARY DIFFERENTIAL EQUATIONS 9+6

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 – VECTOR CALCULUS 9+6

Vector differentiation: Scalar and vector valued functions, gradient, directional derivative, divergence and curl, scalar potential.

Vector integration: Line, surface and volume integrals, statement of Green's, Stoke's and Gauss divergence theorems, simple applications involving squares, rectangles, cubes and rectangular parallelepiped.

UNIT III – ANALYTIC FUNCTIONS 9+6

Function of a complex variable, analytic function, necessary conditions and sufficient conditions (excluding proof), properties of an analytic function, harmonic conjugate, construction of an analytic function by Milne's Thomson method, conformal mapping: $w = z + c$, cz, $1/z$ and bilinear transformation.

UNIT IV – COMPLEX INTEGRATION **9+6**

Statement of Cauchy's integral theorem and Cauchy's integral formula – simple applications,Taylor's and Laurent's expansions, singular points, residues, statement of Cauchy's residue theorem, evaluation of contour integration over unit circle and semi circle (excluding poles on real axis).

UNIT V – LAPLACE TRANSFORM **9+6**

Laplace transform: conditions for existence, transform of elementary functions, basic properties, transform of derivatives and integrals, transform of unit step function and impulse function, transform of periodic functions.

Inverse Laplace transform: standard results – statement of convolution theorem and its applications, initial and final value theorems, solution of linear second order ordinary differential equations with constant coefficients using Laplace transformation.

Total: 75 Hours

TEXT BOOKS

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. T. Veerarajan, "Engineering Mathematics"(I Year), Tata McGraw Hill, 4th Edition, 2011.

REFERENCE BOOKS

1. P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Engineering Mathematics", (for first Year), S. Chand and Co., Ltd., Revised Edition 2011.
2. E. Kreyszig., "Advanced Engineering Mathematics", John Wiley and Sons (Wiley Student Edition), 10th Edition, 2011.
3. S.Karthikeyan, R. Rajeswari, P. Senthilvadivu and R.Shivakumar, "Vector Calculus and Complex Analysis", Sonaversity, Revised Edition, 2017.
4. N. P. Bali, M. Goyal, "Engineering Mathematics", University Science Press, New Delhi, 9th Edition, 2011.

U15PHY203DR - PHYSICS FOR MECHANICAL ENGINEERING

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

1. examine the elastic behaviour of solid materials and apply hydrodynamic principles for the flow of liquids.
2. compare the different modes of heat transfer and apply the thermodynamic processes and laws to compute the efficiency of heat engines.
3. calculate electrical and thermal conductivity of conducting materials.
4. classify semiconductors and analyze the variation of fermi level with temperature and examine the nature of charge carriers.
5. describe the significance of new engineering materials and their applications.

UNIT I – PROPERTIES OF MATTER AND HYDRODYNAMICS 9

Elasticity - Poisson's ratio and relation between moduli (qualitative) -Stress-strain diagram- Factors affecting elasticity - Bending of beams -Cantilever - expression for bending moment – Measurement of Young's modulus by uniform and non-uniform bending- I shaped girders - Stream line flow - Turbulent flow- Poiseuille's formula for flow of liquid through a capillary tube – Determination of coefficient of viscosity of a liquid.

UNIT II – HEAT AND THERMODYNAMICS 9

Thermal conductivity - Forbe's and Lee's disc methods- Radial and cylindrical flow of heat -Thermal conductivity of rubber and glass - Thermal insulation of buildings- Thermal insulating materials -Thermal equilibrium - Zeroth law of thermodynamics - Internal Energy - First law of thermodynamics -Indicator diagram - Isothermal process - Work done in an isothermal expansion - Adiabatic process - Work done in an adiabatic expansion – Reversible and irreversible processes - Second law of thermodynamics - Carnot engine - Efficiency of Canot's cycle - Carnot's cycle as heat engine and refrigerator - Carnot's theorem - Comparative study of Ideal Otto and diesel engines and their efficiency (no derivation) -Entropy - temperature diagram of Carnot's cycle.

UNIT III – CONDUCTING MATERIALS **9**

Conductors-classical free electron theory of metals-Electrical and thermal conductivity-Wiedemann-Franzlaw-Lorentz number-Drawbacks of classical theory-Quantum theory-band theory of solids(qualitative treatment only) - Fermi distribution function- Effect of temperature on Fermi Function-Density of energy states- Carrier concentration in metals - application of conducting materials in induction furnace.

UNIT IV – SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductors – Energy band diagram – direct and indirect band gap semiconductors -Carrier concentration in intrinsic semiconductors - Fermi level – Variation of Fermi level with temperature – Electrical conductivity – Band gap determination– Extrinsic semiconductors – Carrier concentration in N-type and P-type semiconductors (Qualitative Treatment only) – Variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect –Determination of Hall coefficient – Hall effect applications - application of semiconductors in strain measurements.

UNIT V – NEW ENGINEERING MATERIALS **9**

Metallic glasses: Preparation - properties - applications

Shape memory alloys: Characteristics - properties of Ni-Ti alloy – application-advantages and disadvantages of SMA

Advanced Ceramics: Introduction – characteristics – structural ceramics

Nanoscience and Nanotechnology – significance of the nanoscale - different types of nanostructures (Confinement Dimensions 0-D, 1-D, 2-D and 3-D) - Categories of nanomaterials - Fabrication of nanomaterials - Ball milling method and Chemical vapour deposition technique - Carbon nanotubes - Types of carbon nanotubes - CNT structure – properties and applications.

Total: 45 Hours

TEXT BOOKS

1. B. K. Pandey and S. Chaturvedi, 'Engineering Physics', Cengage Learning India Pvt. Ltd., Delhi, 2012.
2. M. Arumugam, 'Materials Science' Anuradha Publications, Kumbakonam, 2006.

REFERENCE BOOKS

1. C. Shanthi et al., Physics for Mechanical Engineering , Sonaversity, Sona College of Technology, Salem (Revised edition, 2017).
2. Rajendran, V, and Marikani A, 'Materials science' TMH Publications, New Delhi, 2004.
3. Subramaniam. N, Brijlal, 'Heat and Thermodynamics', S. Chand Group, New Delhi, 2007 (Unit II).
4. Subramaniam. N, Brijlal, ' Properties of Matter', S. Chand Group, New Delhi, 2007 (Unit I).

U15CHE205CR - CHEMISTRY FOR MECHANICAL ENGINEERING

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

1. analyze the types of polymers, polymerization reactions, polymerization techniques and fabrication methods of polymers for engineering applications.
2. describe the chemistry of engineering materials and their industrial applications.
3. discuss the chemistry of fuels and combustion.
4. explain the industrial importance of phase rule and alloys.
5. outline the principle and processes of metallurgy and powder metallurgy.

UNIT I – POLYMER CHEMISTRY 9

Nomenclature of Polymers – Functionality – Types of Polymerization-Addition-Condensation and Copolymerization – Classification of Polymers – Free Radical Mechanism of Addition Polymerization – Properties of Polymers – Glass transition temperature – tacticity – Methods of Polymerization-Bulk-Solution-Emulsion and Suspension – Plastics – Moulding Constituents of Plastic – Moulding of Plastics into Articles-Injection-Compression and Blow Moulding – Thermoplastic and Thermosetting Resins – Engineering Plastics-Nylon 6,6-Polycarbonate and Polyurethane-Preparation-Properties and Applications – Rubbers-Types-Applications-Vulcanization of Rubber.

UNIT II – CHEMISTRY OF ENGINEERING MATERIALS 9

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling).

Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide.

Lubricants – mechanism of lubrication, liquid lubricants, - properties – (viscosity index, flash and fire points, cloud and pour points, oiliness) – solid lubricants – graphite and molybdenum sulphide.

Modern Composite Materials – Definition, constituents – FRP - types and engineering applications.

UNIT III – FUELS AND COMBUSTION 9

Fuels – calorific value – gross and net calorific values – coal – proximate and ultimate analyses – metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – types – synthetic petrol – Bergius and Fischer Tropsch processes - knocking – octane number and cetane number – power alcohol – biodiesel – Gaseous fuels – Water gas, producer gas, CNG and LPG, Combustion – flue gas analysis by Orsat's method.

UNIT – IV PHASE RULE AND ALLOYS 9

Statement and explanation of terms involved – 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 9

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: 45 Hours

TEXT BOOKS

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi , 2010.
2. B.K. Sharma, "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut (2001).

REFERENCE BOOKS

1. T. Maruthavanan et al., “Chemistry For Mechanical Engineering” Sonaversity, Sona College of Technology, Salem, Revised Edition 2018.
2. Gowariker V.R. , Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006
3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Pub. Co. Ltd., New Delhi (2008).
4. N. Krishnamurthy, K. Jeyasubramanian and P. Vallinayagam, “Applied Chemistry”, Tata McGraw-Hill Publishing Company Limited, New Delhi (1999).

U15MEC206R - MANUFACTURING TECHNOLOGY - I

L	T	P	C	M
3	0	0	3	100

Course Outcomes

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

CO1: gain knowledge on sand casting, pattern materials and the working principle of special casting processes.

CO2: gain knowledge on welding, different welding processes, brazing and soldering.

CO3: acquire knowledge about the various bulk deformation processes.

CO4: explain the different sheet metal characteristics and operations involved in them.

CO5: acquire knowledge about forming and shaping of plastics using different moulding methods.

UNIT I – METAL CASTING 9

Sand Casting- Moulding Tools- Types of Patterns- Pattern Materials- Pattern Allowances- Types of Moulding Sand- Properties- Core Making- Methods of Sand Testing- Moulding Machines: Types- Melting Furnaces: Cupola, Crucible and Electric arc furnace- Special Casting Process: Shell, Investment Casting - Lost Wax Process- Pressure Die Casting- Centrifugal Casting- CO2 Process- Sand Casting Defects- Inspection Methods.

UNIT II – METAL JOINING PROCESS 9

Gas welding: Types- oxy- acetylene, air-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 III – BULK DEFORMATION PROCESSES 9

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

UNIT IV – SHEET METAL PROCESSES 9

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

UNIT V – MANUFACTURING OF PLASTIC COMPONENTS 9

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

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. Magendran parashar & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. J.T. Black, Ronald A. Kohser, "degarmo's materials & processes in manufacturing, 10th ED (With CD)" Wiley India Pvt. Limited, 2010
3. P.N. Rao, Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2009.
4. J.P .Kaushish "Manufacturing Processes" PHI Learning Private limited, second edition 2010.
5. P. C. Sharma, "A text book of production technology", S. Chand and company, IV Edition, 2003.
6. Begma, 'Manufacturing process", John Wilely & sons, VII Edition, 2005.
7. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2002 (Second Indian Reprint)
8. Beddoes. J and Bibby M.J. 'Principles of Metal Manufacturing Processes', Elsevier, 2006.
9. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.

U15GE207R - ENGINEERING MECHANICS

L	T	P	C	M
2	2	0	3	100

Course Outcomes

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

1. the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions.
2. further, they should understand the principle of work and energy. he should be able to comprehend the effect of friction on equilibrium.
3. they should be able to understand the laws of motion, the kinematics of motion and the interrelationship.
4. they should also be able to write the dynamic equilibrium equation. all these should be achieved both conceptually and through solved examples.

UNIT I – BASICS & STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle

Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II – EQUILIBRIUM OF RIGID BODIES IN 2 DIMENSIONS 12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions

UNIT III – FRICTION 12

Frictional force – Laws of Coulomb friction – Angle of friction – cone of friction – Equilibrium of bodies on inclined plane – Ladder friction - Wedge Friction – Belt friction – Screw Jack - Self locking

UNIT IV – PROPERTIES OF SURFACES AND SOLIDS **12**

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Hollow section by using standard formula

Second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia of cylinder

UNIT V – DYNAMICS OF PARTICLES **12**

Displacements, Velocity and acceleration, their relationship – Rectilinear and Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

Total: 60 Hours

TEXT BOOKS

1. Engineering mechanics by sonaversity III edition , by 2013
2. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. Dynamics, McGraw–Hill International Edition, (1997).

REFERENCE BOOKS

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw–Hill, (2001).
4. MeriamJ.L,KraigeL.G,"Engineering Mechanics-Statics" 6th Edition, Wiley, 2010.
5. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
6. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

U15PCL208AR - PHYSICS AND CHEMISTRY LABORATORY II

L	T	P	C	M
0	0	2	1	100

Course Outcomes

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

1. apply the principles of optics, electricity and elasticity to determine the engineering properties of materials.
2. evaluate the amount of iron content in the given sample using spectrophotometry, analyze the amount of chloride in a domestic water sample and analyse the quality of brass by estimating copper.
3. determine the resistivity of the given fuse wire used for house hold applications and determine the dissolved oxygen in two different water samples collected from the students residential areas.

LIST OF EXPERIMENTS (PHYSICS PART)

1. Determination of rigidity modulus of the material using torsion pendulum.
2. Determination of specific resistance of a given wire using Carey-Foster's bridge.
3. Determination of Young's modulus of the material by non-uniform bending method.
4. Determination of wavelength of the spectral lines in the mercury spectrum using a spectrometer.
5. Determination of band gap of a semiconductor diode.
6. Determination of coefficient of viscosity of the given liquid using Poiseuille's method

(Any five experiments may be conducted from the above list)

LIST OF EXPERIMENTS (CHEMISTRY PART)

1. Determination of molecular weight of Polyvinyl alcohol using Ostwald Viscometer.
2. Estimation of copper in brass solution by EDTA method.
3. Determination of Calcium Oxide (CaO) in Cement.
4. Estimation of chromium in waste water.
5. Determination of dissolved oxygen in water by Winkler's method.
6. Estimation of Iron content in water by Spectrophotometric method.

(Any five experiments may be conducted from the above list)

Total: 30 Hours

U15MEC209R - MANUFACTURING TECHNOLOGY LABORATORY – I

L	T	P	C	M
0	0	2	1	100

Course Outcomes

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

CO1: to gain experience on working of general purpose in machine tools and on various manufacturing processes.

CO2: to gain knowledge and experience on working in welding machine.

CO3: to gain knowledge on foundry.

LIST OF EXPERIMENTS

Lathe

1. Simple facing & turning.
2. Step turning model.
3. Taper turning model.
4. Thread cutting operation.
5. Knurling and grooving.
6. Drilling, boring and chamfering.
7. Exercise on radial drilling machine (Drilling, Tapping, Reaming and Counter Sink).
8. Eccentric turning model - Demonstration.

Welding

9. Butt Joints by using Arc welding
10. Lap Joints by using Arc welding
11. Tee Joints by using Arc welding
12. Gas welding – Demonstration

Foundry

13. Foundry – Demonstration

List of Equipments

1. Centre Lathe with accessories	- 15 Nos
2. Pillar type drilling machine	- 01 No
3. Table top drilling machine	- 01 No
4. Radial drilling machine	- 01 No
5. Moulding table	- 05 Nos
6. Moulding boxes, tools, patterns	- 05 Nos
7. Injection Moulding Machine	- 01 No
8. Arc Welding Unit	- 02 Nos
9. Gas Welding Unit	- 01 No

U15CDL210R - COMPUTER AIDED DRAFTING LABORATORY

L	T	P	C	M
0	0	2	1	100

1. General Introduction:

Introduction to CAD Modeling Software – Industrial Applications – Parametric & Feature based modeling. Comparison - CAD models with Proto types. Practice - Sketch – Part Model – Detailing.

Introduction about ANALYSIS.

2. Preparation of Standard Solid Primitives

Create 3D- simple solids- Prism, Pyramid, Cylinder and Cone – Front view-Top view- and side view Create 3D simple models- V-block, Spur Gear, Bolt and Nut etc.).

3. Preparation of Orthographic Drawing and Sectioning:

Ortho graphic view and Cut section of standard Machine Elements.,

4. Material Properties and Rendering

Applying different materials for Machine Components-Steel – Aluminum - Copper- Brass - Silver - Wood Plastic - Ceramic - Concrete etc., Preparing Final CAD outputs with rendering features.

5. Geometric Tolerance and Dimension

Detailing with Fits, Limits and Tolerance.

Introduction to GD&T – Industrial Drawing practice- Machining symbols, Welding Symbols etc.,

Note: Laboratory Practicing CAD Modeling Software: Solidworks 2012.

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester III under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT301DR	Transforms and Boundary value problems	3	2	0	4
2	U15ME301R	Engineering Thermodynamics	3	0	0	3
3	U15ME302R	Strength of Materials	3	0	0	3
4	U15ME303R	Fluid Mechanics	3	0	0	3
5	U15ME304R	Manufacturing Technology-II	3	0	0	3
6	U15CHE304R	Environmental Science and Engineering	3	0	0	3
Practical						
7	U15ME305R	Strength of Materials Laboratory	0	0	2	1
8	U15ME306R	Fluid Mechanics Laboratory	0	0	2	1
9	U15ME307R	Manufacturing Technology Laboratory-II	0	0	4	2
10	U15GE301R	Soft Skills and Aptitude-I	0	2	0	1
					Total Credits	**24**

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, Third Semester BE Mechanical Students and Staff, COE

Course Code	**U15MAT301DR**	L	T	P	C
Course Name	**TRANSFORMS AND BOUNDARY VALUE PROBLEMS**	3	2	-	4

Pre-requisites subject: Vector Calculus, Differential Equations and Complex Analysis

Course Outcomes

Upon completion of this course the students will be able to

CO1 Construct Fourier series which is used in solving initial and boundary value problems, compute complex form and harmonics of Fourier Series

CO2 State Fourier Transform pair and Inverse Fourier Transform Pair, Discuss the properties, state and apply convolution theorem and Parseval's Identify to various functions.

CO3 Form partial differential equations and solve standard types of first order PDE and linear PDE of second and higher order with constant coefficients

CO4 Classify the quasi linear PDE and solve one dimensional wave equations and two dimensional heat equation

CO5 Solve boundary value problems in ODE and PDE, using finite difference approximations

Unit – I **Fourier Series** L 9 T 6

General Fourier series - Dirichlet's conditions, odd and even functions, half range sine and cosine series, complex form of Fourier series, Parseval's identify, harmonic analysis.

Unit – II **Fourier Transforms** L 9 T 6

Fourier integral theorem (without proof) - Fourier transform pair, sine and cosine transforms, properties, transforms of simple functions, convolution theorem, parseval's identity.

Unit – III **Partial Differential Equations** L 9 T 6

Formation of partial differential equations, Lagrange's linear equation, solutions of standard types of first order partial differential equations, linear partial differential equations of second and higher order with constant coefficients

Unit – IV **Boundary value problems** L 9 T 6

Classifications of quasi linear PDE, Solutions of one dimensional wave equation in Cartesian co-ordinates; steady state solution of two dimensional equation of heat conduction in Cartesian co-ordinates (Insulated edges excluded)

Unit – V **Numerical solutions to boundary value problems in Ordinary and Partial Differential Equations** L 9 T 6

Second order ordinary differential equation, finite difference solution of one dimensional heat equation by explicit and implicit methods, one dimensional wave equation and two dimensional Laplace and Poisson equations

Total Number of hours: 75

Learning Resources

Text Books

1. "Transforms and Partial Differential Equations – III" by Sonaversity 2011
2. Ponnusamy S., "Numerical Methods", 1st Edition, Sona Varsity, 2008

Reference Books

1. Bali N.P., and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications (P) Ltd., 2007
2. Ramana B.V.,"Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi 2007
3. Glyn James,"Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education 2007
4. Erwin Kreysizig, "Advanced Engineering Mathematics", 8th edition, Wiley India 2007
5. Grewal B.S., "Higher Engineering Mathematics", 40th Edition, Khanna Publishers, Delhi 2007.

Course Code	**U15ME301R**	L	T	P	C
Course Name	**ENGINEERING THERMODYNAMICS**	3	0	-	3

Pre-requisite subjects: Engineering Physics and Transforms & Partial differential equations

Course Outcomes

Upon completion of this course the students will be able to

CO1 Discuss the thermodynamic properties of system, First Law of Thermodynamics and how to use it to solve engineering problems.

CO2 Explain the Importance of Second law of Thermodynamics and its applications

CO3 Determine the thermodynamic properties of pure substance, steam and PVT Surfaces

CO4 Compare the ideal and real gases and its thermodynamic relations and formulate Maxewells relation, Clausius Clapeyron equations

CO5 Calculate the cooling, heating and humidifier capacities for various airconditioning components by using psychrometric charts.

Unit I BASIC CONCEPT AND FIRST LAW L 9

Basic concepts -thermodynamics concept of continuum, macroscopic approach, Thermodynamic systems and control volume. Properties, state, path process and cycles, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipment-applied to non-flow and flow processes.

Unit II SECOND LAW OF THERMODYNAMICS AND ENTROPY L 9

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed het engine, efficiency, Corollary of Carnot's theorem. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – available and unavailable energy.

Unit III PROPERTIES OF PURE SUBSTANCE L 9

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, 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 AND THERMODYNAMIC RELATIONS L 9

Gas mixtures – properties ideal and real gases, equation of state, Avagadro's Law, Vander Waal's equation of state, compressibility factor, compressibility chart – Dalton's law of partial pressure, exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule – Thomson coefficient.

Unit V PSYCHROMETRY L 9

Psychrometry, properties of atmospheric air and psychrometric charts, air conditioning processes- Sensible heating and cooling, humidification and dehumidification, heating and humidification, cooling and dehumidification, exchange processes. Adiabatic mixing, evaporative cooling.

Total Number of hours: 45

Learning Resources

Text Books

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. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2015.
2. Holman.J.P., "Thermodynamics", 4th Ed. McGraw-Hill, 2008.
3. Michael J Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Baily, "Fundamentals of Engineering Thermodynamics" 8th Edition, John Wiley& sons, 2014
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2004.

Course Code	**U15ME302R**	L	T	P	C
Course Name	**STRENGTH OF MATERIALS**	3	-	-	3

Pre-requisite subjects: Engineering Physics, Engineering Mechanics

Course Outcomes

Upon completion of this course the students will be able to

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

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

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

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

CO5 Solve the problems in connection with the structural design of beams, columns, long mechanical members under compression and analyze columns and struts under various loading conditions.

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

Total Number of hours: 45

Learning Resources

Text Books

1. R K Bansal, "A text book of Strength of Materials", Lakshmi Publications (P) Limited, New Delhi, Sixth Edition, 2018.
2. SS Rattan, '' Strength of Materials'', McGraw Hill Education (India) Private Limited. Chennai, Third Edition, 2017
3. R K Rajput, "Strength of Materials", S Chand & Co., New Delhi, Sixth Edition 2018.

Reference Books

1. Robert L Mott and Joseph A. Untener, ''Applied Strength of Materials'', CRC Press, Sixth Edition , 2016.
2. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi , Second Edition 2012.
3. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
4. Singh D.K "Mechanics of Solids" Pearson Education 2002.
5. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.

Course Code	U15ME303R	L	T	P	C
Course Name	FLUID MECHANICS	3	-	-	3

Pre-requisite subjects: 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 Discuss the fundamental concepts of compressible flow and derive area-velocity relationship.

Unit I FLUID PROPERTIES AND PRESSURE MEASUREMENT L 9

Units & Dimensions. Properties of fluids – mass density, specific weight, specific volume, viscosity, capillarity and surface tension, compressibility, vapor pressure and cavitation. Pressure measurement- Pascal law-measurement of pressure through simple and differential manometers.

Unit II FLUID KINEMATICS AND DYNAMICS L 9

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

Unit III FLOW THROUGH PIPES L 9

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

Unit IV DIMENSIONAL ANALYSIS L 9

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

Unit V COMPRESSIBLE FLOW L 9

Introduction - basic equations of compressible flow - speed of sound wave- mach number- propagation of

pressure waves - stagnation properties. Area–velocity relationship. Introduction to Rayleigh flow and Fanno flow.

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.
6. Yahya S.M. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion. 5th edition New Age international publishers, 6th edition 2018.

Course Code	**U15ME304R**	L	T	P	C
Course Name	**MANUFACTURING TECHNOLOGY - II**	3	-	-	3

Pre-requisites subject: Manufacturing technology-I

Course Outcomes

Upon completion of this course the students will be able to

- **CO1** Classify Machine tools for material removal process and explain the factors affecting tool life - surface finish, cutting fluids.
- **CO2** Demonstrate complete working details of Centre lathe, Capston lathe and Turret lathe.
- **CO3** Make use of the special machine tools and its operation mechanism.
- **CO4** Choose the appropriate milling machine for gear cutting operation and select proper grinding method for grinding particular components.
- **CO5** Evaluate and finalize the exact method of surface treatment for a given application.

Unit I THEORY OF METAL CUTTING L 9 T 0

Introduction: material removal processes, classification of machine tools – nomenclature of single point cutting tool- chip formation, orthogonal cutting, oblique cutting- shear angle in orthogonal cutting- cutting tool materials, tool wear and its types, Taylors tool life, factors affecting tool life - surface finish, cutting fluids.

Unit II CENTRE LATHE AND SPECIAL PURPOSE LATHES L 9 T 0

Centre lathe: constructional features- various operations, tool and work holding devices- taper turning methods, thread cutting, special attachments. Special Purpose Lathe: Capstan and turret lathes – automats – single spindle- Swiss type- automatic screw type, multi spindle - geneva mechanism, Bar feed mechanism.

Unit III SPECIAL MACHINE TOOLS L 9 T 0

Construction, Types, Operations and mechanisms of Shaper, Planner and Slotter. Hole making : drilling –Reaming, Boring- Tapping- operations. Broaching machines: broach construction – push, pull, surface and continuous broaching machines.

Unit IV MILLING AND GRINDING PROCESS L 10 T 0

Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears. Grinding: types of grinding process- types of grinding wheel – Abrasives - cylindrical grinding, surface grinding, Centre less grinding – honing, lapping and buffing.

Unit V SURFACE PROCESSING L 8 T 0

Chemical Cleaning-Mechanical Cleaning-Surface-treatment, Organic coating Electroplating-

Electro less Plating-Electro forming- Hot dipping-chemical conversion coating- anodizing of metals -Physical vapour deposition-chemical vapour deposition- - Application.

Total Number of hours: 45

Learning Resources

Text Books

1. Mikell P Groover, "Principles of Modern Manufacturing" Wiley India Pvt Ltd. 2014.
2. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters & Publishers pvt ltd .2010

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. Milton C.Shaw, 'Metal Cutting Principles', Oxford University Press, Second Edition, 2005.
6. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.
7. HMT – "Production Technology", Tata McGraw-Hill, 2003.

		L	T	P	C
Course Code	**U15CHE304R**				
Course Name	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	3	-	-	3

Course outcomes:

Upon completion of this course the students will be able to

CO1 Discuss the significant aspects of natural resources like forests, water, mineral, food, and energy and land resources.

CO2 Explain the concepts of an ecosystem and provide an overview of biodiversity and its conservation.

CO3 Interpret the causes and effects of various environmental pollutions and propose the effective control measures to disposal the hazardous wastes.

CO4 Survey the social issues with regard to the environment.

CO5 Discuss the impact of human population on the environment.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 12

Definition, Scope and Importance – Need for public awareness – Forest Resources:- Use and over - exploitation, deforestation, Case Studies, Timber Extraction, Dams, Benefits and their effects on forests and tribal people - Water Resources:- Use and Over-Utilization of Surface and ground water , Floods, Drought, Conflicts Over Water – Mineral Resources:- Use–Environmental Effects of Extracting and Using Mineral Resources – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources – Land Resources:- Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources.

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concepts of an Ecosystem – Structure and Function of an Ecosystem – Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Biogeochemical Processes - Ecological Succession – Food Chains, Food Webs and Ecological Pyramids.

Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – 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 10

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 (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of Urban and Industrial Wastes, hazardous wastes and biomedical wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management:- Floods, Earthquake, Cyclone and Landslides, Waste water treatment methods, Green chemistry – principles and applications

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

Sustainable Development – Urban Problems Related To energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns – Environmental Ethics:- Issues and Possible Solutions –- Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies – Wasteland Reclamation – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues Involved in enforcement of Environmental Legislation – Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population Growth, Variation Among Nations – Population Explosion – Family Welfare Programme – environment and Human Health – Human Rights – Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL : 45 PERIODS

Text Books:

1. S. Radjarejesri et al., "Environmental Science" Sonaversity, Sona College of Technology, Salem, 2018.
2. Anubha Kaushik and Kaushik, "Environmental Science and Engineering" New Age International Publication, 4th Multicolour Edition, New Delhi, 2014.

Reference Books:

1. Masters, G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 2nd Edition, 2004.
2. Miller, T.G. Jr., "Environmental Science", Wadsworth Pub. Co.
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.

		L	T	P	C
Course Code	**U15ME305R**				
Course Name	**STRENGTH OF MATERIALS LABORATORY**	-	-	2	1

Course Outcomes

Upon completion of this course the students will be able to

CO1 Determine the compressive strength and tensile strength of various engineering

CO2 Calculate various mechanical properties of materials using appropriate testing machines

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

Total Hours 30

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 (Rockwell & Brinell)
7. Tests on spring – Tension & Compression

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. Impact testing machine.
8. Compression and tension test on spring machine.

		L	T	P	C
Course Code	**U15ME306R**				
Course Name	**FLUID MECHANICS LABORATORY**	-	-	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 Solve real time problems in pipe flow problems

Total Hours 30

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

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

			L	T	P	C
Course Code	**U15ME307R**					
Course Name	**MANUFACTURING TECHNOLOGY LABORATORY-II**		-	-	4	2

Pre-requisites subject: Manufacturing technology Laboratory

Course Outcomes

Upon completion of this course the students will be able to

CO1 Select the proper Machine tools to perform the particular operations in a work piece.

CO2 Measure cutting Force and tool wear of cutting tool using dynamometer and tool maker's microscope.

CO3 Recommend suitable machining operation and machine for a given application.

LIST OF EXPERIMENTS **Total Hours 60**

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 automatic lathe
8. Tool and Cutter grinding machine- grinding various angles on single point tool.
9. Cutting Force measurement using dynamometer.
10. Tools wear measurement using tool maker's microscope.
11. Planner and gear hobbing machine – Demonstration.

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
8. Radial Drilling Machine - 1 No
9. Tool Dynamometer - 1 No
10. Tool Makers Microscope - 1 No

Semester-III	U15GE301R: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 than those in BA-I and II in stated areas of quantitative aptitude and logical reasoning
3. Demonstrate higher than BA-I and II 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. Numbers: Finding units digit, Power rule b. Base system – Progressions: Arithmetic, geometric and harmonic c. HCF and LCM d. Averages e. Percentages f. Ratio and proportion g. Ages h. Partnership i. Profit and loss j. Mensuration: Area, perimeter, volume and Surface area k. Coding and Decoding: Numbers, alphabet, alphanumeric coding and Artificial language l. Direction Sense m. Symbols and series: Numbers, alphabet, symbols, pictures and alphanumeric n. Seating arrangement
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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester IV under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT401DR	Statistics and Numerical Methods	3	2	0	4
2	U15ME401R	Kinematics of Machinery	3	0	0	3
3	U15ME402R	Thermal Engineering	3	0	0	3
4	U15EE409R	Electrical Drives and Microprocessor	3	0	0	3
5	U15ME403R	Applied Hydraulics and Pneumatics Systems	3	0	0	3
6	U15ME404R	Engineering Materials and Metallurgy	3	0	0	3
Practical						
7	U15GE401R	Soft Skills and Aptitude-II	0	0	2	1
8	U15ME405R	Thermal Engineering Laboratory	0	0	4	2
9	U15EE410R	Electrical Drives and Microprocessor Laboratory	0	0	4	2
10	U15ENG401R	Communications Skills Laboratory	0	0	2	1
					Total Credits	**25**

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, Fourth Semester BE Mechanical Students and Staff, COE

Course Code	**U15MAT401DR**	L	T	P	C
Course Name	**STATISTICS AND NUMERICAL METHODS**	3	2	-	4

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

Course Outcomes

Upon completion of this course the students will be able to

CO1 Define the sampling distribution, test and analyze the hypothesis for mean, variance, proportions and differences using z and t, chi – square and F-distribution and also analyze independence of attributes and goodness of fit.

CO2 Apply one way and two way classification techniques and analyze the various standard designs (CRD, RBD, LSD) for the real life problems.

CO3 Explain the methods to solve the algebraic and transcendental equation, a linear system of equations by direct and indirect methods and find eigen value of a matrix by power method.

CO4 Describe and apply the interpolation methods for unequal and equal intervals and obtain the derivatives using those interpolation methods to compute the derivatives and Trapezoidal and Simpson's rule to evaluate the numerical integration.

CO5 Solve the linear and nonlinear ordinary differential equations of first order and second order by single step methods and multi-step methods.

Unit I TESTING OF HYPOTHESIS L 9 T 3

Sampling distribution-Testing of hypothesis for mean, variance, proportions and differences using z and t - chi – square and F-distribution-Test for independence of attributes, goodness of fit.

Unit II DESIGN OF EXPERIMENTS L 9 T 3

Analysis of variance, completely randomized design, randomized block design, Latin square design , 2^2, factorial design

Unit III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS L 9 T 3

Newton – Raphson method, Gauss elimination method, pivoting, Gauss – Jordan methods, iterative methods of Gauss-Jacobi and Gauss- Seidel ,matrix inversion by Gauss -Jordan method, eigen values of a matrix by power method

Unit IV INTERPOLATION, NUMERICAL DIFFERENTIATION & NUMERICAL INTEGRATION L 9 T 3

Lagrange's and Newton's divided difference interpolation, Newtion's forward and backward difference interpolation, approximation of derivatives using interpolation polynomials, numerical integrating using Trapezoidal and Simpson's 1/3 rules

Unit V INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS L 9 T 3

Taylor series method, Euler and modified Euler methods, fourth order Runge – Kutta method for solving first and second order equations, Milne's and Adam's predictor and corrector methods.

Total Number of hours: 75

Learning Resources

Text Books

1. Ponnusamy S., and Santha Kumaran A., "Statistics and Numerical Methods", Sonaversity, 1st Edition, 2009
2. Johnson R.A., and Gupta C.B., "Miller and Freund's, "Probability and Statistics for Engineer's", Pearson Education, Asia, 7th Edition, 2007

Reference Books

1. Grewal, B.S., and Grewal J.S., "Numerical Methods in Engineering and Science", khanna publishers, New Delhi, 6th Edition, 2004
2. Walpole R.E, Myers R.H., and Kye., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007
3. Gerald, C.F and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Editions, 2006

Course Code	**U15ME401R**	L	T	P	C
Course Name	**KINEMATICS OF MACHINERY**	3	-	-	3

Pre-requisites subject: Engineering Physics and Mathematical geometry

Course Outcomes

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.
- **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** Analyze the friction in machine elements such as clutches and brakes

Unit I BASICS OF MECHANISMS L 9 T 0

Basic concepts of Link, Kinematic pair, Kinematic chain, Mechanism, Machine, Degree of Freedom, Kutzbach and Grubler's criterion and Grashoff's law - Kinematic Inversions of four bar chain and slider crank chain - Mechanical Advantage - Transmission angle.

Description of common Mechanisms – Single, Double and Offset slider mechanism. Straight line Mechanisms (Exact & Approximate Straight line).

Unit II KINEMATICS OF LINKAGE MECHANISMS L 9 T 0

Analysis of simple mechanisms, single slider crank mechanism, four bar mechanism) - Graphical methods for displacement, velocity and acceleration polygons; Coincident points – Coriolis acceleration

Velocity analysis using instantaneous centers of simple mechanisms (Single slider crank mechanism and four bar mechanism).

Unit III KINEMATICS OF CAM MECHANISMS L 9 T 0

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

Unit IV GEARS AND GEAR TRAINS L 9 T 0

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

Unit V FRICTION IN MACHINE ELEMENTS L 9 T 0

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction in screw jack – Friction clutches –Single plate clutch and Multi plate clutch – Friction aspects in brakes – Band and Block brakes.

Total Number of Periods: 45

Text Books

1. Sadhu Singh, "Theory of Machines", Pearson Education, New Delhi, 3rd Edition, 2011, ISBN-13: 978-8131760697.
2. S.S.Rattan, "Theory of Machines & Mechanisms", Tata Mcgraw hill publishers, 4th Edition, 2014, ISBN-13: 978-9351343479.
3. Ambekar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007, ISBN-13: 978-8120331341.
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.

Reference Books

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005, ISBN-13: 978-8123908748.
2. Ramamurti,V.,'' Mechanism and Machine Theory", Second Edition, Narosa Publishing House, New Delhi, 3rd Edition, 2010, ISBN: 978-81-7319-892-2.
3. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Pvt. Ltd., New Delhi, 2008, ISBN-13: 978-8185938936.
4. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 2nd Edition, 1992, ISBN-13: 978-8122404265.
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.

Course Code	**U15ME402R**	L	T	P	C
Course Name	**THERMAL ENGINEERING**	3	-	-	3

Pre-requisites subject: Engineering Physics, Engineering Mathematics 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.

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 with p-h chart and tables.

Unit I GAS POWER CYCLES L 9

Otto, Diesel, Dual, 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 STEAM 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, simple cooling load estimation.

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.

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.

Course Code	**U15EE409R**	L	T	P	C
Course Name	**ELECTRICAL DRIVES AND MICROPROCESSOR**	3	-	-	3

Pre-requisites subject: Engineering Physics, Engineering Mathematics

Course Outcomes

Upon completion of this course the student will be familiar with

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

CO2 Explain the Construction, Types, Operation and characteristics of three phase Induction motor.

CO3 Describe about Types of electric drives, Heating and cooling curves.

CO4 Discuss about the Speed control of DC motors and three phase induction motor.

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

Unit I DC MOTORS L 9 T 0

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 AC MOTORS L 9 T 0

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 T 0

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 T 0

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 8085 MICROPROCESSOR L 9 T 0

Intel 8085 Architecture – Intel 8085 Pin Diagram and its functions- Instruction set – Addressing modes – Simple Assembly language Programming – Interrupts.

Total Number of hours: 45

Learning Resources

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, Fourth Edition 2010.
2. Vedam Subramanyan, Electrical Drives concepts and applications, Tata Mc Graw Hill Publications, 2014
2. Gaonkar, R. S., "Microprocessor Architecture, Programming and application with 8085", 6th Edition, Penram International Publishing, 2013.

REFERENCE BOOKS:

1. Pillai.S.K "A first course on Electric drives", Wiley Eastern Limited, 3rd Edition Reprint 2015.

Course Code	**U15ME403R**	L	T	P	C
Course Name	**APPLIED HYDRAULICS AND PNEUMATICS SYSTEMS**	3	-	-	3

Pre-requisites subject: Fluid Mechanics

Course Outcomes

Upon completion of this course the students will be able to

CO1 Discuss the various types of pumps for hydraulic power sources.

CO2 Demonstrate the principle of hydraulic cylinders and fluid motors, Gear, Vane and Piston motors.

CO3 Compare accumulators and intensifiers and able to construct hydraulic circuits for various applications.

CO4 Develop the pneumatic circuits for simple applications using various Pneumatic Components

CO5 Propose Low cost automation system for industry 4.0 by utilizing Servo systems and PLC.

Unit I FLUID POWER SYSTEMS AND POWER GENERATOR L 9 T 0

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Fluid power symbols.

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps

Unit II CONTROL AND ACTUATION ELEMENTS L 9 T 0

Construction of Control Components : Direction control valves – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable -electrical control solenoid valves, Relays.

Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting -special cylinders like-Tandem, Rod-less, Telescopic, Cylinder cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

Unit III HYDRAULIC CIRCUITS L 9 T 0

Hydraulic circuits-reciprocating–quick return-pressure sequencing circuit- Regeneration circuit Drilling circuit, synchronizing circuit, speed control-meter in, meter out and bleed off circuit, safety circuits Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, intensifier – Applications of Intensifier – Intensifier circuit.

Unit IV PNEUMATIC SYSTEMS AND CIRCUITS L 9 T 0

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Fluid Power Circuit Design, Pneumo-hydraulic circuit, Sequential circuit design for simple applications using cascade method.

Unit V SPECIAL SYSTEM AND MAINTENANCE L 9 T 0

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and hydro pneumatic circuits -Introduction to logic circuits.

Introduction to fluidic devices, simple circuits, ladder diagrams, PLC applications in fluid power control circuit –fault finding -Failure and troubleshooting. Low cost automation. Automation requirements for industry 4.0.

Total Number of hours: 45

Learning Resources

Text Books

1. Anthony Esposito, "Fluid Power with Applications", 7th edition, Pearson Education 2005. ISBN:9789332518544,ISBN-10:9332518548.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001. ISBN: 9780074637487.

Reference Books

1. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 2007 .
2. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 2009.

ISBN10:136874436 ISBN13: 9780136874430.

3. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 2002.
4. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006. ISBN-10: 8121926351,ISBN-13: 978-8121926355.
5. Majumdar S.R.- "Pneumatic systems - Principles and maintenance"-Tata McGraw Hill- 1995 ISBN 10: 0074602314 ISBN 13: 9780074602317.
6. Dr A.K. Bewoor , S C Shilwant, " Hydraulics and Pneumatics" Jul 2014, Nirali Prakashan ISBN-10: 9351641341 ISBN-13: 978-9351641346.
7. Andrew Parr, "Hydraulics and Pneumatics: A Technician's and Engineer's Guide,2011, Butterworth-Heinemann. ISBN-10: 0080966748,ISBN-13: 978-0080966748.

Course Code	**U15ME404R**	L	T	P	C
Course Name	**ENGINEERING MATERIALS AND METALLURGY**	3	-	-	3

Pre-requisites subjects: Engineering Chemistry, Engineering Physics

Course Outcomes

Upon completion of this course the students will be able to

CO1	Discuss constitutions of alloys with their formation reactions of solid solutions and phase diagrams.
CO2	Analyze the various heat treatments process and different kinds of heat treatment diagrams for real time applications.
CO3	Compare the Various ferrous & non-ferrous metals and its various alloys in the engineering scope.
CO4	List the non-metallic materials with its properties and its importance and compare themselves with the normal metals and their alloys.
CO5	Test the mechanical properties of various materials by different testing methods.

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

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbon equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

Unit II HEAT TREATMENT L 9 T 0

Definition – Full annealing, process, stress relief, recrystallization and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram, CCR - Hardenability, Jominy end quench test –Austempering, martempering – case hardening - carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening.

Unit III FERROUS AND NONFERROUS METAL L 9 T 0

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

Unit IV NON-METALLIC MATERIALS L 9 T 0

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK,PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics –Introduction to fibre reinforced plastics.

Unit V MECHANICAL PROPERTIES AND TESTING L 9 T 0

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

Total Number of hours: 45

Learning Resources

Text Books

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. R.K.Rajput "Engineering Materials & Metallurgy" S Chand Publications. 2006
3. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2014.

Reference Books

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

Course Code	**U15ME405R**	L	T	P	C
Course Name	**THERMAL ENGINEERING LABORATORY**	-	-	4	2

Pre-requisites subject: Engineering thermodynamics and Thermal engineering.

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

- **CO1** Identify components and experience the function of each component of Internal combustion engine and analyze the suitability of fuels for engines.
- **CO2** Compare the volumetric efficiency of IC engines and air compressors under various delivery pressures.
- **CO3** Evaluate the performance of IC engines, refrigeration and air conditioning systems.

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENTS (for a batch of 30 students)

1. Single Cylinder 4-Stroke 5 HP Kirloskar Diesel Engine 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. Multicylinder 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 Hours: 60

		L	T	P	C
Course Code	**U15EE410R**				
Course Name	**ELECTRICAL DRIVES AND MICROPROCESSOR LABORATORY**	-	-	4	2

Pre-requisites subject: Engineering Physics, Engineering Mathematics.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Determine the performance characteristics of DC and AC motors

CO2 Evaluate the performance characteristics of single phase and three phase R,RL loads.

CO3 Develop the Assembly language program for arithmetic operations using 8085.

Total Hours:60

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 3Phase Induction motor using Voltage Source Inverter (VSI).
11. Addition and Subtraction of two 8 bit numbers using Intel 8085 Microprocessor (Programming with control instructions)
12. Multiplication and Division of two 8 bit numbers using Intel 8085 Microprocessor (Programming with control instructions)

STUDY

1. Study of DC motor starters.
2. Study of AC motor starters.
3. Study of auto-transformers.
4. Study of current, voltage and power measuring instruments.

Course Code	**U15ENG401R**	L	T	P	C
Course Name	**COMMUNICATION SKILLS LABORATORY**	-	-	2	1

(Common to all branches of Third / Fourth Semester B.E / B.Tech programmes)

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

CO1 Communicate confidently and effectively and Demonstrate active listening skills

CO2 Practice soft skills and interpersonal skills to excel in their jobs.

CO3 Use language efficiently to face interviews, participate in group discussions . and present speeches

1. **Listening Comprehension**: Listening and typing – listening and sequencing of sentences – Filling in the blanks – Listening and answering questions.

2. **Reading Comprehension**: Filling in the blanks – Cloze exercises – Vocabulary building – Reading and answering questions.

3. **Speaking: Phonetics**: Intonation – Ear training – Correct Pronunciation – Sound recognition exercises – Common errors in English.

Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

4. Making presentations: introducing oneself – introducing a topic – answering questions – individual presentation practice

5. Creating effective PPTs – presenting the visuals effectively

6. Using appropriate body language in professional contexts – gestures, facial expressions, etc.

7. Preparing job applications - writing covering letter and résumé

8. Applying for jobs online - email etiquette

9. Participating in group discussions – understanding group dynamics - brainstorming the topic – mock GD

10. Training in soft skills - persuasive skills – people skills - questioning and clarifying skills

11. Writing Project proposals: collecting, analyzing and interpreting data / drafting the final report

12. Attending job interviews – answering questions confidently

13. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.

2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.

3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.

4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.

5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.

6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

7. Turton, N.D and Heaton, J.B. Dictionary of Common Errors, Addision Wesley Longman Ltd., Indian reprint 1998.

EXTENSIVE READING

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press,

1989.

2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

Semester – IV	U15 GE 401R: 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. Allegation and mixture b. Time, speed and distance: Unit conversion, Average speed, Relative speed, two objects crossing each other in the same direction and opposite direction, Boats and streams, Races and games c. Clocks d. Calendars e. Blood relations f. Cubes and Dices g. Syllogism (≤3 statements) h. Ranking and order i. Company specific aptitude questions
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

S. Anita

Dr.S.Anita

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester V under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15ME501R	Heat and Mass Transfer	3	0	0	3
2	U15ME502R	Dynamics of Machinery	3	0	0	3
3	U15ME503R	Design of Machine Elements	3	0	0	3
4	U15ME504R	Computer Aided Design and Manufacturing	3	0	0	3
5	U15ME505R	Automobile Engineering	3	0	0	3
6	U15ME904R	**Professional Elective:** Python :Programming and Problem Solving	3	0	0	3
	U15ME920R	**Professional Elective:** IOT for Manufacturing				
	U15ME903R	**Professional Elective:** Heating, Ventilation and Air Conditioning				
Practical						
7	U15ME506R	Heat Power Laboratory	0	0	4	2
8	U15ME507R	Dynamics Laboratory	0	0	4	2
9	U15ME508R	CAD and CAM Laboratory	0	0	4	2
10	U15GE501R	Soft Skills and Aptitude-III	0	0	2	1
					Total Credits	**25**

Approved By

Chairperson, Mechanical Engineering BoS Dr.D.Senthilkumar

Member Secretary, Academic Council Dr.R.Shivakumar

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

Copy to:-

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

Course Code	**U15ME501R**	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** Determine the amount of heat transfer through plane walls, cylinder and composite walls and with internal heat generation.
- **CO2** Analyze the importance of extended surfaces and transient conduction.
- **CO3** Apply the concepts of convective heat transfer in forced convection and free convection systems and describe the concept of boiling and condensation.
- **CO4** Determine the amount of radiation heat exchange between surfaces and its thermal relations.
- **CO5** Evaluate the heat transfer in heat exchangers, by LMTD method and NTU methods, and mass transfer through diffusion.

Unit I STEADY STATE HEAT CONDUCTION L 9 T 0

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation. Critical radius of insulation

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

Types of Fins – Fin equation, fin efficiency-effectiveness– Heat Flow Calculations – Circumferential and longitudinal fins. Introduction to Transient Heat Conduction – Lumped Parameter Model – Semi Infinite Solid and Infinite Solid - Use of Heisler's Chart.

Unit III CONVECTION, BOILING AND CONDENSATION L 9 T 0

Basic Concepts – Convective Heat Transfer Coefficients – 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 – Flow over Bank of tubes – Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Nusselt's theory of Condensation –film wise and dropwise condensation, Pool Boiling, Flow Boiling, Boiling Curve (elementary treatment only).

Unit IV FUNDAMENTALS OF THERMAL RADIATION L 9 T 0

Basic Concepts, Radiative properties-emissivity, absorptivity, reflectivity, transmissibility, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law. –Radiation heat transfer – black surfaces, Grey surfaces, Shape Factor relations – Electrical Analogy – Radiation Shields – Introduction to Gas Radiation.

Unit V HEAT EXCHANGERS & MASS TRANSFER L 9 T 0

Types of Heat Exchangers ,Overall Heat Transfer Coefficient – Fouling Factors. LMTD Method of heat Exchanger Analysis – Effectiveness – NTU Method of Heat Exchanger Analysis –Basic Concepts – analogy between heat transfer and mass transfer- Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion.

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

Total Number of hours: 45

Learning Resources

Text Books

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

Reference Books

1. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.
2. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
3. Nag P.K, "Heat Transfer", Tata McGraw-Hill, New Delhi, 2002.
4. Incropera, Frank.P; Dewitt,David. P "Fundamentals of Heat and Mass Transfer", John Wiley & Sons Pvt. Ltd., 2000.

Course Code	**U15ME502R**	L	T	P	C
Course Name	**DYNAMICS OF MACHINERY**	3	0	0	3

Pre-requisites subjects: Engineering Mechanics and 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 Calculate the Static and dynamic balancing of engines.

CO3 Analyze the principles in mechanisms used for governing of machines

CO4 Analyze the undesirable effects of unbalances resulting from prescribed motions in mechanism.

CO5 Calculate the effect of Dynamics of undesirable vibrations.

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Unit I FORCE ANALYSIS L 9 T 0

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

Unit II BALANCING L 9 T 0

Static and dynamic balancing of rotating masses – Balancing of reciprocating masses-Balancing of locomotives - Balancing of Multi-cylinder engines – Partial balancing of locomotive engines.

Unit III MECHANISM FOR CONTROL L 9 T 0

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled governor. Effect of friction – Hunting and Isochronism-calculation of equilibrium speed and ranges of speed of governors-controlling force diagram for spring controlled governors.

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

Unit IV LONGITUDINAL VIBRATIONS L 9 T 0

Introduction to vibration – Terminology – Classification of vibrations – Undamped and Damped free vibration of single degree of freedom systems-springs in series springs in parallel and combinations- Viscous damping-types of damped system. Forced vibration of single degree of freedom system- harmonic excitation- Logarithmic decrement- magnification factor, vibration isolation and transmissibility. Basics of vibration level measurements.

Unit V TRANSVERSE AND TORSIONAL VIBRATIONS L 9 T 0

Transverse vibrations of shafts and beams-natural frequency- Rayleigh`s method - Dunkerly"s method-whirling of shafts. Torsional vibrations -equivalent shafts- single rotor, two rotor and three rotor systems- Free vibration of geared systems.

Total Number of hours: 45

Learning Resources

Text Books

1. Rattan .S.S, "Theory of Machines", Fourth Edition, Tata McGraw-Hill Publishing Company Ltd, 2014.
2. Sadhu Singh "Theory of Machines", Pearson Education, 2013.

Reference Books

1. Ballaney.P.L "Theory of Machines", Khanna Publishers, 2013.
2. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", New Age International, New Delhi, 2014.
3. Thomas Bevan, "Theory of Machines" CBS Publishers and Distributers, 2005.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", 4th edition, oxford university press.

Course Code	U15ME503R	L	T	P	C
Course Name	DESIGN OF MACHINE ELEMENTS	3	-	-	3

Prerequisites- subject: Engineering Mechanics, Kinematics of Machinery and Strength of Materials

Course Outcomes

Upon completion of this course the students will be able to

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

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

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

CO4 Design the various types of springs like helical, leaf and torsional springs under constant loads and varying loads Flywheels considering stresses in rims and arms for engines and punching machines

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

Unit I STEADY AND VARIABLE STRESSES L 9 T 0

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 – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook - Role of Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

Unit II DESIGN OF SHAFTS AND COUPLINGS L 9 T 0

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

Unit III DESIGN OF FASTENERS AND WELDED JOINTS L 9 T 0

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

Unit IV DESIGN OF SPRINGS AND ENGINE COMPONENTS L 9 T 0

Design of helical, leaf and torsional springs under constant loads and varying loads - concentric springs - Flywheels considering stresses in rims and arms for engines and punching machines

Unit V DESIGN OF BEARINGS L 9 T 0

Design of bearings - sliding contact and rolling contact types. - Selection of Rolling Contact bearings. Cubic mean load - Design of journal bearings - Mckees equation -Lubrication in journal bearings - calculation of bearing dimensions.

Total Number of hours: 45

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

Learning Resources

Text Books

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2017.

2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2008.

Reference Books

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", Fouth Edition, Wiley, 2005

3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill Book Co. (Schaum's Outline), 2010

4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements", Second Edition, Tata McGraw-Hill Book Co., 2006.

5. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.

6. Ansel Ugural, "Mechanical Design – An Integral Approach", First Edition, Tata McGraw-Hill Book Co, 2003.

7. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" Eight Edition, Printice Hall, 2003.

Course Code	**U15ME504R**	L	T	P	C
Course Name	**COMPUTER AIDED DESIGN AND MANUFACTURING**	3	0	0	3

Pre-requisites subjects: Engineering graphics, manufacturing technology –I and Manufacturing technology - II

Course Outcomes

Upon completion of this course the students will be able to

CO1 Discuss the fundamental concepts of Computer aided design and Modeling Techniques.

CO2 Identify various construction components of modern CNC machine and give the details of Automatic Tool changers (ATC).

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

CO4 Plan the shop floor process using group technology in CIM environment.

CO5 Analyze the quality of a product with help of computer aided quality control systems utilize benefits of flexible manufacturing systems.

Unit I COMPUTER AIDED DESIGN L 9 T 0

Introduction to CAD, Interactive display devices, Operator input/output devices, Graphic standards, 2D Transformation- Scaling, Translation and Rotation. Geometric Modeling- Wire Frame Modeling, Surface Modeling, Solid Modeling-Constructive solid geometry (CSG), Boundary Representation (B-Rep). Geometrical tolerances –types-

Unit II COMPUTER AIDED MANUFACTURING L 9 T 0

CNC Technology-Classification of CNC systems-Contouring System-Interpolators, open loop and closed loop CNC systems, Hardware features-Direct Numerical Control. Construction features - Structural members-Slide ways-Sides linear bearings-Ball screws-Spindle drives and feed drives-Automatic Tool changers.

Unit III CNC – PROGRAMMING L 9 T 0

Computer Numerical Control codes- Punched tapes, G,M Code, Standards, Types of dimensioning, Manual Part programming for point to point- Linear, Circular interpolation. Industrial FANUC G-Codes- CNC programming practices for Turning and Milling Operations.

Unit IV GROUP TECHNOLOGY AND CAPP L 9 T 0

Introduction to CIM, Role of Elements, CIM Networking, Group Technology, Part Families, parts Classification & Coding, GT Machine cells, Shop floor phases, Benefits of GT. Computer Aided Process Planning (CAPP), Retrieval type, Generative type Process Planning Systems, Benefits of CAPP.

Unit V COMPUTER AIDED QUALITY CONTROL AND FMS L 9 T 0

Computer Aided Quality Control (CAQC)- Introduction, Contact Inspection methods, Non-Contact Inspection methods, Co-ordinate Measuring Machine vision. Flexible manufacturing Systems- Introduction, Scope, Types, Elements and Benefits of FMS.

Total Number of hours: 45

Learning Resources

Text Books

1. Ibrahim Zeid." CAD-CAM Theory and Practice", Tata McGraw-Hill Publishing Co. Ltd. 2nd edition.
2. P.Radhakrishan, S.Subramanyan, V. Raju, "CAD/CAM/CIM". New Age International Publishers, 3rd Edition 2012.
3. Mikell P. Groover and Emory W. Zimmers, Jr, "CAD/CAM Computer Aided and Manufacturing". Eastern Economy Edition, PHI publishers 2007.

Reference Books

1. Mikell.P.Groover "Automation, Production Systems and computer integrated and manufacturing", Pearson Education 2016.
2. P.N. Rao, "CAD/CAM Principles and Applications". Tata McGraw Hill Publications, 2010.
3. William .M. Neumann and Robert .F. Sproul, "Principle of Interactive Computer Graphics" McGraw Hill Book Co. Singapore, 2001.
4. Paul G. Ranky, "Computer Integrated Manufacturing- An Introduction with Case Studies" Prentice Hall International, 2004.
5. Christman, Alan. "Technology Trends in CAM Software." Modern Machine Shop. December 2005.
6. Leondes, Cornelius, ed. "Computer-Aided Design, Engineering, and Manufacturing." Vol. 5 of The Design of Manufacturing Systems. CRC Press, 2001.
7. Hirz, M., Dietrich, W., Gfrerrer, A., Lang, J. "Integrated Computer-Aided Design in Automotive Development" springer, 2013
8. Ali K. Kamrani , Rasaratnam Logendran "Group Technology And Cellular manufacturing Vol 1),Gorden And Breach Science Publishers ,2000.
9. J. Srinivas "CAD/CAM: Principles and Applications" Oxford University Press; 2016.

		L	T	P	C
Course Code	**U15ME505R**				
Course Name	**AUTOMOBILE ENGINEERING**	3	0	0	3

Pre-Requisite Subjects: Thermal Engineering & Thermodynamics

Course Outcomes

Upon completion of this course the students will be able to

CO1 Explain the vehicle structure and to discuss the various components of engine.

CO2 Select the suitable fuel injection system and ignition system for an automobile engine.

CO3 Discuss the various transmission systems, joints and axle types.

CO4 Compare the different types of steering, brakes and suspension systems of an automobile.

CO5 Adapt the new and alternative energy sources for the automotive systems.

Unit 1 VEHICLE STRUCTURE AND ENGINES L 9 T 0

Types of Automobiles ,Types of vehicle bodies & chasses ,basic layouts of automotive vehicles, specifications and performance parameters of vehicles. Autonomous vehicle.

Components of Engine – Functions and Materials - Review of Cooling and Lubrication systems in Engine – Turbo Chargers and supercharger . Engine Emission Control by 3–Way Catalytic Controller

Unit II ENGINE AUXILIARY SYSTEMS & ELECTRICAL SYSTEM L 9 T 0

Carburetor–working principle- Electronic fuel injection system – Mono-point and Multi - Point Injection Systems – Construction, Operation and Maintenance of Lead Acid Battery, Lithium Ion Battery. Electrical systems – Electronic engine management system Battery generator – Starting Motor and Drives – Lighting and Ignition (DTSI, Battery, Magneto Coil and Electronic Type)-Regulators-cut outs. Adaptive head light system

Unit III TRANSMISSION SYSTEMS AND AXLE TYPES L 9 T 0

Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Simple Floor Mounted Shift Mechanism – Over Drives – Transfer Box Fluid flywheel-Torque convertors– Propeller shaft – Slip Joint – Universal Joints – Differential and types of Rear Axle Types of Front Axle – Hotchkiss Drive and Torque Tube Drive.

Unit IV STEERING, BRAKES AND SUSPENSION SYSTEM L 9 T 0

Wheels and Tyres – Wheel Alignment Parameters - Steering Geometry and Types of steering gear box– Power Steering – Braking Systems – Types and Construction – Diagonal Braking System –Electronic Board Diagnostics (EBD) . Suspension systems. fluid and solid suspension systems- Adaptive suspension system.

Unit V ALTERNATIVE ENERGY SOURCES AND AUTOMOTIVE SAFETY, COMFORT SYSTEMS L 9 T 0

Hydrocarbon fuels, Natural Gas, LPG, Bio-gas, Biodiesel, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells. Safety systems and HVAC system, connected vehicle system- Vehicle ergonomics.

Total Number of hours: 45

Learning Resources

Text Books

1. Kirpal Singh "Automobile Engineering Vol. 1& 2", Standard Publishers, New Delhi.

2. Sethi H.M,"Automobile Technology", Tata McGraw-Hill-2013. ISBN-10: 0074603906, ISBN-13:9780074603901

References

1. William H. Crouse and Donald L. Anglin "Automotive Mechanics", 9th Edition. Tata McGraw-Hill, 2013.

2. Newton, Steeds and Garet, "Motor vehicles", Butterworth Publishers, 2007..

3. Srinivasan.S, "Automotive Mechanics" 4th edition, 2011, Tata McGraw-Hill.ISBN-13: 9780070494916.

4. Joseph Heitner, "Automotive Mechanics", 2nd edition, CBS publishers, 2006. ISBN-10: 8123908911.

5. Donald E. Malen, "Fundamentals of Automobile Body Structure Design", 1st edition, SAE international, 2011. ISBN-10: 0768021693.

Course Code	U15ME506R	L	T	P	C
Course Name	HEAT POWER LABORATORY	0	0	4	2

Pre-Requisite Subjects: 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.

LIST OF EXPERIMENTS **Total Hours 60**

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	1 No
2. Heat transfer through metal bar apparatus.	1 No
3. Heat transfer through Natural convection apparatus.	1 No
4. Heat transfer through Forced convection apparatus.	1 No
5. Heat Transfer through Pin-fin apparatus.	1 No
6. Heat transfer through Stefan- Boltzman constant apparatus.	1 No
7. Heat transfer through Emissivity apparatus.	1 No
8. Heat transfer through parallel/ Counter flow heat Exchanger.	1 No
9. Thermal conductivity of insulating powder.	1 No
10. Thermal conductivity of composite wall material	1 No

		L	T	P	C
Course Code	**U15ME507R**				
Course Name	**DYNAMICS LABORATORY**	0	0	4	2

Pre-Requisite Subjects: 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.

LIST OF EXPERIMENTS **Total Hours 60**

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, Epi-cyclic 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. Epicyclic Gear Train
6. Differential Gear Mechanism (Assembled)
7. Universal Governor
8. Cam Analysis Machine
9. Motorized Gyroscope
10. Whirling of shafts
11. Balancing of rotating masses Apparatus.
12. Balancing of reciprocating masses Apparatus.
13. Dynamics Balancing Machine
14. Moment of Inertia by Oscillation
15. Vibrating Table
16. Compound Pendulum
17. Transverse Vibration Apparatus

Course Code	**U15ME508R**	L	T	P	C
Course Name	**CAD and CAM LABORATORY**	0	0	4	2

Pre-requisites subject: Computer aided drafting laboratory, Manufacturing Technology

Course Outcomes

Upon completion of this course the students will be able to

CO1 Explain the capability Code of practice for Engineering Drawing BIS specifications – Welding symbols riveted joints keys and fasteners.

CO2 Construct the Orthographic views of standard machine components: Brackets V Blocks Stop Block Screw threads and Threaded fasteners.

CO3 Create 3D modeling of Flange coupling Plummer block bearing Universal Joint Machine vice and stuffing box, to understand turning and milling programs in CNC machines by using G & M Codes

Total Hours 60

LIST OF EXPERIMENTS

PART-A-CAD

1. **Drawing Standards**

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.

2. **Introduction to Drafting Software**

Drawing, Editing, Dimensioning and Plotting Commands-Layering concepts-Limits, Fits and Tolerances.

3. **Preparation of 2-D Drawings**

Orthographic views of standard machine components:
Brackets, V Blocks, Stop Block, Screw threads and Threaded fasteners.

4. **Assembly Drawing** (Preparation of assembled view)

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

LIST OF EQUIPMENTS

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

LIST OF SOFTWARE (FOR A BATCH OF 30 STUDENTS)

- Solid Works 2019 -100 users.

PART-B-CAM

1. CNC lathe introduction to basic programming & operations.
2. Part Programming facing, turning, thread cutting (Internal/External).
3. Part Programming for Grooving, Drilling and Boring operation (Internal/External).
4. Part programming using Canned Cycle operations.

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

1. CNC Lathe
2. 3D printer

List of software (for a batch of 30 students)

SolidWorks 2019 CNC in-build simulator.

Course Code **U15ME903R** **3 0 0 3**

Course Name **HEATING, VENTILATION AND AIR CONDITIONING**

Pre-requisites subject: Engineering Thermodynamics, Thermal Engineering and Heat and Mass Transfer

Course Outcomes

Upon completion of this course the students will 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 calculations for various buildings.

CO3 Create 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.

UNIT-1 INTRODUCTION & BASICS OF HVAC 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 L 9

Air conditioning systems - Window Air Conditioning Systems - Split Air Conditioning Systems - Central Air Conditioning Systems - Package Air Conditioning Systems- Variable Refrigerant flow (VRF) system- Chilled water system.

Total hours :45 Hrs

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

Reference Books

1. Edward G.Pita "Air conditioning Principles and systems", PHI learning Private Limited, Fourth edition, Reprint 2012.
2. 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.
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	U15ME904R	L	T	P	C
Course Name	PYTHON: PROGRAMMING AND PROBLEM SOLVING	3	0	0	3

Pre-requisites subject: C - Programming

Course Outcomes

Upon completion of this course the students will be able to

- **CO1** Develop code for simple programs in Python.
- **CO2** Apply operators, expressions and loops in Python programs.
- **CO3** Create functions, strings and lists using Python.
- **CO4** Construct tuples, sets and dictionaries in Python.
- **CO5** Develop graphics programming with turtle.

Unit I INTRODUCTION L 9

History of Python – Installing Python – Problem solving strategies – Problem analysis – Algorithms – Flow charts – Token – Core data type. Object oriented programming: Programming languages – Paradigms – Features – Merits and demerits - Writing simple programs in Python.

Unit II OPERATORS, EXPRESSIONS AND LOOP CONTROL L 9

Arithmetic operators – Translating mathematical formulae into equivalent Python expressions – Bitwise operator – Compound assignment operator. Loop control statements – while loop - for loop – nested loops – break and continue statement.

Unit III FUNCTIONS, STRINGS AND FILE HANDLING L 9

Syntax and basics of a function – Parameter and arguments – Local and global variables – Return statement – Recursive and lambda function. Strings – the str class – Traversing string – Immutable strings – String operators and operations – Files: Types of file – Opening and closing files – Reading and writing files – File positions.

Unit IV LISTS, TUPLES, SETS ANS DICTIONARIES L 9

Lists - Creating – Accessing – Slicing – Python inbuilt functions – List operator – Splitting a string in list. Creating Tuples – Inbuilt functions for Tuples – Indexing and slicing – Operations on Tuple. Creating Sets – Set in and not in operator – Python set class – Set operations – Dictionaries: need – basics – creating – formatting – deleting – comparing.

Unit V GRAPHICAL INTERFACE L 9

Turtle module – moving the turtle in any direction – location – Colors – Drawing basic shapes using iterations – Changing color dynamically using list – Creating bar chart.
GUI in python – root window – containers – canvas – frames and widgets – Creating tables.

Total Number of hours: 45

Learning Resources

Text Books

1. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, New Delhi, 2017.
2. Balagurusamy, E., "Introduction to Computing and Problem Solving Using Python", McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Books

1. Nageswara Rao, R., "Core Python Programming", dreamtech press, second edition, 2018.
2. Ashok Namdev Kamthane & Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, Chennai, 2018.
3. Wesley J. Chun, "Core Python Programming", Pearson, 2nd Edition, 2006.
4. Allen B.Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly Media, 2nd Edition, 2015.

Course Code: U15ME920R **L T P C**

Course Name: IOT for Manufacturing **3 0 0 3**

Course Outcomes

Upon completion of this course the students will be able to

CO1	Assess the physical and logical design of IoT.
CO2	Analyze the basic difference between M2M and IoT and knowledge of IoT components.
CO3	Identify the architecture and infrastructure of cloud computing
CO4	Describe Big Data Analytics, transform data and draw meaningful conclusions
CO5	Design and develop the automation system with enterprise, planning and product lifecycle

UNIT-I Introduction to IoT **L 9**

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, IoT Communication models, IoT communication APIs, Enabling Technologies, IoT levels & Deployment templates.

UNIT-II M2M&Components of IoT **L 9**

Machine to Machine, Difference between IoT and M2M, Sensors, Actuators, Communication modules - RFID, Bluetooth, WiFi, ZigBee.

UNIT-III Communication and Connectivity Technologies **L 9**

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

UNIT- IV Data Analytics and IoT Platforms **L 9**

Big Data Analytics, Big data technologies, Data Analysis process and types - Data Visualization, Data Visualization tools - IoT Platforms, Components of IoT platforms.

UNIT-V: - Industrial IOT **L 9**

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

Total: 45 Hrs.

Learning Resources

TEXTBOOKS

1.David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, —IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCES BOOKS

1.ArshdeepBahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015

2.Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).

3.Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.

4.Internet of Things with Arduino Cookbook, Packt Publications. Author(s): Marco Schwatrz

Semester –V	U15 GE 501R:SOFT SKILLS AND APTITUDE - III	L	T	P	C	Marks
		0	0	2	1	100

Course Outcomes

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

1. Demonstrate capabilities in supplementary areas of soft-skills and job-related selection processes using hands-on and/or case-study approaches
2. Solve problems of advanced levels than those in SSA-II in specified areas of quantitative aptitude and logical reasoning and score 70-75% marks in company-specific internal tests
3. Demonstrate greater than SSA-II level of verbal aptitude skills in English with regard to given topics and score 70-75% marks in company-specific internal tests

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 interview **h.** Mock GDs
2.Quantitative Aptitude and Logical Reasoning Topics	**Solving problems with reference to the following topics :** a. Numbers: Remainder concept b. Time and work: Fraction technique, Efficiency technique, Pipes and cisterns and Chain rule c. Simple interest d. Compound interest e. Set theory: Venn diagram f. Puzzles g. Mathematical operators h. Syllogism (≥4 Statements) i. Data sufficiency j. Statement and assumptions k. Statement and conclusions **l.** Company specific aptitude questions
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

Department of Placement Training

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VI under Regulations 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15ME601R	Finite Element Method	3	0	0	3
2	U15ME602R	Turbo machines	3	0	0	3
3	U15ME603R	Design of Transmission System	3	0	0	3
4	U15ME604R	Metrology and Measurements	3	0	0	3
5		**Professional Elective ***	3	0	0	3
6		**Open Elective ****	3	0	0	3
Practical						
7	U15GE601BR	Soft Skills and Aptitude-IV	0	0	2	1
8	U15ME605R	Computer Aided Analysis Laboratory	0	0	4	2
9	U15ME606R	Metrology and Measurements Laboratory	0	0	4	2
10	U15ME607R	Turbo Machines Laboratory	0	0	4	2
					Total Credits	**25**

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, Sixth Semester BE Mechanical Students and Staff, COE

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
***Professional Elective - NPTEL**						
1	noc21-cs45	Data Analytics with Python	3	0	0	3
2	noc21-cs20	Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3
3	noc21-me32	Introduction to Robotics	3	0	0	3

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
****Open Elective**						
1	U15CE1002R	Disaster Management	3	0	0	3
2	U15CE1003R	Energy Efficiency And Green Building	3	0	0	3
3	U15CE1004R	Municipal Solid Waste Management	3	0	0	3
4	U15CS1001R	Big Data Analytics	3	0	0	3
5	U15CS1002R	Cloud Computing	3	0	0	3
6	U15CS1003R	Internet Of Things	3	0	0	3
7	U15CS1004R-	Mobile Application Development	3	0	0	3
8	U15EE1006R	Renewable Energy Systems	3	0	0	3
9	U15IT1003R	Problem Solving Techniques Using Java Programming	3	0	0	3
10	U15IT1004R	Python Programming	3	0	0	3

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, Sixth Semester BE Mechanical Students and Staff, COE

		L	T	P	C
Course Code	**U15ME601R**				
Course Name	**FINITE ELEMENT METHOD**	**3**	**0**	**0**	**3**

Pre-requisites subject: Engineering Mathematics, Numerical Methods, Strength of Materials and Heat and mass transfer

Course Outcomes

Upon completion of this course the students will be able to

CO1 Discuss the fundamental concepts of classical method, discretization and application of Gaussian elimination.

CO2 Solve one dimensional problem for the elements such as bar and truss.

CO3 Analyze the two dimensional elements problems like scalar variable problems and vector variable problems.

CO4 Utilize the concepts of iso-parametric elements and numerical integration for real time applications

CO5 Apply the concept of finite element in heat transfer and fluid mechanics problems.

Unit I INTRODUCTION L 9 T 0

Historical background- mathematical modeling- Application to the continuum-Discretization - Matrix algebra - Gaussian elimination - Governing equations for continuum-Classical Techniques in FEM - Weighted residual method - Ritz method - engineering applications of FEA.

Unit II ONE DIMENSIONAL PROBLEMS L 9 T 0

Finite element modeling- Coordinates and shapes functions- Potential energy approach -Galarkin approach- Assembly of stiffness matrix and load vector- linear bar element - nodal approximation- development of shape functions- quadratic shape functions - element matrices and vectors- extension to plane truss- development of element equations – assembly- element connectivity -global equations- solution methods.

Unit III TWO DIMENSIONAL PROBLEMS L 9 T 0

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

Unit IV ISOPARAMETRIC ELEMENTS L 9 T 0

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

Unit V APPLICATIONS OF FEM IN HEAT TRANSFER & FLUID MECHANICS L 9 T 0

One dimensional heat transfer element – application to one-dimensional heat transfer problems and fluid mechanics problems- scalar variable problems in 2-Dimensions – application to two-dimensional heat transfer problems.

Total Number of hours: 45

Learning Resources

Text Books

1. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", Prentice-Hall of India, Eastern Economy Editions, 4th Edition, 2015, ISBN-13: 978-9332551824.
2. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition, 2005, ISBN: 9780070601222.

Reference Books

1. Logan D.L., "A First course in the Finite Element Method", Fourth Edition, Cengage Learning, 5th Edition, 2012, ISBN-13: 9788131517307.
2. Rao S.S., "The Finite Element Method in Engineering", Fourth Edition, Published by Elsevier, 5th Edition, 2010, Hardcover ISBN: 9781856176613, eBook ISBN: 9780080952048
3. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., NewDelhi, 2007. ISBN-978-203-2315-5.
4. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions, 2005, 3rd Edition, ISBN: 9780070607415.

Course Code	U15ME602R	L	T	P	C
Course Name	TURBOMACHINES	3	0	-	3

Pre-requisites subject: Engineering Physics and Fluid Mechanics

Course Outcomes

Upon completion of this course the students will be able to

CO1 Discuss the theory of turbo machine and the concept of energy equation of turbo machine.

CO2 Explain the classification, working and construction of velocity triangle and performances of hydraulic turbines.

CO3 Evaluate the performance of centrifugal pumps and explain the performance curves for pumps

CO4 Analyze the performance of steam turbines using velocity triangle.

CO5 Identify the methods of improving the efficiency of Gas turbines.

Unit I INTRODUCTION L 9 T 0

Fluid machines-Classification. Turbo machines - parts of turbo machines. Comparison between positive displacement machines and turbo machines. Types of turbo machines. Euler's energy transfer equation –components of energy transfer.

Unit II HYDRAULIC TURBINES L 9 T 0

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

Unit III PUMPS L 9 T 0

Centrifugal pumps – classification – working - Velocity triangle-work done- Efficiencies-Specific speed-Performance calculations. Priming, Cavitation. Comparison between positive displacement pumps and roto dynamic pumps.

Unit IV STEAM TURBINES L 9 T 0

Introduction. Classification-Impulse and Reaction. Compounding –need for compounding-methods of compounding. Velocity diagram - condition for maximum efficiency-degree of reaction .simple problems on single stage turbines and governing of turbines.

Unit V GAS TURBINES AND JET ENGINES L 9 T 0

Brayton cycle – open cycle and closed cycle. Methods of improving the efficiency of a simple cycle. Jet engine-construction and working of turbo jet engine, ram jet and pulse jet engine.

Total Number of hours: 45

Learning Resources

Text Books

1. B.K.Venkanna, "Fundamentals of Turbomachinery" PHL Learning Private Limited, 2014.
2. Yahya.S.M., 'Turbines, Compressores and Fans", Tata McGraw-Hill, 2010.

Reference Books

1. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.2010
2. Sukumar Pati., "Fluid Mechanics and Hydraulics Machines", Tata McGraw Hill publications (P) Ltd, New Delhi, 2012
3. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
4. Ganesan .V., "Gas Turbines", Tata McGraw-Hill, New Delhi, 2002.

Course Code	**U15ME603R**	**L**	**T**	**P**	**C**
Course Name	**DESIGN OF TRANSMISSION SYSTEMS**	**3**	**-**	**-**	**3**

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 also able to utilize the same to solve practical problems.

Unit I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS L 9 T 0

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 PARALLEL AXIS HELICAL GEARS L 9 T 0

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 0

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 0

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 0

Design of plate clutches – axial clutches - cone clutches - internal expanding rim clutches - internal and external shoe brakes.

Total Number of hours: 45

Learning Resources

Text Books

1. Bhandari V.B, "Design of Machine Elements", Tata McGraw-Hill Education, 2010.
2. Kurt M. Marshek; Robert C. Juvinall, "Fundamentals of Machine Component Design", 5th Edition, Wiley 2011.
3. Robert L Norton, "Machine Design - An Integrated Approach", Pearson Education, New Delhi, 2003.

Reference Books

1. Joseph E. Shigley, Charles R. Mischke and Charles R. Mischke"Mechanical Engineering Design", McGraw – Hill International Editions, 2003.
2. Prabhu, T.J., "Design of Transmission Elements", Prabhu publisher, 2003.
3. Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson.," Fundamentals of Machine Elements", CRC Press., 2013.
4. G.M. Maitra. and L.V. Prasad., "Hand book of Mechanical Design", McGraw-Hill Inc., US, New edition 1985.

Course Code	U15ME604R	L	T	P	C
Course Name	METROLOGY AND MEASUREMENTS	3	-	-	3

Pre-requisites subjects: Engineering Physics – Manufacturing Technology – I & II

Course Outcomes

Upon completion of this course the students will be able to

CO1	Explain fundamentals of General Measurement system and Errors in Measurement.
CO2	Discuss fundamentals of Linear and Angular Measurements and various devices used for measuring the different parameters.
CO3	Describe screw thread terminology, errors in threads, measurement of various elements of thread, Gear and their types, gear terminology, measurement of various elements of gears.
CO4	Analyze the working principle of various precision instruments based on laser, machine tool metrology and coordinate measuring machine.
CO5	Discuss the measurement of force, power, torque, flow and temperature.

Unit I CONCEPT OF MEASUREMENT L 9 T 0

Introduction to Metrology - General concept - Generalized measurement system - Units and standards - Types of standards - Measuring instruments- Sensitivity, readability, repeatability, range of accuracy, precision - Static and dynamic response – Systematic environment - Their effect on Precision and Accuracy and random errors - Correction, calibration, interchangeability.

Unit II LINEAR AND ANGULAR MEASUREMENT L 9 T 0

Linear measuring instruments - Vernier, micrometer, dial gauge, height gauge, depth gauge, slip gauges and classification, Interferometery, optical flats, limit gauges - Comparators: mechanical, pneumatic and electrical types, applications. Angular measurements - Sine bar, optical bevel protractor – Autocollimator - angle alignment telescope - applications.

Unit III FORM MEASUREMENT L 9 T 0

Principles and Methods of straightness - Flatness measurement - Thread measurement – floating carriage micrometer, gear measurement – gear tooth vernier, gear tester, surface finish measurement - Roundness measurement - Applications.

Unit IV ADVANCES IN METROLOGY L 9 T 0

Basic concept of laser advantages of laser in metrology - laser Interferometers – types - DC and AC Lasers interferometer - application in linear, angular measurements and machine tool metrology - Basic concept of Coordinate measuring machine (CMM) - Constructional features - types, applications - digital devices - computer aided inspection.

Unit V COMPUTER AIDED QUALITY CONTROL AND FMS L 9 T 0

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type – strain gauge, piezoelectric type sensors – load cell –pressure sensors – dynamometer – transducers - Flow measurement: Venturimeter, Orifice meter, rotameter, Pitot tube – special flow measurement - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration.

Total Number of hours: 45

Learning Resources

Text Books

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 2009
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 2001

Reference Books

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005
3. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000
4. Bewoor "Metrology & Measurement" Tata McGraw-Hill Education, 2009
5. Bucher and Jay L "The Metrology Handbook, Hardcover, 2012
6. Raghavendra and Krishnamurthy Engineering Metrology and Measurements, Paperback, 2013.

Course Code	**U15ME605R**	**L**	**T**	**P**	**C**
Course Name	**Computer Aided Analysis Laboratory**	**-**	**-**	**4**	**2**

Pre-requisites subject: Computer Aided Drafting Laboratory, Strength of material laboratory and Heat and mass transfer laboratory

Course Outcomes

Upon completion of this course the students will be able to

CO1 Analyze displacement, stress and strain of one dimensional and two dimensional element problems using analysis software.

CO2 Solve displacement, stress ,strain and temperature distribution of 2D components using analysis software

CO3 Develop a model, analyze and simulation of the real time problems using modeling and analysis software.

LIST OF EXPERIMENTS

Analysis:

1. Analysis of ID element such as bar, rod and truss
2. Analysis of beams (cantilever, simply supported and fixed beam)
3. Analysis of an axis-symmetric element
4. Mode frequency analysis of beams (cantilever, simply supported and fixed beam)
5. Heat transfer analysis of 2D components (conduction and convection)
6. Harmonic analysis of 2D components
7. CAD Modeling and analysis of crane hook
8. CAD modeling and analysis of heat sink ,heat exchanger and fin
9. CAD modeling and analysis of cell phone tower and electric tower
10. CAD modeling and static analysis of chassis frame

Simulation:

1. Simulation of Air conditioning system with condenser and evaporator temperatures as input to estimate COP
2. Simulation of cam and follower mechanism.
3. Simulation of Spring Mass Damper System Control
4. Simulation of heat exchanger process

LIST OF EQUIPMENTS:

60 systems (Intel core 2 quad E8200@2.33GHz,1033MHz FSB cache, 2GB RAM, 250GB HDD, 18.5" TFT Monitor)

LIST OF SOFTWARE (For a Batch of 30 Students)

(a) ANSYS 12.0

(b) MATLAB 7.0

Total Number of hours: 45

Course Code	**U15ME607R**	**L**	**T**	**P**	**C**
Course Name	**TURBO MACHINES LABORATORY**	**-**	**-**	**4**	**2**

Course Outcomes

Upon completion of this course the students will be able to

CO1 Analyze the performance of the various pumps and turbines (Pelton, Francis and Kaplan turbine).

CO2 Conducting performance test on centrifugal blower.

CO3 Discuss the Performance test on Turbo alternator plant.

Total Number of hours: 45

LIST OF EXPERIMENTS

1. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible pump
2. Conducting experiments and drawing the characteristic curves of Gear pump.
3. Conducting experiments and drawing the characteristic curves of Pelton wheel.
4. Performance Test on Steam Boiler.
5. Conducting experiments and drawing the characteristics curves of Francis turbine.
6. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
7. Performance test on centrifugal blower.
8. Performance test on Steam turbine.

List of Equipments (for a batch of 30 students)

1. Centrifugal pump/submersible pump setup
2. Gear pump setup
3. Pelton wheel turbine setup
4. Francis turbine setup
5. Kaplan turbine setup
6. Steam Turbine Test Rig
7. Centrifugal Blower Test Rig.
8. Revomax Boiler Model RXA-06.

Course Code U15ME606R L T P C

Course Name Metrology & Measurements Laboratory 0 0 4 2

Course outcomes

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

CO -1	Calibrate the Vernier, Micrometer and Dial Gauge; checking the dimensions of slip gauges and comparators; Measure the taper angle using sine bar / bevel protractor and Measurement of cutting tool parameters.
CO -2	Measuring straightness and flatness, Checking Profiles using projector and Floating carriage micrometer, Comparison of dimensional tolerances.
CO -3	Measurement of Force; Measuring of Gear Tooth Vernier. Demonstrate the LVDT/Wheatstone Bridge and Torque sensor.

Total Hours 45

LIST OF EXPERIMENTS

1. Calibration of Vernier, Micrometer and Dial Gauge
2. Checking Linear Dimensions of a part using slip gauges
3. Measurement of Taper Angle using sine bar / bevel protractor
4. Measurement of cutting tool parameters using tool makers microscope
5. Measurement of straightness and flatness using auto-collimator
6. Measurement of thread parameters using Profile projector and Floating carriage micrometer
7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Force using load cell / proving ring
10. Measurement of Gear tooth dimensions using Gear Tooth Vernier
11. Study of Displacement using Strain Gauge / LVDT / Wheatstone Bridge
12. Study of torque using torque sensor

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

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

Semester –VI	U15 GE 601B R: SOFT SKILLS AND APTITUDE – IV (For all Department 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. Crypto arithmetic problems b. Permutation & Combination c. Probability d. Clocks & Calendars e. Functions & polynomials f. Logarithm g. Geometry h. Puzzles i. Data interpretation j. Data Sufficiency k. Company specific aptitude questions (AMCAT & Co cubes)
a. 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 aptitude questions

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

U15ME1001R RAPID PROTOTYPING 3 0 0 3

Pre-requisites subjects:: Manufacturing Technology

COURSE OUTCOMES

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

CO1 Discuss the advantages and need of time compression in recent product development and explain the product development steps.

CO2 Classify Rapid prototyping techniques (RP) and explain the liquid based RP process like STL and direct metal laser sintering principles and also discuss its process parameters.

CO3 Explain the principle of working solid based RP process like fused deposition modeling and laminated object manufacturing

CO4 Discuss various powder based RP process like solid ground curing and 3D printer and its process parameters

CO5 Explain advanced rapid tooling like laser engineered net shaping and ballistic particle manufacturing and know the various software and STL file format for RP process and also discuss application of RP process in medical field.

UNIT – I INTRODUCTION 9

Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling

UNIT – II CLASSIFICATION OF RAPID PROTOTYPING 9

Classification of RP systems, Stereo lithography systems – Principle – process parameters – process details – machine details, Applications- Direct Metal Laser Sintering (DMLS) system – Principle – process parameters details.

UNIT – III FDM & LOM 9

Fusion Deposition Modelling – Principle – process parameters – process details – machine details, Applications – Laminated Object Manufacturing – Principle – process parameters – process details – machine details, Applications.

UNIT – IV SGC & 3DP 9

Solid Ground Curing – Principle – process parameters – process details – machine details, Applications. 3 – Dimensional printers – Principle – process parameters – process details – machine details, Applications, and other concept modelers like thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

UNIT – V LENS & Rapid Tooling 9

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) – Principle – Introduction to rapid tooling – direct and indirect method, software for RP – STL files, Magics, Mimics – Application of Rapid prototyping in Medical field.

Lecture: 45; Tutorial: 0; Total: 45

TEXT BOOKS:

Text Books:

1. Pham D.T. & Dimov.S.S., "Rapid manufacturing", Springer-Verlag, London, 2001.
2. Amitabha Ghosh, "Rapid Prototyping – A Brief Introduction", Affiliated East –West Press Private Limited, New Delhi, 2002

REFERENCES:

1. N.Hopkinson, R.J.M, Hauge, p m, dickens, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006
2. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying", Wiley, 2006
3. Paul F. Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals of Stereolithography", McGraw Hill 1993.
4. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003
5. Rafiq I. Noorani "Rapid Prototyping: Principles and Applications" John Wiley & Sons, 2005
6. Liou W L, Liou F W "Rapid Prototyping and Engineering applications: A tool box for prototype development" CRC Press,2005

Course Code	U15ME1002 R	L	T	P	C
Course Name	RENEWABLE ENERGY SOURCES	3	0	0	3

Pre-Requisite Subject: Power plant Engineering, 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.

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.

Course Code	**U15ME1003R**	**L**	**T**	**P**	**C**
Course Name	**INDUSTRIAL ROBOTICS**	**3**	**0**	**0**	**3**

Pre-requisite subject: Kinematics of machinery, Dynamics of machinery, Mechatronics system design and Applied hydraulics and pneumatics systems.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Classify various types of robot and discuss the kinematics of robot.

CO2 Analyze drives, controls and grippers for robot.

CO3 Compare proximity and range sensors and discuss various components involved in robotic vision system.

CO4 Summarize the industrial application of robots.

CO5 Write the robot programming and describe the use of Artificial Intelligence techniques.

Unit I INTRODUCTION AND ROBOT KINEMATICS L 9 T 0

Definition need and scope of industrial robots – Robot anatomy – Work volume – Precision movement – Classification of robots. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

Unit II ROBOT DRIVES AND CONTROL L 9 T 0

Controlling the robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and pneumatic drives – Linear and rotary actuators and control valves –Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

Unit III ROBOT SENSORS L 9 T 0

Transducers and sensors – Sensors in robots – Tactile sensors – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Grabbing – Image processing and analysis – Image segmentation – Pattern recognition – Training of vision system.

Unit IV ROBOT CELL DESIGN AND APPLICATION L 9 T 0

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.

Unit V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS L 9 T 0

Methods of robots programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – Problem representation in AI – Problem reduction and solution techniques – Application of artificial intelligence in robots.

Total Number of hours: 45

Learning Resources

Text Books:

1. Yoram Koren, "Robotics for Engineers" Mc Graw-Hill, 1987.
2. Mikell, P.Groover, Mitchell Weis, Roger, N.Nagel, Nicholas G.Odrey, " Industrial robotics Technology, Programming and applications" Mc Graw-Hill 2012

Reference Books:

1. K.S.Fu, R.C.Gonzalez and C.S.G lee, "Robotics control, Sensing, Vision and Intelligence" Mc Graw-Hill, 2008.
2. Kozyrey, Yu. "Industrial Robotics", MIR Publishers Moscow 1985.
3. Richard D, Klafter, Thomas A, Chmielewski, Micheal Negin, "Robotics Engineering – An integrated Approach", Prentice-Hall of India Pvt Ltd 1989.
4. Deb S.R, S.Deb, "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 2010
5. Timothy Jordanides et al, "Expert Systems and Robotics", Springer-Verlag, New York may 1991.
6. Ashitava Ghosal," Robotics fundamental concepts and Analysis," oxford university press, 11th compression 2015.
7. Ramachandran Nagarajan,"Introduction To Industrial Robotics", Pearson, 2016.
8. R.k.Rajput, "Robotics and Industrial Automation", S.Chand & Company Ltd., New Delhi, 2012.

Course Code	U15ME1004R	L	T	P	C
Course Name	INDUSTRIAL SAFETY	3	0	0	3

Pre-requisites subjects: nil

Course Outcomes

Upon completion of this course the students will be able to

- CO1 Summarize various legal provisions available in safety regulation.
- CO2 Analyze industrial environment hygiene and develop precautionary measure to avert occupational diseases.
- CO3 Demonstrate the uses of different grades of fire protection systems related with different classes of fire.
- CO4 Develop Agronomical study of different work environment in industries.
- CO5 Discuss the importance of safety training and its impact on shop floor of factories.

Unit I BASICS OF SAFETY ENGINEERING & ACTS L 9 T 0

Evolution of modern safety concept –safety performance monitoring. Acts – factories act – 1948 – Statutory authorities – inspecting staff – Tamilnadu Factories Rules 1950 under Safety and health – environment act – 1986 – Air act 1981, water act 1974 – other acts. Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process.

Unit II OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE L 9 T 0

(Basic concepts, related hazards and exposure limits)

Physical Hazards – Noise, heat, radiation, vibration, recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases. Biological and Ergonomical Hazards-Basic concepts. Occupational Health-Concept and spectrum of health – functional units and activities of occupational health services, pre-employment and post-employment medical examinations – occupational related diseases, levels of prevention of diseases, notifiable occupational diseases. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, Preliminary Hazard Analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

L 9 T 0

Unit III FIRE ENGINEERING AND EXPLOSIVE CONTROL

Fire properties of solid, liquid and gases – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – Principles of explosion – Explosion Protection – Electrical Safety. Electrical Hazards – Primary and Secondary hazards – concept of earthing – protection systems – fuses, circuit breakers and over load relays – first aid. cardiopulmonary resuscitation techniques

Unit IV ERGONOMICS L 9 T 0

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, modern ergonomics, and future directions for ergonomics. Anatomy, Posture and Body Mechanics: anatomy of the sprine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, effectiveness and cost effectiveness. Anthropometry and its uses in ergonomics, Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Ergonomics in IT industries.

Unit V SAFETY EDUCATION AND TRAINING L 9 T 0

Importance of training – identification of training needs – training methods – programmes, seminars, conferences, competitions –motivation – communication – role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety Training.

Total Number of hours: 45

Learning Resources

Text Books:

1. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982.

Reference books

1. The factories Act 1948, Madras Book Agency, Chennai, 2000.
2. Guidelines for Hazard Evaluation Procedures Centre for Chemical Process Safety, AICHE 1992.
3. Introduction to Ergonomics, R.S. Bridger, Taylor & Francis.
4. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.

U15ME1005R MAINTENANCE ENGINEERING 3 0 0 3

Pre-requisites subjects: Metrology and Measurement, Automobile Engineering

Course Outcomes

Upon completion of this course the students will be able to

CO1 Apply the basic principle of maintenance and practices the maintenance in organization and economics.

CO2 Discuss various maintenance polices and preventive maintenance.

CO3 Analyze the various aspects of condition monitoring and estimate on load and off load testing.

CO4 Evaluate various repair techniques and predict the fault locations.

CO5 Demonstrate various methods of repairing material handling equipment.

Unit I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING L 9 T 0

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

Unit II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE L 9 T 0

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repairs cycle - Principles and methods of lubrication – TPM.

Unit III CONDITION MONITORING L 9 T 0

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

Unit IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS L 9 T 0

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failureanalysis – Failures and their development – Logical fault location methods – Sequential fault location.

Unit V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT L 9 T 0

Repair methods for Material handling equipment - Equipment records – Job order systems –Use of computers in maintenance.

Total Number of hours: 45

Learning Resources

Text Books

1. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 2006.
2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995.

Reference Books

1. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
2. Mishra R.C. and Pathak K. “Maintenance Engineering and Management” Prentice Hall of India Pvt. Ltd. 2007.
3. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
4. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988.

Course Code	**U15ME1006R**	**L**	**T**	**P**	**C**
Course Name	**SUPPLY CHAIN MANAGEMENT**	**3**	**0**	**0**	**3**

Pre-requisites subjects: No prerequisites.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Explain the decision phases and apply competitive and supply chain strategies.

CO2 Summarize the drivers of supply chain performance.

CO3 Calculate the factors influencing network design.

CO4 Analyze the role of forecasting in a supply chain

CO5 Understand the role of aggregate planning, inventory, IT and coordination in a supply chain

Unit I Strategic Framework ,Drivers and Metrics L 9 T 0

Introduction to Supply Chain Management, Types, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope. Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

Unit II DESIGNING SUPPLY CHAIN NETWORK L 9 T 0

Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

Unit III FORECASTING IN SC L 9 T 0

Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

Unit IV AGGREGATE PLANNING AND INVENTORIES IN SC L 9 T 0

Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Determination of Optimal level of product availability.

Unit V COORDINATION IN SC L 9 T 0

Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect, Supplier relationship management.

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, 2010.
2. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2000.

Reference Books

1. Shari.P.B and Lassen.T.S, "Managing the global supply chain", Viva books, New Delhi, 2000.
2. Ayers.J.B, "Hand book of supply chain management", The St. Lencie press,2000.
3. Joel D. Wisner, Principles of Supply chain management, Cengage Learning, 2007
4. Monczka et al., Purchasing and Supply Chain Management, Cengage Learning,Second edition, Second Reprint, 2002.

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VII 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U15GE701R	Professional Ethics And Human Values	3	0	0	3	45
2	U15ME701R	Power Plant Engineering	3	0	0	3	45
3	U15ME702R	Mechatronics System Design	3	0	0	3	45
4	U15ME910R	Enterprise Resource Planning	3	0	0	3	45
	U15ME921R	Supply Chain Management and Analytics					
5	U15ME919R	Robotics and Industrial Automation	3	0	0	3	45
	U15ME922R	Manufacturing System Design					
6		***Open Elective	3	0	0	3	
Practical							
7	U15ME703R	Mechatronics and Simulation Laboratory	0	0	4	2	60
8	U15ME704R	Project Design	0	0	8	4	120
9	U15ME705R	In Plant Training	0	0	2	1	30
					Total Credits	**25**	

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VII 2015R (CBCS)
Branch: Mechanical Engineering
*****Open Elective**

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U15CE1002R	Disaster Management	3	0	0	3	45
2	U15CE1003R	Energy Efficiency and Green Building					
3	U15CS1004R	Mobile Application Development					
4	U15CS1005R	Object Oriented Programming and Data Structures					
5	U15EC1008R	Mobile Technology and its Applications					
6	U15EE1004R	Energy Conservation and Management					
7	U15EE1006R	Renewable Energy Systems					
8	U15EE1007R	Innovation, IPR and Entrepreneurship Development					
9	U15IT1003R	Problem Solving Techniques using Java Programming					
10	U15MC1002R	3D Printing Technology					

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

Course Code **U15GE701R** L T P C

Course Name **PROFESSIONAL ETHICS AND HUMAN VALUES** 3 0 0 3

Pre requisite subject: Nil

Course Outcomes

Upon completion of this course the students will be able to

CO1 Develop the core values that shape the ethical behavior of an engineer.

CO2 Apply Kohlberg Gilligan's theory in resolving moral Dilemmas.

CO3 Analyze role of engineer as an ethical experimenter in solving societal problems.

CO4 Create ways to reduce various risks in working environment.

CO5 Apply ethical principles in global technology development.

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

COs	**U15GE701R / PROFESSIONAL ETHICS AND HUMAN VALUES**													
	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	3	2	3	3	3	3	3	3	3
CO2	3	1	1	1	1	3	1	3	2	1	3	1	2	3
CO3	3	1	2	1	1	1	3	1	3	2	3	2	3	2
CO4	3	1	1	1	1	3	1	3	3	1	3	3	3	3
CO5	3	1	1	2	1	3	3	3	3	3	2	3	2	2

Unit I **HUMAN VALUES** L 9 T 0

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

Unit II **Engineering Ethics** L 9 T 0

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit III **Engineering as Social Experimentation** L 9 T 0

Engineering as Experimentation – Engineers as Responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit IV Engineer's Responsibility for Safety L 9 T 0

Safety and Risk – Assessment of Safety and Risk – Risk analysis-Reducing Risk – The Government Regulator's Approach to Risk - Case Studies -Chernobyl and Bhopal.

Responsibilities and Rights Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit V Global Issues L 9 T 0

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

Total Number of hours: 45

Learning Resources

Text Books

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", 4th edition McGraw Hill, New York, 2014.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.

Reference Books

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico,2014.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2014.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.

Course Code **U15ME701R** L T P C

Course Name **POWER PLANT ENGINEERING** 3 0 0 3

Pre-requisites subjects: Fluid mechanics and machinery, Thermodynamics & Thermal engineering.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Describe the working principle of steam power plant and its various components.

CO2 Discuss the various nuclear reactors and safety disposal nuclear wastes.

CO3 Discuss the performance of Diesel and Gas turbine power plants with merits and demerits.

CO4 Propose the various techniques involved in harvesting power from renewable energy.

CO5 Assess the cost of power generation and analyze the environmental issue of power plants

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

COs	**U15ME701R / POWER PLANT ENGINEERING**													
	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	2	1	3	1	3	3	3	3
CO2	3	3	3	3	3	3	1	1	2	1	3	1	2	3
CO3	3	3	3	3	3	1	3	1	3	1	3	2	3	3
CO4	3	3	3	3	3	3	1	1	3	1	3	3	3	3
CO5	3	3	3	3	3	3	3	1	3	1	2	3	2	2

Unit I STEAM POWER PLANT AND ITS COMPONENTS L 9 T 0

Layout of steam power plant -Fuel and Ash handling systems. Steam Boilers – High pressure and supercritical boilers – Fluidized bed boilers. Combustion equipment for burning coal – Mechanical stokers – Pulverizers. Electrostatic precipitator, Draught – different types, Surface condenser, Cooling towers.

Unit II NUCLEAR POWER PLANTS L 9 T 0

Nuclear energy – Fission and Fusion reaction - Layout of nuclear power plants - Types of reactors, pressurized water reactor - Boiling water reactor - Gas cooled reactor - Fast breeder reactor - Waste disposal and safety.

Unit III DIESEL AND GAS TURBINE POWER PLANTS L 9 T 0

Layout and types of Diesel power plants and components, selection of engine type, applications. Gas Turbine power plant – Layout - Analysis & Optimization of Brayton cycle - reheating, regeneration and inter cooling. Combined Cycle Power Plants

UNIT IV POWER FROM RENEWABLE ENERGY L 9 T 0

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines - Pumped Storage plant. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geothermal, Biogas.

Unit V POWER PLANT ECONOMICS ANDENVIRONMENTAL ISSUES L 9 T 0

Power tariff types, Load distribution parameters, load curve. Cost of electric energy-fixed and operating costs-energy rates. Comparison of site selection criteria, relative merits- demerits of power plants. Pollution control technologies for Coal and Nuclear Power Plants.

Total Number of hours: 45

Learning Resources

Text Books

1. El-Wakil M.M. 'Power Plant Technology' Mc-Graw Hill 2010.
2. Arora S.C. and Domkundwar.S, 'A Course in Power Plant Engineering', Dhanpatrai, 2013.
3. Nag P.K., 'Power Plant Engineering', Tata-McGraw Hill, 4th Edition, 2014.

Reference Books

1. R.K.Rajput,'Power Plant Engineering', Laxmi Publications, 2016.
2. G.D.Rai,'Introduction to Power Plant Technology", Khanna Publishers, 1995.
3. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

Course Code **U15ME702R** L T P C

Course Name **MECHATRONICS SYSTEM DESIGN** 3 0 0 3

Pre requisite: Electrical Derives and Control, Electronics and Micro Processors, Applied Hydraulics and Pneumatics

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

CO2 Identify different types of sensors for measuring flow, position, velocity and acceleration.

CO3 Design the hydraulic and pneumatic actuation for Mechatronics system.

CO4 Construct Ladder programming using Programming logic controller for the given application

CO5 Apply mechatronics system design process for industrial requirement.

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**U15ME702R /MECHATRONICS SYSTEM DESIGN**													
	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P0 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	3	3	3	1	3	1	1	1	3	3	3	3
CO2	3	3	3	3	3	1	3	1	1	1	2	1	2	3
CO3	3	3	2	3	2	1	3	1	1	1	3	2	3	3
CO4	3	3	3	3	3	1	3	1	1	2	2	3	3	3
CO5	3	3	3	3	2	1	3	1	1	1	2	3	2	2

Unit I **Introduction to Mechatronics and Sensors** L 9 T 0

Introduction to Mechatronics: definition and key issues – evolution – elements – mechatronics approach to modern engineering design. Introduction to Mechatronics system – Measurement systems – control systems and Microprocessor based controllers.

Introduction to Sensors: Performance terminology – Characteristics: Static & Dynamic, Selection of sensors.

Unit II **Transducers and Advanced sensor** L 9 T 0

Transducers: Linear and Rotational Sensors, Acceleration Sensors, Force Measurement, Torque and Power Measurement, Flow Measurement, Temperature Measurements.

Advanced sensors: RFID sensor-Sniff Sensor-Smart senor-types-Properties

Unit III Actuators and Control Actions L 9 T 0

Actuators: Hydraulic and Pneumatic Actuation Systems – Directional control valves- Solenoids, Mechanical Actuation systems – Cams- Gear Trains – Ratchet and pawl.

Control Actions : On – Off mode, Proportional mode, Derivative mode, Integral Mode, PI Mode, PD mode –PID Controllers.

Unit IV Programming Logic Controllers and Real time interfacing L 9 T 0

Programming Logic Controllers:

Relay logic, basic structure, input/output processing, timers, internal relays and counters, shift resisters, ladder diagram and programming, selection of a PLC problem, Applications.

Unit V Case Studies on Mechatronic System L 9 T 0

Introduction –Control of Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C. Motor& Solenoids – Engine management systems – Controlling temperature of a hot/cold reservoir using PID – Control of pick and place robot – Part identification and tracking using RFID.

Total Number of hours: 45

Learning Resources

Text Books

1. Bolton, N.,Mechatronics: A Multidisciplinary Approach, 4th edition, Pearson Education, 2013.
2. Nitaigour Premchand Mahalik., Mechatronics: Principles, Concepts and Applications, Tata Mc Graw Hill,2003

Reference Books

1. Patranabis D.,Sensor and Actuators, Prentice Hall of India (Pvt) Ltd., 2005.
2. Ernest O. Doeblin, Measurement system, Application and design, , Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004
3. Devdas shetty, Richard A. Kolk, "Mechatronics System Design", 2nd Edition, Cengage Learning 2011
4. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010
5. De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

Course code	**U15ME703R**	L T P C
Course Name	**MECHATRONICS AND SIMULATION LABORATORY**	0 0 4 2

Pre- requisite: Microprocessor lab, Electrical drives lab

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 and lab view in automation industry.

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

COs	**MECHATRONICS AND SIMULATION LABORATORY**													
	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	1	2	1	2	1	2	3	3	3
CO2	3	3	3	3	3	1	2	1	2	1	2	3	3	3
CO3	3	3	3	3	3	1	2	1	2	1	2	3	3	3

LIST OF EXPERIMENTS **Total Number of Hours: 60**

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 with logic sequence using Electro pneumatic trainer kits.
4. Simulation of basic Hydraulic, Pneumatic using software.
5. Design of circuits with Programmable logic sequence using Electro pneumatic trainer.
6. Servo controller interfacing for open loop and closed loop.
7. PID controller interfacing of DC motor 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. Data acquisition using NI Hardware's and LabVIEW

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 control - 1 No.
3. Fluid sim- hydro & pneumo Software - 2 sets
4. LabVIEW software - 10 sets
5. Data acquisition setup - 1 each
6. Data acquisition setup - 1 each

Course Code	**U15ME705R**	L T P C
Course Name	**IN-PLANT TRAINING**	0 0 2 1

Course Outcomes

Upon completion of this course the students will be able to

CO1 Experience the discipline of working in a professional engineering organization.

CO2 Develop the functional and organization of a business.

CO3 Interact with professional and non-professional groups.

CO4 Apply engineering techniques such as design and problem solving.

CO5 Develop technical, interpersonal and communication skills, both oral and written.

Total Number of hours: 30

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

COs	**IN-PLANT TRAINING**													
	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	2	2	1	2	1	2	3	3	3
CO2	3	3	3	3	3	1	2	2	2	1	2	3	3	3
CO3	3	3	3	3	3	2	2	1	2	1	2	3	3	3

Acceptable Areas of Industrial Training

1. Students may be employed in any capacity associated with the development, design and/or manufacture of products including production, quality control, chemical analysis, plant maintenance, design office duties or research in materials processing, materials engineering and materials characterization.
2. It is desirable that the student be assigned to some member of the technical staff in the plant who will give general guidance on the work to be undertaken. Whilst difficult, it is desirable to obtain experience in a range of activities including design, analysis, experimentation, production, and other on-site activities. It is important that students make the most of their Industrial Training by soliciting varied and challenging projects from the employer.
3. Students are allowed to undergo minimum of 2 weeks of industrial training between Semesters 6 and 7. The industry/organization is to be selected with the approval of the Department Consultative Committee.
4. A training report has to be submitted by each student group for his in-plant training.

Course Code	**U15ME704R**	L T P C
Course Name	**PROJECT DESIGN**	0 0 8 4

Course Outcomes

Upon completion of this course the students will be able to

CO1 Identify Problem, formulate survey literature and analyze engineering problems.

CO2 Design system component that acquires the needs for public health and environment consideration.

CO3 Ability to form team for carrying the project in multi-disciplinary settings and design documentation with effective presentation.

Total Number of hours: 120

CO / PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**IN-PLANT TRAINING**													
	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	2	2	2	2	1	2	3	3	3
CO2	3	3	3	3	3	2	2	2	2	1	2	3	3	3
CO3	3	3	3	3	3	2	2	2	2	1	2	3	3	3

1. The students are expected to get formed into a team of convenient groups of not more than 4 members on a project.
2. Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide has to be completed within the first two weeks from the day of beginning of 7th semester.
3. The group has to identify and select the problem to be addressed as their project work; make through literature survey and finalize a comprehensive aim and scope of their work to be done.
4. A project report has to be submitted by each student group for his project work.
5. Three reviews have to be conducted by a team of faculty (minimum of 3 and maximum of 5) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

Course Code **U15ME910R** L T P C

Course Name **ENTERPRISE RESOURCE PLANNING** 3 0 0 3

Pre-requisites subjects: 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

COs	ENTERPRISE RESOURCE PLANNING													
	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	2	2	3	2	2	3	3	3	3	3	3	3
CO2	3	3	3	2	2	1	3	2	3	2	3	2	3	3
CO3	3	2	2	3	3	2	2	2	2	3	2	2	3	3
CO4	2	3	1	2	2	3	2	3	2	2	2	2	3	3
CO5	2	3	3	3	3	2	2	1	2	3	3	3	3	3

Unit I INTRODUCTION L 9 T 0

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 T 0

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 T 0

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 T 0

Extended ERP systems and ERP add-ons, Customer Relationship Management, E- ERP and CRM integration, SCM, Business process Reengineering, Wireless Technology used in ERP, Business analytics & Intelligence, Future trends in ERP

Unit V ERP E-BUSINESS L 9 T 0

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, 2010.
2. Alexis Leon, "Enterprise Resource Planning", second edition, Tata McGraw Hill, Publishing Company Limited, New Delhi. 2008.

Reference Books

1. Marianne Bradford, Modern ERP Select, Implement & Use Today's Advanced Business System, North Carolina state university, 2014.
2. Alexis Leon, ERP Demystified" second edition, Tata McGraw Hill, Publishing Company Limited, New Delhi. 2008.
3. Daniel E. O'Leary, "Enterprise Resource Planning (ERP) Systems", Cambridge University Press, 2000.
4. Mary Summer, "Enterprise Resource Planning", Pearson Education, 2005.

Course Code U15ME919R L T P C

Course Name ROBOTICS AND INDUSTRIAL AUTOMATION 3 0 0 3

Pre-requisite subject: Kinematics of machinery, CAD/CAM, Design of transmission system and Applied hydraulics & pneumatics systems.

Course Outcomes

Upon completion of this course the students will be able to

CO1 Elaborate various robot configurations, end effectors and analyze the kinematics of robot.

CO2 Demonstrate hydraulic, pneumatic and electrical drives system in industrial robotics.

CO3 Construct different types of robot cell layout and elaborate industrial application of robot.

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

CO5 Recognize various material handling systems for automation and write robot program for some industrial automation system.

CO / PO, PSO Mapping

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

COs	**U15ME919 R / ROBOTICS AND INDUSTRIAL AUTOMATION**													
	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	1	2	3	2	3	2	3	2	3	3	1
CO2	2	3	3	3	3	1	1	2	1	1	3	1	2	3
CO3	3	2	3	3	3	2	3	1	3	2	1	2	3	2
CO4	3	2	3	1	3	1	1	3	3	1	1	3	3	3
CO5	2	3	3	2	3	2	3	1	3	3	2	3	2	2

Unit I INTRODUCTION AND ROBOT KINEMATICS L 9

Definition - Need and scope of Industrial robots – Types- robot configuration, Robot anatomy; Joints and links -Work volume – Precision movement – Classification of robots. Robot Kinematics – Direct and inverse kinematics- Problems–Coordinate transformation, Types of end effectors –Design of Grippers –Types- Tools as end effectors – The Robot/End effector interface.

Unit II ROBOT DRIVES AND CONTROL L 9

Introduction to robot drive system –Types- Controlling the robot motion –Feedback control-Problems on Position, velocity sensors– Design of drive systems – Hydraulic and pneumatic drives – Problems on Actuators and Motors-Applications. Control valves –Electro hydraulic servo valves, electric drives.

Unit III ROBOT CELL DESIGN AND APPLICATION L 9

Robot cell layouts –Types– Multiple Robots and machine interference- Problems – Other consideration in work cell design - work cell control - Problems based on robot cycle time analysis Design of robots for Industrial application – Material transfer, Spot welding, assembly, Inspection, Defence, medical and spray coating- Safety in robotics.

Unit IV INTRODUCTION TO AUTOMATION L 9

Introduction- Types of automation; Reasons for automating; Automation strategies. Integrated design issues in automation systems, the Mechatronics design process- benefits, Architecture of industrial automation system, building blocks of automation systems,

Programmable Automation: NC and CNC systems; Adaptive control systems. Flexible Manufacturing Systems (FMS): Processing stations; Computer control systems; FMS layout configurations - Basics of industry 4.0 and smart manufacturing.

Unit V ROBOT PROGRAMMING AND ARTIFICIAL INTELLIGENCE L 9

Methods of robots programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – Problem representation in AI – Problem reduction and solution techniques – Application of artificial intelligence in robots.

Total Number of hours: 45

Learning Resources

Text Books:

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

Reference Books:

1. Mikell, P.Groover "Automation, Production system and Computer Integrated Manufacturing, Pearson Education. Asia 2001
2. Richard D, Klafter, Thomas A, Chmielewski, MichealNegin, "Robotics Engineering – An integrated Approach", Prentice-Hall of India Pvt Ltd 1984.
3. Deb S.R, "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994
4. Khushdeep goyal & Deepak bhandari,"Industrial automation and robotics",S.K.Kataria & Christoph Jan Bartodziej "The Concept Industry 4.0: An Empirical Analysis of Technologies and application in production logistics" Springer gabler 2017

Course Code	**U15ME922R**	L	T	P	C	
Course Name	**MANUFACTURING SYSTEM DESIGN**	3	0	0	3	

Pre-requisites subject: Manufacturing Technology, Computer Aided design and Manufacturing

Course Outcomes

Upon completion of this course the students will be able to

CO1 Acumen the different plant layout design and implementation of capacity planning for manufacturing system.

CO2 Apply the various tools, techniques and methodology of demand forecasting to improve the efficiency of project management.

CO3 Apply the various tools, techniques and methodology of lean manufacturing to improve the efficiency of an organization.

CO4 Understand the various inventory and maintenance management techniques.

CO5 Explain the reliability concepts and identify the data requirements.

CO / PO, PSO Mapping

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

COs	**U15ME922R / MANUFACTURING SYSTEM DESIGN**													
	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P0 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2
CO1	2	3	2	3	3	2	1	1	2	3	2	1	2	3
CO2	2	3	2	3	3	2	1	1	2	3	2	1	3	3
CO3	2	3	2	3	3	2	1	1	2	3	2	2	3	3
CO4	2	3	2	3	3	2	1	1	2	3	2	2	3	3
CO5	2	3	2	3	3	2	1	1	2	3	2	2	3	3

Unit – I FACILITY, CAPACITY & LAYOUT PLANNING L 9 T 0

Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – event, Load distance model, closeness ratings. Types of plant layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

Unit – II DEMAND FORECASTING & PROJECT MANAGEMENT L 9 T 0

Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, numerical problems, Long term forecast methodologies. Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques, Analyzing cost-time trade-offs – Case study.

Unit – III LEAN MANUFACTURING L 9 T 0

Origin of lean production system – Customer focus – Muda (waste) – Standards – 5S system Total Productive Maintenance –Overall efficiency Kaizen - Jidoka concept – Poka-Yoke (mistake proofing) – Worker Involvement– Quality circle activity – Hoshin Planning System (systematic planning methodology) – Lean culture – APQP – SOP – PPAP – Factories of the future.

Unit – IV INVENTORY AND MAINTENANCE MANAGEMENT L 9 T 0

Introduction to EOQ models, Inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, Kanban, Zero inventory, Maintenance strategies and planning, economics: quantitative analysis, Replacement strategies and policies – economic service life, opportunity cost.

Unit – V RELIABILITY CONCEPTS L 9 T 0

Definition of reliability , Performance and reliability, Reliability requirements, System life cycle , Mean time between failures , Mean time to failure , Mortality Curve, Availability, Maintainability, Bathtub curve, Time dependent failure models, Distributions, Normal, Weibull, Lognormal, Life distribution measurements, Accelerated life tests and Data requirements for reliability.

Total Number of hours: 45

Learning Resources

Text Books

1. Mishra R C, "Reliability and Maintenance Engineering", New Age International, 2006.
2. Pannererselvam, R "Production and Operations Management", 3rd Edition, PHI, 2012.

Reference Books

1. Issa Bass and Barbara Lawton, "Lean Six Sigma using Sigma XL and Minitab", Tata McGraw Hill 2010.
2. Donna C. S. Summers, "Six sigma: Basic tools and techniques", Pearson / Prentice Hall 2007.
3. R. B. Chase, N. J. Aquilano, & F. R. Jacobs, "Operations Management – For Competitive Advantage", 11th Edition, SIE, TMH, 2007.
4. Kanishka Bedi, "Production and Operations Management", 2nd Edition, Oxford Higher Education, 2007.

Course Code **U15ME921R** L T P C

Course Name **SUPPLY CHAIN MANAGEMENT AND ANALYTICS** 3 0 0 3

Pre-requisites subjects: Manufacturing process.

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

COs	**U15ME921R / SUPPLY CHAIN MANAGEMENT AND ANALYTICS**													
	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	1	3	3	2	2	3	3	3	3	3	2	3
CO2	3	3	3	3	2	3	3	2	3	1	3	2	3	3
CO3	3	2	3	2	3	2	3	1	2	3	2	3	3	2
CO4	2	3	1	2	3	3	1	3	3	2	2	2	3	3
CO5	2	3	3	3	3	2	2	2	2	3	3	3	2	3

Unit I **SUPPLY CHAIN PLANNING** L 9 T 0

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 T 0

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 T 0

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 T 0

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 T 0

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, 2010.
2. N. Chandrasekaran, Supply Chain Management- Process, System and Practices, 1st Edition, Oxford, 2010.

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, 2000.
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
5. Monczka et al., Purchasing and Supply Chain Management, Cengage Learning, Second edition, Second Reprint, 2002.

COURSE CODE **U15ME1002R** L T P C

COURSE NAME **RENEWABLE ENERGY SOURCES** 3 - - 3

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

Course Outcomes

Upon completion of this course the students will be able to

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

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

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

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

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

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

Unit I **INTRODUCTION**

L 9 T 0

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

Unit II **SOLAR & BIO ENERGY**

L 9 T 0

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

Unit III GEO THERMAL AND HYDRO ENERGY SOURCES

L 9 T 0

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

Unit IV WIND AND TIDAL ENERGY

L 9 T 0

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

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

Unit V OTHER RENEWABLE ENERGY SOURCES

L 9 T 0

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

Total Number of hours: 45

Learning Resources

Text Books

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

Reference Books

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

COURSE CODE U15ME1004R L T P C

COURSE NAME INDUSTRIAL SAFETY 3 - - 3

Course Outcomes

Upon completion of this course the students will be able to

CO1 Summarize various legal provisions available in safety regulation.

CO2 Analyze industrial environment hygiene and develop precautionary measure to avert occupational diseases.

CO3 Demonstrate the uses of different grades of fire protection systems related with different classes of fire.

CO4 Develop Agronomical study of different work environment in industries.

CO5 Discuss the importance of safety training and its impact on shop floor of factories.

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

Unit I BASICS OF SAFETY ENGINEERING & ACTS

L 9 T 0

Evolution of modern safety concept –safety performance monitoring. Acts – factories act – 1948 – Statutory authorities – inspecting staff – Tamilnadu Factories Rules 1950 under Safety and health – environment act – 1986 – Air act 1981, water act 1974 – other acts. Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process.

Unit II OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

L 9 T 0

(Basic concepts, related hazards and exposure limits)

Physical Hazards – Noise, heat, radiation, vibration, recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases. Biological and Ergonomical Hazards-Basic concepts. Occupational Health-Concept and spectrum of health – functional units and activities of occupational health services, pre-employment and post-employment medical examinations – occupational related diseases, levels of prevention of diseases,

notifiable occupational diseases. Hazard assessment, rocedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, Preliminary Hazard Analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

Unit III FIRE ENGINEERING AND EXPLOSIVE CONTROL

L 9 T 0

Fire properties of solid, liquid and gases – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – Principles of explosion – Explosion Protection – Electrical Safety. Electrical Hazards – Primary and Secondary hazards – concept of earthing – protection systems – fuses, circuit breakers and over load relays – first aid cardiopulmonary resuscitation techniques.

Unit IV ERGONOMICS

L 9 T 0

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, modern ergonomics, and future directions for ergonomics. Anatomy, Posture and Body Mechanics: anatomy of the sprine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, effectiveness and cost effectiveness. Anthropometry and its uses in ergonomics, Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Ergonomics in IT industries.

Unit V SAFETY EDUCATION AND TRAINING

L 9 T 0

Importance of training – identification of training needs – training methods – programs, seminars, conferences, competitions –motivation – communication – role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety Training.

Total Number of hours: 45

Learning Resources

Text Books

1. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982.

Reference Books

1. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
2. Guidelines for Hazard Evaluation Procedures Centre for Chemical Process Safety, AICHE 1992.
3. The factories Act 1948, Madras Book Agency, Chennai, 2000.
4. Introduction to Ergonomics, R.S. Bridger, Taylor & Francis.

COURSE CODE U15ME1005R L T P C

COURSE NAME MAINTENANCE ENGINEERING 3 - - 3

Pre-requisites subjects: Metrology and Measurement, Automobile Engineering

Course Outcomes

Upon completion of this course the students will be able to

CO1 Apply the basic principle of maintenance and practices the maintenance in organization and economics.

CO2 Discuss various maintenance polices and preventive maintenance.

CO3 Analyze the various aspects of condition monitoring and estimate on load and off load testing.

CO4 Evaluate various repair techniques and predict the fault locations.

CO5 Demonstrate various methods of repairing material handling equipment.

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

Unit I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING L 9 T 0

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

Unit II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE L 9 T 0

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repairs cycle - Principles and methods of lubrication – TPM.

Unit III CONDITION MONITORING L 9 T 0

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

Unit IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS L 9 T 0

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis

– Failures and their development – Logical fault location methods – Sequential fault location.

Unit V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT L 9 T 0

Repair methods for Material handling equipment - Equipment records – Job order systems –Use of computers in maintenance.

Total Number of hours: 45

Learning Resources

Text Books

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 2006.
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995.

Reference Books

1. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
2. Mishra R.C. and Pathak K. "Maintenance Engineering and Management" Prentice Hall of India Pvt. Ltd. 2007.
3. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
4. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.

COURSE CODE U15ME1010R L T P C

COURSE NAME 3D PRINTING 3 - - 3

Prerequisites- subject: CAD / CAM & Engineering Materials.

Course Outcomes

Upon completion of this course the students will be able to

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

CO2 Familiarize the various Liquid based additive manufacturing technologies.

CO3 Explain the different Solid based additive manufacturing technologies.

CO4 Discuss the different Powder based additive manufacturing technologies.

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

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

Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	2	3	3	3	3	1	3	3	2	3	1	1	2
CO – 2	2	3	1	1	3	1	3	1	2	1	3	1	2	3
CO – 3	2	3	1	1	3	2	3	1	1	3	3	1	2	3
CO – 4	2	2	2	2	3	3	3	1	2	2	3	3	2	3
CO - 5	3	1	3	3	3	3	2	1	3	3	2	3	3	2

Unit I INTRODUCTION

L 9 T 0

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

Unit II LIQUID BASED SYSTEMS

L 9 T 0

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

Unit III SOLID BASED SYSTEMS

L 9 T 0

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

Unit IV POWDER BASED SYSTEMS

L 9 T 0

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

Unit V TOOLING, APPLICATIONS AND FUTURE DIRECTIONS OF 3D PRINTING

L 9 T 0

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

Total Number of hours: 45

Learning Resources

Text Books

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

Reference Books

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

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VIII 2015R (CBCS)
Branch: Mechanical Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	U15ME801R	Project Work	0	0	24	12	360
					Total Credits	**12**	

Approved By

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