SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

B.E-Mechatronics 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: Mechatronics

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: Mechatronics

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	U15PHY203FR	Physics For Mechatronics Engineering	3	0	0	3	BS
4	U15CHE205ER	Chemistry For Mechatronics Engineering	3	0	0	3	BS
5	U15MEA206R	Basic Mechanical and Electrical Engineering	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/ Mechatronics & HOD-Mechatronics** Dr. P. Suresh	**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: Mechatronics Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT301DR	Transforms and Boundary Value Problems	3	2	0	4
2	U15MC301R	Fluid Mechanics and Machinery	3	0	0	3
3	U15MC302	Strength of Materials	3	0	0	3
4	U15MC303R	Manufacturing Technology	3	0	0	3
5	U15MC304R	Electrical Machines and Drives	3	0	0	3
6	U15MC305R	Electron Devices and Circuits	3	0	0	3
Practical						
7	U15MC306R	Fluid Mechanics and Strength of Materials Laboratory	0	0	4	2
8	U15MC307R	Electron Devices and Circuits Laboratory	0	0	2	1
9	U15MC308R	Electrical Machines and Drives Laboratory	0	0	4	2
10	U15GE301R	Soft Skill and Aptitude – I	0	0	2	1
					Total Credits	**25**

Approved By

Chairman, Mechatronics Engineernig BoS
Dr.P.Suresh

Member Secretary, Academic Council
Dr.R.Shivakumar

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

Copy to:-
HOD/Mechatronics Engineering, Third Semester BE MCT 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: Mechatronics Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT401DR	Statistics and Numerical Methods	3	2	0	4
2	U15CHE405R	Environmental science and Engineering	3	0	0	3
3	U15MC401R	Applied hydraulics and pneumatics	3	0	0	3
4	U15MC402R	Theory of machines	3	0	0	3
5	U15MC403R	Sensors and Instrumentation	3	0	0	3
6	U15MC404R	Microprocessors and microcontrollers	3	0	0	3
Practical						
7	U15MC405R	Hydraulics and pneumatics Laboratory	0	0	4	2
8	U15MC406R	Sensors and Instrumentation Laboratory	0	0	2	1
9	U15MC407R	Microprocessors and Microcontroller Laboratory	0	0	4	2
10	U15GE401R	Soft Skills and Aptitude – II	0	0	2	1
					Total Credits	**25**

Approved By

Chairperson, Mechatronics Engineering, BoS
Dr.P.Suresh

Member Secretary, Academic Council
Dr.R.Shivakumar

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

Copy to:-
HOD/ Mechatronics Engineering, Fourth Semester BE MCT 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: Mechatronics Engineering

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit
Theory							
1	U15MC501R	Computer Aided Design and Manufacturing		3	0	2	4
2	U15MC502R	Thermodynamics and Heat Transfer		3	0	0	3
3	U15CS508R	Object Oriented Programming and Data Structures		3	0	0	3
4	U15MC503R	Embedded Systems and Internet of Things		3	0	0	3
5	U15MC504R	Industrial Automation		3	0	0	3
6	U15MC901R	**Professional Elective-1**	Control Systems	3	0	0	3
	U15MC902R		Industrial Drives				
	U15MC903R		Additive Manufacturing				
Practical							
7	U15MC505R	Embedded Systems and Internet of Things Laboratory		0	0	4	2
8	U15MC506R	Industrial Automation Laboratory		0	0	4	2
9	U15MC507R	Mini Project-I		0	0	2	1
10	U15GE501R	Soft Skills and Aptitude – III		0	0	2	1
						Total Credits	**25**

Approved By

Chairperson, Fashion Technology BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/ Mechatronics Engineering, Fifth Semester BE MCT 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: Mechatronics Engineering

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit
Theory							
1	U15MC601R	Python programming		3	0	0	3
2	U15MC602R	Power Electronics		3	0	2	4
3	U15MC603R	Automotive Electronics		3	0	0	3
4	U15MC604R	Artificial Intelligence		3	0	0	3
5	noc21-me55	**Professional Elective: (NPTEL)**	Principles of Mechanical Measurement	3	0	0	3
	noc21-ee05		Control Engineering				
6	U15CE1004R	**Open Elective**	Municipal Solid Waste Management	3	0	0	3
	U15EE1001R		Electric Mobility				
	U15EE1006R		Renewable Energy Systems				
	U15FT1001R		Fundamentals of Fashion Design				
	U15IT1003R		Problem solving Techniques Using Java Programming				
	U15IT1005R		Introduction to Database Technology				
	U15ME1002R		Renewable Energy Sources				
	U15ME1004R		Industrial Safety				

Practical						
7	U15MC605R	Python Programming Laboratory	0	0	4	2
8	U15ENG601R	Communication Skills Laboratory	0	0	2	1
9	U15MC606R	Mini Project-II	0	0	2	1
10	U15GE601BR	Soft Skill and Aptitude – IV	0	0	2	1
					Total Credits	24

Approved By

Chairperson, Mechatronics Engineering BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/ Mechatronics Engineering, Sixth Semester BE MCT 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: Mechatronics 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	U15MC701R	Robotics		3	0	0	3	45
3	U15MC702R	Micro Electro Mechanical Systems		3	0	0	3	45
4	U15MC904R	**Elective**	Image Processing and Computer vision	3	0	0	3	45
5	U15MC905R	**Elective**	Industrial Engineering	3	0	0	3	45
	U15MC906R		Total quality management					
6	U15CS1004R	**Open Elective**	Mobile Application Development	3	0	0	3	45
	U15EC1008R		Mobile Technology and its Applications					
	U15EE1004R		Energy Conservation and Management					
	U15EE1006R		Renewable Energy Systems					
	U15EE1007R		Innovation, IPR and Entrepreneurship Development					
	U15IT1003R		Problem Solving Techniques Using Java Programming					
	U15ME1004R		Industrial Safety					
	U15ME1005R		Maintenance Engineering					
	U15ME1010R		3D Printing					

Practical							
7	U15MC703R	Robotics Laboratory	0	0	4	2	60
8	U15MC704R	Image Processing Laboratory	0	0	3	1.5	45
9	U15MC705R	Technical Seminar	0	0	3	1.5	45
					Total Credits	**23**	

Approved By

Chairperson, Mechatronics Engineering BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/ Mechatronics Engineering, Seventh Semester BE MCT 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: Mechatronics Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	U15MC801R	Project Work	0	0	24	12	360
					Total Credits	**12**	

Approved By

Chairperson, Fashion Technology BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/ Mechatronics Engineering, Eighth Semester BE MCT 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: Mechatronics

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

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: Mechatronics

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	U15PHY203FR	Physics For Mechatronics Engineering	3	0	0	3	BS
4	U15CHE205ER	Chemistry For Mechatronics Engineering	3	0	0	3	BS
5	U15MEA206R	Basic Mechanical and Electrical Engineering	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/ Mechatronics & HOD-Mechatronics** Dr. P. Suresh	**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.

TEXT BOOK

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

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.

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.

U15PHY203FR - PHYSICS FOR MECHATRONICS 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. calculate electrical and thermal conductivity of conducting materials.
2. classify semiconductors and analyze the variation of Fermi level with temperature and examine the nature of charge carriers.
3. compare the types of magnetic materials and explain the applications of superconducting materials.
4. compare the different modes of heat transfer and apply the thermodynamic processes and laws to compute the efficiency of heat engines.
5. describe the significance of new engineering materials and their applications.

UNIT I – CONDUCTING MATERIALS 9

Conductors-classical free electron theory of metals-Electrical and thermal conductivity-Wiedemann-Franz law-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 II – SEMICONDUCTOR PHYSICS 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 III – MAGNETIC AND SUPERCONDUCTING MATERIALS **9**

Origin of magnetic moment – Bohr magneton – Dia, para and ferromagnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials – Ferrites – applications – Magnetic hard disc.

Superconductivity-Properties - Types of superconductor – BCS theory of superconductivity (Qualitative) - High Tc superconductors – Applications of superconductors: SQUID, cryotron, magnetic levitation in trains.

UNIT IV – 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 Carnot'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 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

Nano science and Nanotechnology – significance of the nano scale - 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 Mechatronics Engineering , Sonaversity, Sona College of Technology, Salem (Revised edition, 2017).

2. V. Rajendran and A. Marikani, 'Materials science' TMH Publications, New Delhi, 2004.

3. N. Subramaniam, Brijlal, ' Heat and Thermodynamics', S. Chand Group, New Delhi, 2007(Unit II).

4. N. Subramaniam, Brijlal, ' Properties of Matter', S. Chand Group, New Delhi, 2007 (Unit I).

U15CHE205ER - CHEMISTRY FOR MECHATRONICS 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,

- describe the chemistry of engineering materials and their industrial applications.
- discuss the chemistry of fuels and combustion.
- explain the industrial importance of phase rule and alloys.
- outline the principle and processes of metallurgy and powder metallurgy.
- describe the chemistry of organic electronic materials and electrochemical processes.

UNIT I – 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.

Polymers – Introduction and Nomenclature of Polymers – Types of Polymerization-Addition-Condensation and Copolymerization – Conducting polymers.

UNIT II – 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 III – 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 IV – 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.

UNIT V – CHEMISTRY OF ORGANIC ELECTRONIC MATERIALS AND ELECTROCHEMICAL PROCESSES **9**

Organo Electronics - Organic Semiconducting Materials – Working Principle and Advantages over Inorganic Semiconducting Materials - P-Type and N-Type Organic Semiconducting Materials - Pentacene Fullerenes- C-60 – Organic dielectric materials - definition and examples-Organic Light Emitting Diodes (Oleds) - Construction-Working Principle and Applications – Organic Transistors- Construction-Working Principle and Applications in Electronic Industries.

Electrochemical processes - Plating Techniques – Electro plating and electroless plating of nickel – Fabrication of PCBs – Electrochemical etching of copper from PCB.

Total : 45 Hours

TEXT BOOKS

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

REFERENCE BOOKS

1. T. Maruthavanan et al., “Chemistry For Mechatronics Engineering” Sonaver sity, Sona College of Technology, Salem, 2019 Edition.
2. Gowariker V.R. , Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006
3. B.K. Sharma, “Engineering Chemistry”, Krishna Prakasan Media (P) Ltd., Meerut (2001).
4. N. Krishnamurthy, K. Jeyasubramanian and P. Vallinayagam, “Applied Chem istry”, Tata McGraw-Hill Publishing Company Limited, New Delhi (1999).

U15MEA206R - BASIC MECHANICAL AND ELECTRICAL 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. describe the essential features and working principles of conventional power plants and pumping system.
2. state the working principle of petrol and diesel ic engines
3. explain the working of refrigerators and air conditioning systems.
4. state the fundamental laws of electrical circuits and explain the basic principles related to dc and ac electrical circuits
5. explain the constructional features and principles of operation of dc and ac motors

UNIT I – POWER PLANT ENGINEERING 9

Introduction, Classification of Power Plant -Working principle of steam, Gas, Diesel, Hydro -Electric and Nuclear Power plants –Merits and Demerits -Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) –Centrifugal Pump. Concept of IoT in Power plant.

UNIT II – INTERNAL COMBUSTION ENGINES 9

Internal combustion engines as automobile power plant –Working principle of Petrol and Diesel Engines Four stroke and two stroke cycles Comparison of four stroke and two stroke engines. Concept of IoT in automobile.

UNIT III – REFRIGERATION AND AIR CONDITIONING 9

Terminology of refrigeration and air conditioning; Principle of vapour compression and absorption system-Layout of typical domestic refrigerator -window and split type room air conditioner. Concept of IoT in room air conditioning system.

UNIT III – DC AND AC CIRCUITS 9

DC Circuits: Ohm's law, Kirchhoff's laws, Series and Parallel circuits, Star – Delta transformation – Simple Problems.

AC Circuits: AC waveform standard terminologies, Single phase RL, RC, RLC series circuits – Simple Problems. Introduction to three phase circuits.

UNIT IV – DC AND AC MOTORS **9**

DC Generator: construction of DC Machine –working principle of DC Generator – EMF equation – Types of DC Generator –DC Motor: Working principle of DC Motor –Types of DC Motor – Transformer: Working principle of Transformer – EMF equation –Transformation ratio.

Total: 45 Hours

TEXT BOOKS

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. V.K. Mehta and Rohit Mehta, "Principles of Electrical Engineering and Electronics", S. Chand publishers, 2011.
4. S.K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson publishers, 2012.

REFERENCE BOOKS

1. S.R.J. Shantha Kumar, "Basic Mechanical Engineering", 2nd Edition, Hi-Tech Publications, 2000.
2. P.K.Nag, "Power Plant Engineering" 3rd Edition, Tata McGraw-Hill Education, 2002.
3. Sudhakar A and Shyam Mohan SP, Circuits and Network Analysis and Synthesis", Tata Mc Graw Hill 2007.
4. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill 2002.
5. A.K. Sawhney, "A Course in Electrical & Electronic Measurements &Instrumentation", Dhanpat Rai and Co 2004.
6. B.L. Theraja, "Fundamentals of Electrical Engineering and Electronics", S. Chand publishers, 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: Mechatronics Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT301DR	Transforms and Boundary Value Problems	3	2	0	4
2	U15MC301R	Fluid Mechanics and Machinery	3	0	0	3
3	U15MC302	Strength of Materials	3	0	0	3
4	U15MC303R	Manufacturing Technology	3	0	0	3
5	U15MC304R	Electrical Machines and Drives	3	0	0	3
6	U15MC305R	Electron Devices and Circuits	3	0	0	3
Practical						
7	U15MC306R	Fluid Mechanics and Strength of Materials Laboratory	0	0	4	2
8	U15MC307R	Electron Devices and Circuits Laboratory	0	0	2	1
9	U15MC308R	Electrical Machines and Drives Laboratory	0	0	4	2
10	U15GE301R	Soft Skill and Aptitude – I	0	0	2	1
					Total Credits	**25**

Approved By

Chairman, Mechatronics Engineernig BoS
Dr.P.Suresh

Member Secretary, Academic Council
Dr.R.Shivakumar

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

Copy to:-
HOD/Mechatronics Engineering, Third Semester BE MCT Students and Staff, COE

U15MAT301DR	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	L	T	P	C
		3	2	0	4

Course Outcomes

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

CO1:	Describe the general form of Fourier series, expand the periodic functions in terms of Fourier coefficients and find the complex form and harmonics of Fourier series.
CO2:	Describe the complex (or infinite) Fourier transform pairs, sine and cosine transform pairs and their properties and state convolution theorem and solve the problems related to Parseval's identity.
CO3:	Form the partial differential equations, solve first order linear andnon linear partial differential equations of certain type, solve homogeneous and non homogeneous linear partial differential equations with constant coefficients of higher order.
CO4:	Classify the second order partial differential equations and solve boundary value problems in linear hyperbolic and elliptic partial differential equations.
CO5:	Solve the boundary value problems in ordinary differential equations and partial differential equations by various finite difference approximations.

Pre-requisite

1. Vector Calculus, Differential Equations and Complex Analysis

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO 1	PSO2
CO1	3	3	2	3							3	2	3	3
CO2	3	3	2	3							3	2	3	3
CO3	3	3	2	3							3	2	3	3
CO4	3	3	2	3							3	2	3	3
CO5	3	3	2	3							3	2	3	3

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01:Fourier Series	**09+6 Hours**

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 02:Fourier Transforms	**09+6 Hours**

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

Unit 03:Partial Differential Equations	**09+6 Hours**

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 04:Boundary value problems	**09+6 Hours**
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 05:Numerical solutions to boundary value problems in Ordinary and Partial Differential Equations	**09+6 Hours**
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	

Theory: 45Hrs	**Tutorial: 30 Hrs**	**Total Hours: 75 Hrs**

Text Books

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

Extensive Reading

REFERENCES

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.

U15MC301R	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Apply mathematical knowledge to predict the properties and characteristics of a fluid.
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 describe the importance of dimensional analysis by using Buckingham's ∏ theorem.
CO4:	Discuss the theory of turbo machines and their classification and analyze the performances of the hydraulic turbines.
CO5:	Explain the working principle of centrifugal pumps & reciprocating pumps and analyze their performances.

Pre-requisite

1. Engineering Physics and
2. Transforms & Partial differential equations

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct			Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)		Course end survey

Unit 01:FLUID PROPERTIES AND FLOW CHARACTERISTICS — **09 Hours**

Units & Dimensions. Properties of fluids – mass density, specific weight, specific volume, viscosity, capillarity and surface tension, compressibility, vapor pressure and cavitation. Types of fluid flow-application of continuity equation, Euler's equation along streamline, Bernoulli's equation and its applications- Orifice meter, Venturi meter.

Unit 02:FLOW THROUGH PIPES — **09 Hours**

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

Unit 03: DIMENSIONAL ANALYSIS	**09 Hours**
Need for dimensional analysis – methods of dimensional analysis – Buckingham's ∏ theorem, Dimensionless parameters- application of dimensionless parameters. Models and Similitude.	
Unit 04:HYDRAULIC TURBINES	**09 Hours**
Turbines: definition and classification – impulse and reaction. Construction of velocity diagrams. Pelton turbine - Francis turbine -Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies and performance calculations.	
Unit 05:HYDRAULIC PUMPS	**09 Hours**
Pumps: Definition and classifications. Centrifugal pump- working principle, velocity triangles, head and efficiencies, performance calculations. Reciprocating pump – classification, working principle- performance calculations, function of air vessel. Comparison of pumps. Rotary pumps working principles of gear and vane pumps	

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

Text Books

1. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, (9th edition), Laxmi publications (P) Ltd, New Delhi, 2015

REFERENCES

1. Sukumar Pati., "Fluid Mechanics and Hydraulics Machines", Tata McGraw Hill publications (P) Ltd, New Delhi, 2012.
2. C.S.P.Ojha, R.Berndtsson, P.N.Chandramouli., Fluid Mechanics and Machinery, Oxford University Press, New Delhi, 2010.
3. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2004
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
5. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2004
6. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2011

U15MC302R	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Analyse the state of stresses and strains in engineering components as a result of different loading conditions in the machine members and structures.
CO2:	Investigate the effect of various loading combinations by determining the principal stresses, principal planes and maximum shear stress u on machine and structural parts using Mohr's circle.
CO3:	Applythe principles and equations, necessary tools to analyze structural members under axial loads, bending, shear, and torsion.
CO4:	Evaluate the material behaviour under pure torsion on circular shafts.
CO5:	Design the structural beams, columns, long mechanical members under compression and different loading condition.

Pre-requisite

1.Engineering Mechanics

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6)	Seminar (5)	Course end survey
Internal test II (6)	Moodle (7)	
Internal test III (6)	Attendance (5)	
Assignment (5)	End semester Examination (60)	

Unit 01:Stress, Strain and Deformation of Solids — **09 Hours**

Simple stress and strain – Stresses and strains due to axial force - Mechanical properties of materials – Stress-strain curve –- Hooke's law - Factor of safety – Stepped shafts – Uniformly varying sections – Stresses in composite sections - Temperature stresses – Poisson's ratio - shear modulus, bulk modulus, relationship between elastic constants.

Unit 02:Analysis of Stresses in Two Dimensions — **09 Hours**

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 03: Beams - Loads and Stresses	**09 Hours**
Beams – types of supports – simple and fixed, types of load – concentrated, uniformly distributed, varying distributed load, combination of above loading – relationship between bending moment and shear force – bending moment, shear force diagram for simply supported, cantilever and over hanging beams – Point of contra flexure. Introduction to Theory of simple bending.	
Unit 04:Torsion in Shafts and springs	**09 Hours**
Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts 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 05:columnsand Deflection of Beams	**09 Hours**
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 Deflection of beams – double integration method – Macaulay's method – slope and deflection using moment area method.	

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

Text Books

1. R K Bansal, "A text book of Strength of Materials", Lakshmi Publications (P) Limited, New Delhi, 2007.
2. R K Rajput, "Strength of Materials", S Chand & Co., New Delhi, 2006.

REFERENCES

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.
6. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.

U15MC303R	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Elaborate the sand casting, pattern materials and welding, different welding processes.
CO2:	Describe the various bulk deformation processes, different sheet metal operations and shaping of plastics using different moulding methods.
CO3:	Identify the cutting tool materials and its specific purpose and explain about lathe details, main dissimilarity of capstan and turret lathes.
CO4:	Illustrate the principle of reciprocating machine tools.
CO5:	Explain the working principle of milling and grinding processes.

Pre-requisite

1.Engineering Physics – I

2. Engineering practice laboratory

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6)	Seminar (5)	Course end survey
Internal test II (6)	Moodle (7)	
Internal test III (6)	Attendance (5)	
Assignment (5)	End semester Examination (60)	

Unit 01:METAL CASTING AND METAL JOINING PROCESS — **09 Hours**

Sand Casting- Moulding Tools- Types of Patterns- Pattern Materials- Moulding Sand- Properties- Melting Furnaces: Cupola, Crucible and Electric arc furnace- Special Casting Process: Shell, Investment Casting - Lost Wax Process- Gas welding- Arc welding -TIG welding- MIG welding-Resistant welding.

Unit 02:SHEET METAL AND PLASTIC COMPONENTS — **09 Hours**

Drawing Process: Wire drawing, Tube drawing, Metal Spinning, Rolling: Type of rolling mills- Extrusion:- Principles of Extrusion – Types – Hot and Cold extrusion, Sheet metal: Rubber pad forming- Explosive forming. Moulding of thermoplastics- injection moulding- blow moulding – Rotational moulding

Unit 03: CENTRE LATHE	**09 Hours**
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 04:SPECIAL MACHINE TOOLS	**09 Hours**
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 05:MILLING AND GEAR PROCESS	**09 Hours**
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, centreless grinding – honing, lapping and buffing.	

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

Text Books

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media promoters Pvt Ltd., Mumbai, 2001.
2. Mikell P Groover, " Principles of Modern Manufacturing" Wiley India Pvt Ltd. 2014.

REFERENCES

1. B.S. Magendranparashar& R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. P.N. Rao, Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 2002.
3. J.P .Kaushish "Manufacturing Processes" PHI Learning Private limited, second edition 2010.
4. P. C. Sharma, "A text book of production technology", S. Chand and company, IV Edition, 2003.
5. Begma, 'Manufacturing process", John Wilely& sons, VII Edition, 2005.
6. SeropeKalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2002 (Second Indian Reprint)
7. Beddoes. J and Bibby M.J. 'Principles of Metal Manufacturing Processes', Elsevier, 2006.
8. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.

U15MC304R	ELECTRICAL MACHINES AND DRIVES	L	T	P	C
		3	0	0	3

Course Outcomes

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

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 Speed control of DC motor.
CO5:	Discuss Speed control of three phase induction motor.

Pre-requisite

1. Basic Electrical Engineering

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01:DC MACHINES — **09 Hours**

DC generator: Construction, principle of operation, EMF equation, OCC and external characteristic curves, and efficiency. **DC motors**: Construction, principle of operation, torque-speed characteristics & Starters.

Unit 02:AC MACHINES — **09 Hours**

AC Motors: three-phase induction motor: Construction, types, principle of operation, torque-slip characteristics, and starting methods, Introduction to synchronous motor.

Unit 03: ELECTRIC DRIVES INTRODUCTION — **09 Hours**

Basic Elements – Types of Electric Drives – factors influence 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 04:Conventional and solid state speed control of d.c. drives	**09 Hours**
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Controlled rectifiers (1Phase Half wave & full wave) and DC choppers (Class A,B C,D & E).	
Unit 05:CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	**09 Hours**
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip Power recovery scheme – Inverters, Cyclo converter and AC voltage regulators.	

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

Text Books

1. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw-Hill, 2010.
2. G.K. Dubey, "Fundamentals of Electrical Drives", Narosa publications, 2010.

REFERENCES

1. Vedam Subramaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2001.
2. Nagrath, I.J. and Kothari, D.P., "Electrical Machines", Tata McGraw-Hill, 1998.
3. Pillai, S.K., "A First Course on Electric Drives", Wiley Eastern Limited, 1998.
4. Singh, M.D. and Khanchandani, K.B., "Power Electronics", Tata McGraw-Hill, 1998.

U15MC305R	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Describe the properties of semiconductor devices and various types of diodes.
CO2:	Design the hybrid models of configurations of BJT and its stability analysis.
CO3:	Discuss the operation of amplifiers.
CO4:	Evaluate the performance of differential amplifiers and the concepts of feedback amplifiers and their characteristics.
CO5:	Evaluate the performance characteristics of multistage amplifiers and different types of oscillators.

Pre-requisite

1.Engineering physics

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01:PN JUNCTION DEVICES	**09 Hours**

PN junction diode – structure, operation and V-I characteristic – current equation – drift current density and diffusion current density – diffusion and transient capacitance – Zener breakdown – zener reverse characteristic – zener as regulator

Unit 02:BIPOLAR JUNCTION AND FIELD EFFECT TRANSISTORS	**09 Hours**

BJT – structure, operation and V-I characteristic – JFET – structure, operation and V-I characteristic, CURRENT Equation, MOSFET – structure, operation and V-I characteristic – types of MOSFET

Unit 03: AMPLIFIERS	**09 Hours**

BJT small signal model – biasing – analysis of CE, CB, CC amplifiers – Gain and frequency response – MOSFET small signal model – biasing – analysis of CS and source follower – gain and frequency response.

Unit 04:MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER	**09 Hours**
BIMOS cascade amplifier, differential amplifier – common mode and difference mode analysis – tuned amplifiers – single tuned amplifiers – gain and frequency response.	
Unit 05:FEEDBACK AMPLIFIERS AND OSCILLATORS	**09 Hours**
Advantages of negative feedback – voltage / current, series, shunt feedback – positive feedback – condition for oscillations, phase shift – Wien bridge, Hartley, colpitts and crystal oscillators	

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

Text Books

1. David A. Bell, Electronic devices and circuits, Prentice Hall of India, 2004.
2. Sedra Smith, Micro electronic circuits, Oxford University Press, 2004.

REFERENCES

1. Rashid, Micro electronic circuits, Thomson publications, 1999.
2. Floyd, Electron devices, pearson Asia 5th Edition, 2001.
3. Donald A Neamen, Electronic Circuit Analysis and Design, Tata McGrawHill, 3 rd Edition, 2003
4. Rashid, Micro electronic circuits, Thomson publications, 1999.

U15MC306R	FLUID MECHANICS AND STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Understand the working principles of flow measuring instruments and to determine the Coefficient of discharge of orifice/venturi meters.
CO2:	Investigate the mechanical properties of materials.
CO3:	Evaluate the real time problems in the fluid flow and material strength analysis.

Pre-requisite

1.Engineering Physics

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2			1	3	2	1	2	3	2
CO2	3	3	3	2	2			1	3	2	1	2	3	2
CO3	3	3	3	2				1	3	2			3	2

Course Assessment methods

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

List of Experiments

Part-A: Fluid Mechanicslaboratory

1. Determination of the Coefficient of discharge of given Orifice meter and Venturi meter.
2. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible pump
3. Conducting experiments and drawing the characteristic curves of reciprocating pump.
4. Conducting experiments and drawing the characteristic curves of Gear pump.
5. Conducting experiments and drawing the characteristic curves of Pelton wheel.
6. Conducting experiments and drawing the characteristics curves of Francis turbine.
7. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Part-B: Strength of Materialslaboratory

1. Tension Test on MS Steel.
2. Compression test – MS Steel.
3. Double shear test in UTM.
4. Tests on spring – Tension and Compression.
5. Hardness test on various machines.
6. Impact test – Charpy and Izod.

Total Hours: 60 Hrs

U15MC307R	ELECTRON DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Design different configurations of BJT.
CO2:	Examine the characteristics of JFET, MOSFET and IGBT.
CO3:	Evaluate the real time problems in Electron device and circuits.

Pre-requisite

1.Engineering physics

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

List of Experiments

1. Design of small signal model of transistor with CE configuration.
2. Verify the characteristics of MOSFET.
3. Verify the characteristics of PN Diode
4. Verify the characteristics of Zener Diode.
5. Verify the characteristics of JFET
6. Verify the characteristics of IGBT.
7. Design of Hartley and Colpitts oscillator.
8. Design of RC phase shift and Wein bridge oscillator.
9. Design of voltage and current series amplifier.
10. Design of negative feedback amplifier.

Total Hours: 30 Hrs

U15MC308R	ELECTRICAL MACHINES AND DRIVES LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Understand the concept of starters and starting of motor and experiment the Controlling of DC and AC motors.
CO2:	Test the motors and generators and draw the performance curves and explain the working and testing of transformers. Discuss the Speed and torque control of DC motors.
CO3:	Give the solution for real time problems in electrical machines.

Pre-requisite

1. Basic electrical engineering

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

List of Experiments

1. Load test on DC Shunt & DC Series motor.
2. O.C.C & Load characteristics of DC Shunt and DC Series generator.
3. Speed control of DC shunt motor (Armature, Field control).
4. Load test on single phase transformer.
5. O.C & S.C Test on a single phase transformer.
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor.
8. Load test on three phase squirrel cage Induction motor.
9. Speed control of three phase slip ring Induction Motor.
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters

Total Hours: 60 Hrs

U15GE301R	SOFT SKILLS AND APTITUDE – I (Common to all Branches)	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Demonstrate capabilities in specific soft-skill areas using hands-on and/or case-study approaches.
CO2:	Solve problems of greater intricacy than those in BA-I and II in stated areas of quantitative aptitude and logical reasoning.
CO3:	Demonstrate higher than BA-I and II levels of verbal aptitude skills in English withregard to specific topics.

CO/PO, PSO Mapping

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

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

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 following topics:

a) Problems on ages
b) Ratio and proportion
c) Mixtures and Solutions
d) Partnerships
e) Averages
f) Data Arrangement- Linear and Circular
g) Data Interpretation-Bar/Pie
h) Problems on cubes

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: Mechatronics Engineering

S.No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit
Theory						
1	U15MAT401DR	Statistics and Numerical Methods	3	2	0	4
2	U15CHE405R	Environmental science and Engineering	3	0	0	3
3	U15MC401R	Applied hydraulics and pneumatics	3	0	0	3
4	U15MC402R	Theory of machines	3	0	0	3
5	U15MC403R	Sensors and Instrumentation	3	0	0	3
6	U15MC404R	Microprocessors and microcontrollers	3	0	0	3
Practical						
7	U15MC405R	Hydraulics and pneumatics Laboratory	0	0	4	2
8	U15MC406R	Sensors and Instrumentation Laboratory	0	0	2	1
9	U15MC407R	Microprocessors and Microcontroller Laboratory	0	0	4	2
10	U15GE401R	Soft Skills and Aptitude – II	0	0	2	1
					Total Credits	**25**

Approved By

Chairperson, Mechatronics Engineering, BoS
Dr.P.Suresh

Member Secretary, Academic Council
Dr.R.Shivakumar

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

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

U15MAT401DR	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	2	0	4

Course Outcomes

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

CO1:	Define the sampling distribution, test and analyse the hypothesis for mean, variance, proportions and differences using z and t, chi-square and F – distribution and also test and analyse the independence of attributes and goodness of fit.
CO2:	Apply one-way and two – way classification techniques and analyse the various standard designs (CRD, RBD, LSD) for the real – life problems.
CO3:	Explain the methods to solve algebraic and transcendental equation, a linear system of equations by direct and iterative methods and find eigen value of a matrix by power method.
CO4:	Describe and apply the interpolation methods for equal and unequal intervals, and obtain the derivatives using those interpolation methods to compute.
CO5:	Solve linear and nonlinear ordinary differential equations of first and second order by single and multi step methods.

Pre-requisite

Transforms & Partial differential equations

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P0 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3		2	-	-	-	-	-	-	-	3	-
CO2	2	3	3	-	-	2	-	-	-	-	2	-	3	-
CO3	2	-	-	2	-	2	-	-	-	-	-	-	-	2
CO4	2	-	-	2	-	2	-	-	-	-	-	-	-	2
CO5	2	-	-	2	-	2	-	-	-	-	-	-	-	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: TESTING OF HYPOTHESIS	**09+6 Hours**

Testing of hypothesis for proportions, means, standard deviations using z and t - chi – square test for population variance, goodness of fit, independence of attributes – F – test.

Unit 02: DESIGN OF EXPERIMENTS	**09+6 Hours**

Completely randomized design, randomized block design, Latin square design , 22, factorial design

Unit 03: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	**09+6 Hours**
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 04: INTERPOLATION, NUMERICAL DIFFERENTIATION & NUMERICAL INTEGRATION	**09+6 Hours**
Lagrange's and Newton's divided difference interpolation, Newton's forward and backward difference interpolation, approximation of derivatives using interpolation polynomials, numerical integrating using Trapezoidal and Simpson's 1/3 rules	
Unit 05: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	**09+6 Hours**
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.	

Theory: 45 Hrs	**Tutorial: 30 Hrs**	**Total Hours: 75 Hrs**

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, 8th Edition, 2011

Extensive Reading

REFERENCES

1. Grewal, B.S., and Grewal J.S., "Numerical Methods in Engineering and Science", khanna publishers, New Delhi, 6th Edition, 2014
2. Walpole R.E, Myers R.H., and Kye., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2012
3. Gerald, C.F and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Editions, 2006

U15CHE405R	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	State the importance of the acute need for environmental awareness and discuss significant aspects of natural resources like forests, water, mineral, food, energy and land resources
CO2:	Explain the concepts of an ecosystem and provide an overview of biodiversity and its conservation.
CO3:	Define the various known kinds of environmental pollution and discuss their causes, effects and control measures.
CO4:	Give an account of the social issues with regard to the environment.
CO5:	Discuss the impact of human population on the environment.

Pre-requisite

Engineering chemistry

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6)	Seminar (5)	Course end survey
Internal test II (6)	Moodle (7)	
Internal test III (6)	Attendance (5)	
Assignment (5)	End semester Examination (60)	

Unit 01: Introduction to Environmental Studies and Natural Resources **12 Hours**

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 02: Ecosystems and Biodiversity	**9 Hours**
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 03: Environmental Pollution	**10 Hours**
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 04: Social Issues and the Environment	**8 Hours**
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 05: Human Population and the Environment	**6 Hours**
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.	

Theory: 45 Hr	**Tutorial: -**	**Total Hours: 45 Hr**

Text Books

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Third Edition, 2008.
2. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co., 14th edition 2014

REFERENCES

1. S. Radjarejesri et al., "Environmental Science" Sonaversity, Sona College of Technology, Salem, 2018.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, India-2002
3. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II., third edition 2009.
4. Masters, G.M., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 2nd Edition, 2004.
5. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", University Grands Commission, Universities Press India Private Limited, Hyderguda, 2005.

U15MC401R	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Apply the pump theory and classifications and able to use the fluid power in his/her professional career.
CO2:	Demonstrate the principle of hydraulic cylinders and fluid motors, Gear, Vane and Piston motors.
CO3:	Compare accumulators and intensifiers and justify the usage of accumulators on real time feedback circuits in their professional career.
CO4:	Differentiate the different Pneumatic approaches for simple applications and able to synthesis the new approach specific to their application.
CO5:	Define fluidic devices applications with basic trouble shooting methodologies and types of Servo systems.

Pre-requisite

Fluid Mechanics and machinery

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	3	1							3	3
CO2	3	3	3										3	3
CO3	2	3	1	3	2							3	3	3
CO4	3	3	3	3		3							3	3
CO5	3	2	3	3	3	3		3				3	3	3

Course Assessment methods

Direct		Indirect
Internal test I (6)	Seminar (5)	Course end survey
Internal test II (6)	Moodle (7)	
Internal test III (6)	Attendance (5)	
Assignment (5)	End semester Examination (60)	

Unit 01: FLUID POWER SYSTEMS AND GENERATOR **09 Hours**

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 02: CONTROL AND ACTUATION ELEMENTS **09 Hours**

Construction of Control Components: Direction control valves – 3/2 way valve – 4/2 way valve – 4/3 valve-5/3 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 03: HYDRAULIC CIRCUITS	**09 Hours**

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 04: PNEUMATIC SYSTEMS AND CIRCUITS	**09 Hours**

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 05: SPECIAL SYSTEM AND MAINTENANCE	**09 Hours**

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.

Theory: 45 Hr	**Tutorial: -**	**Total Hours: 45 Hr**

Text Books

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education,7th edition, 2013.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2011.

REFERENCES

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.
3. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 2002.
4. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.

U15MC402R	THEORY OF MACHINES	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1: Identify and enumerate different link-based mechanisms with a force-motion relationship in components subjected to external forces.

CO2: Design and evaluate the performance of different cams and followers.

CO3: Interpret the force analysis of simple mechanisms.

CO4: Design and evaluate the performance of rotating & reciprocating masses.

CO5: Value the principles in mechanisms used for governing of machines

Pre-requisite

Engineering Mechanics

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	3	3			3			3		3	3	3
CO2	3	3	3	3			3			2			3	3
CO3	3	3	3	3						2		2	3	3
CO4	3	3	3	3						2			3	3
CO5	3	3	3	3			3						3	3

Course Assessment methods

Direct		Indirect
Internal test I (6)	Seminar (5)	Course end survey
Internal test II (6)	Moodle (7)	
Internal test III (6)	Attendance (5)	
Assignment (5)	End semester Examination (60)	

Unit 01: INTRODUCTION TO MECHANISMS — **09 Hours**

Definitions Link or Element, Kinematic Pairs, Kinematic chain, Degrees of Freedom, Grubler's Criterion (without derivation), Kinematic Chain, Mechanism, Structure, Mobility of Mechanism, Mechanical Advantage, Transmission angle. Inversions of Kinematic Chains: Four bar chain, Single slider and Double slider. Common Mechanisms, Straight line Mechanisms (Exact & Approximate Straight line).

Unit 02: KINEMATICS OF CAM — **09 Hours**

Cams: Types of cams, Types of followers. Displacement, Velocity & Acceleration Time curves for cam Profiles. Disc cam with Reciprocating follower having Knife- Edge, Roller & Flat-face follower, Disc cam with oscillating roller follower. Follower motions including,

SHM, Uniform velocity, Uniform acceleration & retardation and Cycloidal motion.	
UNIT 03: FORCE ANALYSIS	**09 Hours**
Static force analysis: Introduction: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, free body diagrams. Static force analysis of four-bar mechanism and slider-crank mechanism with and without friction. Dynamics force analysis: Alembert's principle, Inertia force, inertia torque, Dynamic force analysis of reciprocating engine (Analytical method)	
Unit 04: BALANCING OF ROTATING & RECIPROCATING MASSES	**09 Hours**
Balancing of Rotating Masses: Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Balancing of Reciprocating Masses: Balancing of Locomotives, Multi cylinder engine, partial balancing of locomotive engines.	
Unit 05: GYROSCOPE & GOVERNORS	**09 Hours**
Governors: Types of governors; force analysis of Watt, Porter (Problem alone) and Hartnell governors (Theory). Controlling force, stability, sensitiveness, isochronism, effort and power. Gyroscope: Gyroscopic couple, Effect of gyroscopic couple on ship, aeroplane, stability of two-wheelers.	

Theory: 45Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books

1. Ratan, S.S., "Theory of Machines", Tata McGraw Hill Publishing company Ltd., 4th Edition, 2014.
2. Sadhu Singh., "Theory of Machines", Pearson Education India, 2nd Edition 2013.
3. Thomas Bevan, "Theory of Machines", Pearson Education India, 1948, 3rd Edition, 2010.

REFERENCES

1. R. S. Khurmi, J. K. Gupta. "Theory of Machines" Eurasia Publishing House, 2008.
2. B.L. Balleney, "Theory of Machines", Khanna Pub. Delhi, 2012.
3. Shigley J.E and Uicker J.J "Theory of Machines and Mechanisms," McGraw Hill ISE, 2011.
4. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", New Age Intl.,New Delhi, 2nd Edition, 2012.
5. Ambekar A. G, "Mechanism and machine theory", PHI Learning Pvt. Ltd, New Delhi, 2007.

U15MC403R	SENSORS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Understand the units and standards, their conversions, characteristics and error analysis of measurement systems.
CO2:	Describe the different sensors available in mechanical measurements
CO3:	Classify the different types signal conditioning systems.
CO4:	Design a signal conditioning circuit and data acquisition system
CO5:	Develop the virtual instrumentation systems.

Pre-requisite

Electron devices and circuits

1.

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO 12	PSO 1	PSO 2
CO1	3		3	2			2			2			3	2
CO2	3		3	2			2			2			3	2
CO3	3		3	2			2			2			3	2
CO4	3		3	2			2			2			3	2
CO5	3		3	2			2			2			3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: GENERAL CONCEPTS OF MEASUREMENT — **09 Hours**

Generalized Measurement System – Performance Characteristics – Static and Dynamic Characteristics – Errors in Measurements – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers

Unit 02: SENSORS — **09 Hours**

Introduction -Sensor Characteristics - Fundamentals of Time and Frequency- Linear and Rotational Sensors-Acceleration Sensors-Force Measurement-Torque and Power Measurement-Flow Measurement-Temperature Measurements-Distance Measuring and Proximity Sensors-Light sensor.

Unit 03: **SIGNALCONDITIONING** — **09 Hours**

Instrumentation amplifier characteristics, OP-Amp- characteristics- OP-Amp circuits used in instrumentation- A/D and D/A conversion, Clipper and clamper, Frequency to voltage, voltage to frequency Conversion concept and methods.

Unit 04: **DATA ACQUISITION**	**09 Hours**
Real-time interfacing – Introduction - Elements of data acquisition and control - Overview of I/O process, Data Acquisition Conversion-General configuration-single channel and multichannel data acquisition – Data conversion – Introduction to Digital Transmission system.	
Unit 05 VIRTUAL INSTRUMENTATION	**09 Hours**
Block diagram and architecture of the virtual instrumentation - VIs and sub VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.	

Theory: 45 Hr	**Tutorial: -**	**Total Hours: 45 Hr**

Text Books

1. John G. Webster, "Measurement, Instrumentation, and Sensors Handbook", CRC Press. 2014.
2. Brian Morriss, "Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics", McGraw Hill International Edition, 1995.

REFERENCES

1. Buchanan, W, "Industrial Instrumentation and Control", Butterworth-Heinemann Publishers, 1999.
2. Patranabis, D, "Sensors and Transducers", Wheeler Publishing Co, Ltd., New Delhi, 2003.
3. Holeman . J, "Experimental Methods for Engineers", Mc Graw Hill, 10th Edition, 2010.
4. Deoblin E.O. "Measurement Systems - Application and Design", McGraw Hill, 4th Edition, 2005.

U15MC404R	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Outline the architecture, discuss the addressing modes, instruction set interrupt structure and develop skill in simple program writing of Intel 8085 microprocessor
CO2:	Discuss various Peripheral Interfacing function and interface with 8085 processor
CO3:	Outline the architecture, discuss the addressing modes, instruction set interrupt structure and develop skill in simple program writing of Intel 8086 microprocessor
CO4:	Explain the architecture, discuss the addressing modes, instruction set interrupt structure and develop skill in simple program writing of Intel 8051 microcontroller
CO5:	Apply the interfacing techniques in motors and traffic light controller for microcontroller based simple applications

Pre-requisite

Electron devices and circuits

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2				2				3	2
CO2	3	3	3	2	2				2				3	2
CO3	3	2	3	2	2				2				3	2
CO4	3	3	3	2	2				2				3	2
CO5	3	3	3	2	2				2				3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar (5) Moodle (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: 8085 MICROPROCESSORS — **09 Hours**

8085 architecture – Instruction set – Addressing modes– Machine cycles and timing diagrams – interrupts - memory interfacing, typical EPROM and RAM Interfacing.

Unit 02: PERIPHERALS INTERFACING OF 8085 — **09 Hours**

Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 keyboard display controller ,8254 timer/ counter.

Unit 03: **8086 MICROPROCESSORS** — **09 Hours**

8086 architecture – 8086 addressing modes – Memory organization- Instruction set –Stack Structure of 8086- interrupts.

Unit 04: **MICROCONTROLLER** — **09 Hours**

8051: Architecture, I/O pins – ports and circuits – Memory organization (internal and

external) – counters and timers – serial data I/O – interrupts. PIC18F: Architecture, I/O pins – ports and circuits		
Unit 05: 8051 PROGRAMMING AND APPLICATIONS		**09 Hours**
8051 addressing modes – instruction set –Interfacing of stepper motor, speed control of DC motor, Introduction to raspberry and Arduino boards.		
Theory: 45 Hr	**Tutorial: -**	**Total Hours: 45 Hr**
Text Books		
1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.		
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.		
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051, McGraw Hill Edu,2013.		
REFERENCES		
1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.		
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, 'Microprocessors and Microcontrollers', Oxford University Press, 2010.		

U15MC405R	HYDRAULICS AND PNEUMATICS LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Demonstrate the working principles of Hydraulic, Pneumatic pump and various actuators.
CO2:	Construct various hydraulic and, Pneumatic circuits using valves.
CO3:	Perform Industrial based circuit operations.

Pre-requisite:

1.Fluid Mechanics and fluid machinery

2.Fluid Mechanics and fluid machinery laboratory

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3		3		2			3		2	2	2
CO2	3	3	3		3		2			2		2	2	2
CO3	3	3	3		3		3			2		2	3	3

Course Assessment methods

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

List of Experiments

1. [A] Study of Construction and working of Hydraulic equipments
   [B] Study of Construction and working Pneumatic equipments
2. Design and testing of hydraulic circuit for pressure control using pressure relief valve
3. Design and testing of hydraulic circuit for flow control using pressure /non-pressure compensated flow control valve.
4. Design and testing of hydraulic circuit for direction control using two-way valves
5. Design and testing of pneumatic circuit for single acting cylinder.
6. Design and testing of pneumatic circuit for double acting cylinder.
7. Design and testing of pneumatic circuit for flow control using meter in circuit.
8. Design and testing of pneumatic circuit for flow control using meter out circuit
9. Design and testing of pneumatic circuit for logic controls
10. Design and testing of pneumatic circuit for with multiple cylinder sequences
11. Modelling and analysis of hydraulic and pneumatic system using software

Total Hours: 60 Hrs

U15MC406R	SENSORS AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Ability to use the sensors for the measurement of different signals and use of signal processing techniques to convert them to useful signal.
CO2:	Create appropriate design procedure to obtain a required measurement data for displacement
CO3:	Develop an appropriate design procedure, suitable for signal conversion to interface with computer

Pre-requisite

Electron devices and circuits

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	3						2			3	2
CO2	3	3	3	3						2			3	2
CO3	3	3	3	3						2			3	2

Course Assessment methods

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

List of Experiments

1. Measurement of temperature using thermocouple, thermistor and RTD
2. Measurement of displacement using POT, LVDT & Capacitive transducer
3. Torque measurement using torque measuring devices
4. Strain Measurement using strain gauge
5. Servomotor position control using photo electric pickup
6. Wave Shaping circuit
7. Analog to Digital Converters
8. Digital Comparator
9. Voltage to frequency converter
10. Frequency to Voltage Converter
11. Position and velocity measurement using encoders
12. Study on the application of data acquisition system for industrial purposes

U15MC407R	MICROPROCESSORS AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Write an assembly language program to perform basic arithmetic operations using 8085 Microprocessor instructions and also to interface various devices using 8085 instructions.
CO2:	Write an assembly language program to perform basic arithmetic operations using 8086 Microprocessor instructions.
CO3:	Write an assembly language program to perform basic arithmetic operations using 8051Microcontroller instructions.

Pre-requisite

1. Electron devices and circuits
2. Electron devices and circuits Laboratory

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3						2			3	2
CO2	3	3	3	3						2			3	2
CO3	3	3	3	3						2			3	2

Course Assessment methods

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

List of Experiments

1. Assembly Language Programming of 8-bit binary addition and subtraction using 8085 processor.
2. Assembly Language Programming of 8-bit binary multiplication and division using 8085 processor.
3. Assembly Language Programming of 16-bit addition and multiplication using 8085 processor.
4. Assembly Language Programming of 8-bit Minimum / Maximum number, Ascending / Descending order using 8085 processor.
5. Assembly Language Programming of Interface Experiments (A/D and D/A interface) using 8085 processor.
6. Interfacing and Programming of Stepper Motor control using 8085 processor.
7. Assembly Language Programming of 16-bit binary addition and subtraction using 8086 processor.
8. Assembly Language Programming of 16-bit binary multiplication and division using 8086 processor.

9. Assembly Language Programming of 8-bit binary addition and subtraction using 8051 microcontrollers.
10. Assembly Language Programming of 8-bit binary multiplication and division using 8051 microcontroller.
11. Study and Interface of Arduino board.
12. Study and Interface of Raspberry PI board.

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: Mechatronics Engineering

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit
Theory							
1	U15MC501R	Computer Aided Design and Manufacturing		3	0	2	4
2	U15MC502R	Thermodynamics and Heat Transfer		3	0	0	3
3	U15CS508R	Object Oriented Programming and Data Structures		3	0	0	3
4	U15MC503R	Embedded Systems and Internet of Things		3	0	0	3
5	U15MC504R	Industrial Automation		3	0	0	3
6	U15MC901R	**Professional Elective-1**	Control Systems	3	0	0	3
	U15MC902R		Industrial Drives				
	U15MC903R		Additive Manufacturing				
Practical							
7	U15MC505R	Embedded Systems and Internet of Things Laboratory		0	0	4	2
8	U15MC506R	Industrial Automation Laboratory		0	0	4	2
9	U15MC507R	Mini Project-I		0	0	2	1
10	U15GE501R	Soft Skills and Aptitude – III		0	0	2	1
						Total Credits	**25**

Approved By

Chairperson, Fashion Technology BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/ Mechatronics Engineering, Fifth Semester BE MCT Students and Staff, COE

U15MC501R	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	2	4

Course Outcomes

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

CO1:	State fundamental concepts of Computer aided design and Modeling Techniques.
CO2:	Explain construction and development 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:	Explain and describe the process planning and group technology in CIM environment.
CO5:	Explain about the computer aided quality control systems based CMM testing and explain flexible manufacturing systems.

Pre-requisite

1. Engineering graphics
2. Manufacturing technology

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

Unit 01 COMPUTER AIDED DESIGN — **9+6 Hours**

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).

Unit 02: COMPUTER AIDED MANUFACTURING — **9+6 Hours**

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 - work holding devices and tool holding devices-Automatic Tool changers

Unit 03: CNC – PROGRAMMING — **9+6 Hours**

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

Unit 04: GROUP TECHNOLOGY AND CAPP	**9+6 Hours**
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 05: COMPUTER AIDED QUALITY CONTROL AND FMS	**9+6 Hours**
Computer Aided Quality Control (CAQC)- Introduction, Contact Inspection methods, Non-Contact Inspection methods, Co-ordinate Measuring Machine. Flexible manufacturing Systems- Introduction, Scope, Types, Elements and Benefits of FMS.	

Theory: 45 Hrs	**Practical: 30 Hr**	**Total Hours: 75 Hrs**

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".
4. Eastern Economy Edition, PHI publishers 2007.

REFERENCES

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.

U15MC502R	THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Express the basic concepts and laws of thermodynamics
CO2:	Perform the analysis of air standard cycles
CO3:	Evaluate the conduction heat transfer for a given system
CO4:	Demonstrate the types of convection and determine heat transfer coefficient
CO5:	Investigate the radiation effect among different surfaces

Pre-requisite

1.Engineering Physics
2.Fluid Mechanics

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO2	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO3	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO4	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO5	3	3	3	2	1	1	2	1	1	2	1	1	3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I LAWS OF THERMODYNAMICS **9 Hours**

Systems-closed and open systems - properties, processes and cycles- equilibrium- work and heat Transfers-Zeroth law-first law for a closed system and flow processes - enthalpy - second law –entropy.

UNIT II AIR STANDARD CYCLES **9 Hours**

Air standard cycles-Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - Rankine cycle-cycle efficiency

UNIT III INTRODUCTION TO HEAT TRANSFER AND CONDUCTION **9 Hours**

Basic Concepts- Mechanism of Heat Transfer - Conduction - Fourier Law of Conduction - General Differential equation of Heat Conduction -Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction-Transient heat conduction (elementary treatment only).

UNIT IV CONVECTION **9 Hours**

Boundary Layer Concept -Heat Transfer Coefficient - Types of Convection - Forced Convection - External Flow and Internal Flow - Flow over Plates, Cylinders and Spheres-internal flow (elementary treatment only).

UNIT V RADIATION **9 Hours**

Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law -Black Body Radiation and radiation between surfaces.

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

Text Books
1. P. K. Nag, Engineering Thermodynamics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013
2. R.C Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International Publishers, New Delhi, 2017
REFERENCES
1. P. K. Nag, Applied Thermodynamics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd edition ISBN: 9780070151314, 0070151318
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics - An Engineering Approach in SI Units, Tata McGraw Hill Publishing Company, New Delhi, 2010
3. Frank P. Incropera and David P. DeWitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons Pvt. Ltd., Singapore, 2006.
4. T. D. Eastop and Mc Conkey, Applied Thermodynamics for Engineering Technologists, Pearson, New Delhi, 2004.
5. C. P. Kothandaraman, S. Domkundwar and A. V. Domkundwar, A course in Thermal Engineering, Dhanpatrai and Co. Pvt. Ltd., New Delhi, 2012

U15CS508R	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Understand the basic concepts of object-oriented programming.
CO2:	Design program for real time applications using inheritance and polymorphism.
CO3:	Apply various linear tree data structures in real time applications.
CO4:	Implement the operations of tree traversals and hashing techniques
CO5:	Develop and apply algorithms for real time applications using graphs

Pre-requisite

1. Programming in C

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I PRINCIPLES OF OOP **9 Hours**

Basic Concepts of Object Oriented Programming – Expressions – Control Structures – Functions – Classes and Objects – Class Members – Access Control – Pointers – Constructors and Destructors – Parameter Passing Methods – Inline Functions – Static Class Members – This Pointer –Friend Functions – Dynamic Memory Allocation (new and delete).

UNIT II INHERITANCE AND POLYMORPHISM **9 Hours**

Inheritance Basics – Types of Inheritance – Base Class Access Control –Compile Time Polymorphism –Runtime Polymorphism using Virtual Functions – Abstract Class –Exception Handling.

UNIT III DATA STRUCTURES **9 Hours**

Basic Data Structures –Abstract Data Type – Linear Data Structures – List ADT – Single – Double and Circular – Stack ADT – Queue ADT.

UNIT IV TREES AND GRAPHS **9 Hours**

Basic Terminologies –Tree Traversals – Binary Trees – Binary Search Tree ADT – Graph Traversals –Shortest Path Algorithm – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm – Kruskal's Algorithm.

UNIT V SEARCHING TECHNIQUES **9 Hours**

Searching Techniques – Linear Search – Binary Search – Sorting Techniques – Insertion – Bubble and Merge Sort.

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

TEXT BOOKS

1. Mark Allen Weiss, "Data structures and Algorithms Analysis in C++", 4th Edition, Prentice Hall, 2013.
2. E. Balagurusamy, "Object-Oriented Programming With C++", 3rd Edition, Tata McGraw Hill, 2006.

REFERENCE BOOKS

1. Adam Drozdek, "Data structures and algorithms in C++", 3rd Edition, Cengage Learning, 2013.
2. Langsam, Augenstein and Tanenbaum "Data structures using C and C++", 2nd Edition, Prentice Hall of India, 1998.
3. Micheal T. Goodrich, Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", Wiley Student edition, John Wiley and Sons, 2009.

U15MC503R	EMBEDDED SYSTEMS AND INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Explain the need of embedded systems and their development procedures.
CO2:	Summarize the concepts involved in Real time operating systems.
CO3:	Explain the construction, addressing modes and instructions sets of PIC micro controller.
CO4:	Identify suitable/appropriate sensors for an application and design circuits
CO5:	Examine the important aspects of IoT architectures and write programs for Arduino and Raspberry Pi to build system

Pre-requisite
NIL

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS	**9 Hours**
Overview of embedded systems, embedded system design process, challenges - common design metrics and optimizing them. Hardware - Software codesign embedded product development	
UNIT II Real Time Operating System	**9 Hours**
Real time operating systems Architecture - Tasks and Task states - Tasks and Data - Semaphone and shared data - Message queues, mail boxes and pipes - Encapsulating semaphores and queues - interrupt routines in an RTOS Environment. Introduction to Vx works, RT Linux.	
UNIT III PERIPHERALS AND NETWORKING	**9 Hours**
Architecture - Instruction set - Addressing modes - Timers - Interrupt logic - CCP modules – ADC- Networking - CAN BUS - I 2C - GSM - GPRS - Zig bee	
UNIT IV SENSORS AND CIRCUITS	**9 Hours**
Sensor – Introduction, Terminology, Behavior, Selection, Circuits – Overview and Applications, Battery Issue and Energy Management, Wireless Link, Digital and Analog – Digital Computing, Analog to Digital Interfaces	
UNIT V IOT ARCHITECTURE AND PROGRAMMING	**9 Hours**
IoT Architectures – embedded System, Gateway and Cloud (MGC) Architecture and other reference models and architectures Arduino vs Raspberry Pi vs Electric Imp – Key features and comparisons Arduino Interfaces – Arduino IDE - Programming	

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

Text Books
1. Frank Vahid, Tony Givargis Embedded system design: a unified hardware/ software introduction. Wiley publication. 2002
2. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
REFERENCES
1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons Ltd., UK, 2014.
3. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata Mc Graw Hill, 2011
4. John B. Peatman, "Design with PIC Microcontrollers" Prentice Hall, 2003.

U15MC504R	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Illustrate the requirements of industrial Automation
CO2:	Explain the configuration and components of PLC devices
CO3:	Design PLC programming using ladder logic.
CO4:	Explain the distributed control systems
CO5:	Develop control for motor devices

Pre-requisite

Electronic Devices and circuits

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	P09	PO10	PO1 1	PO1 2	PSO1	PSO2
CO1	3	3	3	2			2			2			3	2
CO2	3	3	3	2			2			2			3	2
CO3	3	2	3	2	3		2			2			3	2
CO4	3	3	3	2			2			2			3	2
CO5	3	3	3	2			2			2			3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I INTRODUCTION TO INDUSTRIAL AUTOMATION **9 Hours**

Requirements of industrial automation – Industrial electrical equipment requiring control and integration through PLC – Functions of the central distributed control panels in a plant – conventional central relay and interlock panels and the various components used – advantages of PLC based system.

UNIT II PLC HARDWARE **9 Hours**

PLC configuration and various components of the PLC – PLC inputs and outputs modules – Power Supplies – Programming format – Construction of PLC Ladder Diagrams – Analog Input and analog output devices – CPU, I/O cards.

UNIT III PLC AND SCADA **9 Hours**

Networking of PLCs-Data communication-Fieldbus, PROFI bus, and Mod bus-OSI Model types-OPC function. Supervisory Control and Data Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data Storage

UNIT IV	DISTRIBUTED CONTROL SYSTEM	9 Hours
Evolution - Architectures - Comparison - Local control unit - Process interfacing issues - Communication facilities. Operator interfaces - Low level and high level operator interfaces - Operator displays - Engineering interfaces - Low level and high level engineering interfaces		
UNIT V	**PLC BASED ELECTRIC DRIVES**	**9 Hours**
Controlling a Robot with PLC – PLC control of Stepper Motor – PLC Based AC motor Drive and DC Motor Drive.		
Theory: 45 Hrs	**Tutorial: --**	**Total Hours: 45 Hrs**

Text Books

1.	John W. Webb and Ronald A.Reis "Programmable Logic Controllers", Prentice – Hall of India Publishers, 2007.
2.	Frank D Petruzella, "Programmable Logic Controllers", McGraw Hill Publishers, 3 rd Edition, 2010.

REFERENCES

1.	John R Hackworth, "Programmable Logic Controllers: Programming Methods and Applications", Pearson education, 1st Edition, 2003.
2.	Siemens PLC Hand book for total automation
3.	Allen – Bradley hand book for total automation
4.	GE – Fanuc hand book for total automation

U15MC505R	EMBEDDED SYSTEMS AND INTERNET OF THINGS LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Write embedded programs for any application
CO2:	Create communication between peripherals using appropriate interfaces
CO3:	Design and develop an IoT application using Arduino sensors and actuators

Pre-requisite

Sensors and instrumentation

Course Assessment methods

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

List of Experiments

I/O Programming

Interrupts and Timer application

Interfacing Keypad

Interfacing LCD

Interfacing ADC/DAC

Using Arduino

To control LED.

To identify objects using IR and PIR sensor.

Interfacing Arduino with modules and Shields

Simple Project

Each student has to select an IoT Application / Product / System Requirement, that the student will develop during this course after thorough literature survey and analysis including feasibility and develop the same.

Total Hours: 60 Hrs

U15MC506R	INDUSTRIAL AUTOMATION LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Develop the PLC program for the implementation of logic gates
CO2:	Develop the PLC program for controlling the parameters like Pressure, Level and Flow
CO3:	Design the real time PLC program for various applications like bottle filling, cylinder actuation and elevator control

Pre-requisite

1.Electronic Devices and circuits laboratory
2.Hydraulics and pneumatics laboratory

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

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

Course Assessment methods

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

List of experiments/demonstrations:

1. Write ladder logic program for AND and OR gate.
2. Write ladder logic program for NAND and NOR gate.
3. Write ladder logic program for NOT and EX-OR gate.
4. Automate the level and flow control using PLC.
5. Conduct the temperature control using PLC
6. Conduct the pressure and flow control using PLC.
7. Conduct the control of elevator using PLC
8. Study the Bottle filling process using PLC
9. Conduct the cylinder sequencing using simple pneumatic direct control valve.
10. Write ladder logic program for the traffic light controller using PLC
11. Conduct the special I/O for speed control of DC motor using PLC.
12. Programming in HMI and SCADA.

Total Hours: 60 Hrs

U15MC507R	MINI PROJECT-I	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Frame a real world problem, identify the requirement and develop the design solutions. Express the technical ideas, strategies and methodologies.
CO2:	Apply the new tools, algorithms, techniques that contribute to obtain the solution of the project. Examine and validate through conformance of the developed prototype and analysis the cost effectiveness.
CO3:	Prepare report and present the oral demonstrations.

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	2	2	2	2	1	1	3	2
CO2	3	3	3	3	3	2	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	2	3	3	3	3	1	1	3	2

Course Assessment methods

Direct		Indirect
Review- I (10 marks) Review- II (10 marks) Review- III (10 marks) Project report (20 marks)	End semester Examination (50 marks)	Course end survey

1. The students formed into a team of convenient groups of not more than 4 members on a project are not allowed to change their team members.
2. Every project team should report to their faculty guide for discussion from the day of beginning of 5th semester.
3. The group has to analyze the selected problem addressed in their project work to draw solution.
4. A project report has to be submitted by each student group at the end of the 5th semester.
5. Three reviews have to be conducted by a team of faculty (minimum of 1 and maximum of 2) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

U15MC901R	Professional Elective 1 CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Derive the transfer function of a given system using mathematical models
CO2:	Determine the time response of systems and analyse the steady state error
CO3:	Calculate the frequency domain specifications using frequency response plots.
CO4:	Determine and analyse the stability of given system.
CO5:	Solve the state equations using state space model.

Pre-requisite

1. Electrical machines and drives
2. Engineering mathematics

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	1	1	2	1		2			3	2
CO2	3	3	3	2	1	1	2	1		2			3	2
CO3	3	3	3	2	1	1	2	1		2			3	2
CO4	3	3	3	2	1	1	2	1		2			3	2
CO5	3	3	3	2	1	1	2	1		2			3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I FUNDAMENTAL LAWS OF ELECTRICAL ENGINEERING AND CIRCUIT ELEMENTS — **9 Hours**

Introduction – types of control systems-linear –non-linear – continuous discrete – open loop and closed loop systems – mathematical model of control systems – transfer functions – mechanical translational system –mechanical rotational systems – electrical analogous of mechanical systems – transfer function of field controlled DC motor – block diagram algebra – signal flow graph – Mason's gain formula – transfer function of armature controlled DC motor.

UNIT II TIME RESPONSE ANALYSIS — **9 Hours**

Time response – standard test signals – type and order of control system – time response of first order system for unit step, unit ramp and impulse input – time response of second order system for unit step input– time domain specifications – steady state error and static error constants – generalized error coefficients –correlation between static and dynamic error coefficients – controllers: P, PI and PID – Tuning methods.

UNIT III	FREQUENCY RESPONSE ANALYSIS		9 Hours
Frequency response – frequency domain specifications – correlation between time and frequency response –frequency response plots – polar plot – bode plot.			
UNIT IV	**STABILITY ANALYSIS**		**9 Hours**
The concepts of stability – necessary conditions for stability –relative stability - Routh Hurwitz stability criterion – root locus – effect of addition of poles – effect of addition of zeros.			
UNIT V	**COMPENSATORS AND STATE SPACE ANALYSIS**		**9 Hours**
Compensators: introduction – types – lag, lead and lag-lead (qualitative treatment only).State space analysis: concepts of state, state variables and state model for linear continuous time systems – state space representation using physical variable and phase variable method – solution of state equation using Laplace transform method.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: -- Hr**	**Total Hours: 45 Hrs**

Text Books

1. I.J.Nagrath and M.Gopal, "Control Systems Engineering", 5th Edition, New Age International (P) Ltd,Publishers, 2006.
2. Samarajit Gosh, "Control Systems Theory and Applications", Second edition, Pearson publications, 2012.

REFERENCES

1. M.Gopal, "Control Systems, Principles and Design", Fourth Edition, Tata McGraw Hill, New Delhi,2012.
2. A.Nagoorkani, "Control Systems Engineering", First edition, RBA Publications, 2010.
3. S.Palani, "Control Systems Engineering", Second Edition, Tata McGraw Hill,2010.
4. B. C. Kuo, "Automatic Control Systems", John wiley and sons, 8th edition, 2003.

U15MC902R	Professional Elective 1 INDUSTRIAL DRIVES	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Analyze the behaviour of power converter for dc drives.
CO2:	Explain the principles of operation of induction motor drives.
CO3:	Analyze the working principles of Synchronous motor drives.
CO4:	Analyze and operating principle of Permanent magnet motor drives.
CO5:	Explain the principles of operations of Switched reluctance motor drives.

Pre-requisite

Electrical machines and drives

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO2	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO3	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO4	3	3	3	2	1	1	2	1	1	2	1	1	3	2
CO5	3	3	3	2	1	1	2	1	1	2	1	1	3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I POWER CONVERTERS FOR DC DRIVES **9 Hours**

single phase converter fed D.C motor drive. -Class A, B, C, D and E chopper-controlled DC motor. -Drive employing dual converter fed DC motor drive. Drive circuits for stepper motor.

UNIT II INDUCTION MOTOR DRIVES **9 Hours**

Solid state controllers for Stator voltage control, Rotor side speed control of wound rotor induction motors. Voltage source and Current source inverter fed induction motor drives -voltage fed inverter control-v/f control.

UNIT III SYNCHRONOUS MOTOR DRIVES **9 Hours**

Modelling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

UNIT IV PERMANENT MAGNET MOTOR DRIVES **9 Hours**

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

UNIT V SWITCHED RELUCTANCE MOTOR DRIVES			9 Hours
Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: -- Hr**	**Total Hours: 45 Hrs**

Text Books	
1.	B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2.	V Subramanyam , " Thyristor control of Electric Drives ", Tata Mcgraw hill, 2012
REFERENCES	
1.	P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
2.	R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC press, 2006.
3.	H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4.	R. Krishnan, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications", CRC press, 2006.

U15MC903R	Professional Elective 1 ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Explain steps involved in Rapid tooling and Addictive manufacturing.
CO2:	Discuss various fabrication & modelling techniques.
CO3:	Analyse the working principle of various precision instruments based on laser, Electron beam machine.
CO4:	Describe the concept of 3D printing, Direct and Indirect tooling techniques.
CO5:	Identify the suitable AM process to fabricate metallic components through reverse engineering.

Pre-requisite

1. Engineering Physics
2. Manufacturing Technology

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

UNIT I INTRODUCTION **9 Hours**

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats – Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems

UNIT II LIQUID POLYMER AND SOLID BASED SYSTEMS **9 Hours**

Stereo lithography Apparatus (SLA), Digital Light Projection (DLP), Photo polymerization process, Solid Ground Curing (SGC), Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.

UNIT III POWDER BASED SYSTEMS	9 Hours
Selective Laser Sintering (SLS), Three-dimensional Printing (3DP), 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 IV OPEN SOURCE PRINTER AND RAPID TOOLING	**9 Hours**
Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, 3D printing direct, 3D Metal printing, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications	
UNIT V REVERSE ENGINEERING AND APPLICATIONS OF ADDITIVE MANUFACTURING	**9 Hours**
Reverse Engineering - Application of CMM, Laser scanner, CT and MRI scan in acquiring point data - Software for STL file processing. Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems	

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

	Text Books
1.	C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
2.	D. T.Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
	REFERENCES
1.	I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
2.	L.W. Liou, F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
3.	A. K. Kamrani, E. A. Nasr, Rapid Prototyping: Theory and practice, Springer, 2006

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: Mechatronics Engineering

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit
Theory							
1	U15MC601R	Python programming		3	0	0	3
2	U15MC602R	Power Electronics		3	0	2	4
3	U15MC603R	Automotive Electronics		3	0	0	3
4	U15MC604R	Artificial Intelligence		3	0	0	3
5	noc21-me55	**Professional Elective: (NPTEL)**	Principles of Mechanical Measurement	3	0	0	3
	noc21-ee05		Control Engineering				
6	U15CE1004R	**Open Elective**	Municipal Solid Waste Management	3	0	0	3
	U15EE1001R		Electric Mobility				
	U15EE1006R		Renewable Energy Systems				
	U15FT1001R		Fundamentals of Fashion Design				
	U15IT1003R		Problem solving Techniques Using Java Programming				
	U15IT1005R		Introduction to Database Technology				
	U15ME1002R		Renewable Energy Sources				
	U15ME1004R		Industrial Safety				

Practical						
7	U15MC605R	Python Programming Laboratory	0	0	4	2
8	U15ENG601R	Communication Skills Laboratory	0	0	2	1
9	U15MC606R	Mini Project-II	0	0	2	1
10	U15GE601BR	Soft Skill and Aptitude – IV	0	0	2	1
					Total Credits	24

Approved By

Chairperson, Mechatronics Engineering BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/ Mechatronics Engineering, Sixth Semester BE MCT Students and Staff, COE

U15MC601R	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Write the logic in the form of algorithm and pseudo code.
CO2:	Illustrate the basic concepts of python programming.
CO3:	Design and develop the various data structures using python.
CO4:	Apply exception handling and code organization mechanisms using python.
CO5:	Solve the problems using advanced concepts in python.

Pre-requisite

Programming in C

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Introduction	9 Hours

Introduction to Programming: Why Programming? - What is a program? - Variables and Operators - Decision constructs - Iteration constructs, Algorithms: Introduction and representation, Python Programming: What is a programming language? - Variables and Data types - Operators - Implicit/Explicit Type conversions

Unit 02: Basic Programming using Python	9 Hours

Control Structures: Selection Control Structures - Iteration Control Structures, Unit Testing: Path Coverage - Boundary Value Analysis, Introduction to Debugging, Functions in Programs: Syntax - Argument behaviour - Recursive Functions

Unit 03: Data Structures in Python	9 Hours

Collections: List, Array, Tuple, String, Set, Dictionary, Types of arguments, Variables and its scope

Unit 04: Exception Handling and Code Organization using Python	9 Hours

Exception Handling - Modules and Packages - Libraries and Functions, File Handling

Unit 05: Advanced Python	9 Hours

Regular Expressions, Concurrency, Lambda functions, Higher Order functions, Scientific Computing using Python: Saving Scripts- Numpy Arrays - IPython Notebooks

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

	Text Books
1.	Ashok Namdev Kamthane (Author), Amit Ashok Kamthane "Programming and Problem Solving with Python" McGraw-Hill Education, 2018
2.	Swaroop C N, " A Byte of Python ", ebshelf Inc., 1 st Edition, 2013
	REFERENCES
1.	Wesley J. Chun, "Core Python Programming", Pearson, 2nd Edition, 2006
2.	Allen B.Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly Media, 2 nd Edition, 2015

U15MC602R	POWER ELECTRONICS	L	T	P	C
		3	0	2	4

Course Outcomes

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

CO1:	Explain different types of power semiconductor devices and their VI and switching characteristics with protection circuits.
CO2:	Illustrate the operation, characteristics and performance parameters of single phase and three phase controlled converters.
CO3:	Classify different types of chopper and to analyse the operation of choppers with relevant mode waveforms.
CO4:	List various types of inverter and Explain the operation of single phase and three phase inverters with and outline voltage control and harmonic reduction methods.
CO5:	Explain operation of single phase and three phase AC voltage regulators with its sequence control techniques and Summarise the operation of cycloconverters

Pre-requisite

Electron Devices and Circuits

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Power Semi-Conductor Devices	9+6 Hours

Symbol, VI and Switching characteristics of Power diodes, SCR, BJT, MOSFET, IGBT and IGCT – Firing and Gating circuits for MOSFET, IGBT – Protection for thyristor – Series and parallel operation of SCR and MOSFET.

Unit 02: Phase-Controlled Converters	9+6 Hours

Single phase half wave and full wave converter - half controlled bridge converter and full controlled bridge converter with R,RL Load – Estimation of average & RMS values of load voltage, load current and input power factor.

Three phase full bridge converter – Half controlled and fully controlled converter with R, RL Load – Estimation of average & RMS values of load voltage, load current for R load.

Unit 03: DC to DC Converter	9+6 Hours

DC Choppers : Principle of step up , step down chopper and Step Up/Down Chopper operation – Control strategies – Classification & operation of choppers class(A,B,C,D,E) – Operation of voltage, current and load commutated choppers

Unit 04: Inverters	9+6 Hours

Types of inverters – operation of Single phase and three phase (120 °, 180 °) voltage source inverter modes analysis with star connected R load – operation of single phase current source inverter – series inverters – parallel inverter – Voltage control of Single phase inverters – harmonic reduction techniques and filters			
Unit 05: AC to AC Converters			9+6 Hours
AC Voltage Controllers : Single phase voltage regulators – half wave and full wave with R, RL loads – sequence control of AC regulators – two stage sequence regulator with R, RL load – Multistage sequential control of AC regulators – Introduction to Three phase regulators (no analysis). Cycloconverters : Single phase to single phase cycloconverter – three phase to single phase and three phase to three phase cycloconverters.			
Theory: 45 Hrs	Tutorial: --	Practical: 30 Hrs	Total Hours: 75 Hrs

Text Books	
1.	M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson India, fourth edition, 2018.
2.	P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition 2003.
REFERENCES	
1.	Singh.M.D.&Khanchandani.K.B. Power Electronics Mcgraw Education (India) Private limited, New Delhi 2016.
2.	Ned Mohan, Tore. M.Undeland, William.P.Robbins, 'Power Electronics: Converters, applications and Design', John Wiley and sons, third edition, 2003.
3.	Philip T. Krien, " Power Electronics' Oxford University Press, 2012.
4.	Daniel.W.Hart, "Power Electronics", Indian Edition, McGraw Hill, 3 rd Print, 2013.

U15MC603R	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Deliberate the various types of sensors and microprocessor application in automobiles.
CO2:	Demonstrate the engine control systems.
CO3:	Analyze the electronic management systems used in auto motives.
CO4:	Investigate the hydraulic actuation system, Vehicles lighting Circuits and electric windows systems.
CO5:	Examine the various applications electronic control systems used in auto motives.

Pre-requisite

Basic Electrical and Mechanical Engineering

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Fundamentals of Automotive Electronics	9 Hours

Basic sensor arrangement – Types of sensors. Oxygen Sensor – Cranking Sensor – Position Sensors – Engine cooling water temperature Sensor – Engine oil pressure Sensor – Fuel metering – Vehicle speed sensor and detonation sensor – Stepper motors – Relays, solenoids - Microprocessor and Micro Computer applications in automobiles.

Unit 02: Engine Management Systems	9 Hours

Introduction - components for engine management system - Open loop and closed loop control system – Engine cranking and warm up control – Acceleration, deceleration and idle speed control-Integrated engine system – Feedback carburetor system – Throttle body injection and multi point fuel injection system– Advantage of electronic ignition systems – Types of solid state ignition systems and their principles of operation – Electronic spark timing control.

Unit 03: Electronic Management Systems	9 Hours

Introduction-Electronic management of chassis systems, Vehicle motion control, anti - lock braking system, Tyre pressure monitoring system, Collision avoidance system, Traction control system, Active suspension system, Key less entry system and Electronic power steering system.

Unit 04: Electronics Actuators	9 Hours

Wiper system, flasher, electric fuel pump, hydraulic actuation system, Brake Actuation Warning

System. Traficators, Flash System, Windshield Wiper, Starting Systems – Charging Systems –climate control and electronic displays, Vehicles lighting Circuits Signaling Circuit, electric windows systems, seat belt tensioners.			
Unit 05: Electronics Control Systems			9 Hours
Introduction of Control Systems - Automatic Cabin climate control, Automatic Cruise Control, Air Bag Control, ABS Control, Automatic Transmission Control, Electronic steering Control, Automatic gear control, Electric Power Steering, Electronic Distributor-less ignition control, Electronic Fuel Control Exhaust emission control , Electronic Clutch Control, Automotive central locking and anti-theft system control.			
Theory: 45 Hrs	Tutorial: --	Practical: -- Hr	Total Hours: 45 Hrs

Text Books	
1.	William Ribbens, Understanding Automotive Electronics, Newnes Publishers, India, 2013.
2.	U.Kiencke, and L. Nielson, "Automotive Control Systems", Springer Verlag Berlin, 2000
3.	Jiri Marek, Hans Peter trah, 'Sensers Applications, Sensers for Automotive Technology', 1st Edition (Wiley -VCH)
4.	Bechfold, Understanding Automotive electronics, SAE, 1998.
REFERENCES	
1.	Robert Bosch, "Automotive Handbook" SAE, 2003.
2.	W.F. Walter, Electronic Measurements", Macmillan Press Ltd., London.
3.	E.Dushin, Basic Metrology and Electrical Measurements", MIR Publishers, Moscow, 1989.
4.	Sonde.B.S. "Transducers and Display System", Tata McGraw Hill Publishing Co. Ltd.New Delhi
5.	Judge.A.W, „Modern Electric Equipments for Automobiles", Chapman and Hall, London.

U15MC604R	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Identify and design suitable agent program for the given problem
CO2:	Solve real time problems using heuristic based algorithms
CO3:	Design logical agent to construct knowledge base and deduce proofs through inference rules
CO4:	Design decision making agent to explore uncertainties in the problem domain using probabilistic reasoning methods
CO5:	Solve the problems using suitable machine learning algorithm and design expert systems

Pre-requisite

Object Oriented Programming and Data Structures

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodletest (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Introduction	9 Hours

The foundations of AI - The History of AI- Intelligent agents- Applications–Problem solving – Problem spaces–Searching techniques–Blind search strategies: Breadth first search–Depth first search–Iterative deepening–Bi-directional search–Comparing search strategies

Unit 02: Problem Solving	9 Hours

Informed/ Heuristic search - A* search - Hill-climbing search- Genetic Algorithm– Markovian Decision Process (MDP) – Maximum value policies, Adversarial games– value/policy iteration – Minimax – Alpha-beta pruning – Temporal difference (TD) - Constraint satisfaction problem - factor graphs - Backtracking search.

Unit 03: Knowledge Representation and Reasoning	9 Hours

Knowledge representation - Logics – First order logic- Inference in first order logic – Higher order logic - Markov logic- Forward and backward chaining- Unification and resolution- Ontological engineering

Unit 04: Uncertain knowledge and Decision making	9 Hours
Uncertainty-Probabilistic reasoning - Semantics of Bayesian network - Inference in Bayesian network- Direct sampling method - Probabilistic reasoning over time – Hidden Markov Models- Basics of utility theory, sequential decision problems - decision network– policy -Decision process in infinite horizon: Optimal policy, Value iteration - policy iteration- Partially observable decision process	
Unit 05: Learning	9 Hours
Learning from observation – Types of learning – Supervised Learning - Unsupervised and Reinforcement learning- Knowledge in learning- Expert system – Interface –Language and tools	

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

Text Books

1.	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2014.
2.	SIA publishers, "Artificial Intelligence", SIA Publishers and Distributors (P) Ltd, 2019.
3.	Peter Jackson, "Introduction to Expert Systems", 3rd edition, AWL, 1999

REFERENCES

1.	David Pool and Alan Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University, 2011.
2.	Christopher M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2013.
3.	Nils J. Nilsson, "The Quest for Artificial Intelligence: A History of Ideas and achievements", Cambridge University Press, 2010.
4.	Daphne Koller and N Friedman, "Probabilistic Graphical Models - Principles and Techniques", MIT, 2009

noc21_me55	Principles of Mechanical Measurement	L	T	P	C
		3	0	0	3

Course Outline :

Measurement is always of fundamental significance to the practicing engineers. For the development of any mechanical design procedure, experiments are of paramount interest. Accordingly measurement and correct interpretation of the concerned observation are necessary part of any standard engineering task and also R&D. Present course will introduce the students to the fundamentals of measurement, discussing about various relevant concepts & terminologies. The mathematical background required to categorize & analyze various measurement devices will be prepared and a very pertinent discussion on digitalization will be presented. Subsequently several classical and modern procedures for measuring parameters of scientific interest, such as displacement, motion, stress, force, flow, pressure, temperature etc., will be discussed in detail. Measurement is a topic of fundamental interest in engineering and hence any engineering firm & concerned industry should find this course interesting & valuable.

Intended audience :

Undergraduate students of Mechanical Engg. and similar branches; Faculty member associated with Mechanical Engg.; Practicing engineers associated with production/manufacturing industries.

Prerequisites : :

No specific pre-requisite. Fundamental knowledge of Mechanics and basics of Mathematics should be sufficient.

Course layout:

Week 1 : Introduction to Measurement
Week 2 : Response of Measurement Systems
Week 3 : Digital Techniques in Measurement
Week 4 : Data Processing
Week 5 : Displacement Measurement
Week 6 : Stress and Strain Measurement
Week 7 : Force and Torque Measurement
Week 8 : Pressure Measurement
Week 9 : Flow Measurement
Week 10 : Temperature Measurement
Week 11 : Motion Measurement
Week 12 : Special Topics

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

Text and references Books

1.	T.G. Beckwith, J.H. Lienhard V & R.D. Marangoni, Mechanical Measurements, Pearson, New Delhi, 2013.
2.	E.O. Doeblin & D.N. Manik, Measurement Systems, 6th edition, McGraw Hill India Pvt. Ltd., New Delhi, 2013.
3.	J.P. Holman, Experimental Methods for Engineers, 7th edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2004.

noc21_ee05	Control Engineering	L	T	P	C
		3	0	0	3

Course Outline :

This course shall introduce the fundamentals of modeling and control of linear time invariant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems. The 11th module of the course will cover a detailed application of filter design in the field of navigation and human movement (gait). Students will be able to design their very own basic navigational system using inertial sensors and microcontrollers. Any industry into Industrial Automation

Intended audience :

Undergraduate students taking course on Control Engineering

Prerequisites : Network and Circuits,
Basic Engineering Mathematics.

Course layout:

Week 1: Mathematical Modelling of Systems
Week 2: Laplace Transforms, transfer functions, block diagram representation.
Week 3: Block diagram reduction, Time response characteristics.
Week 4: Introduction to stability, Routh Hurwitz stability criterion.
Week 5: Root locus plots, stability margins.
Week 6: Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain.
Week 7: Basics of control design, the proportional, derivative and integral actions.
Week 8: Design using Root Locus
Week 9: Design using Bode plots
Week 10: Effects of zeros, minimum and non-minimum phase systems.
Week 11: State space analysis
Week 12: Design using State space

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

Text Books

1.	Control Systems Engineering, Norman S. Nise, Wiley, 6th edition.
2.	Modern Control Engineering, Katsuhiko Ogata, Pearson Education Inc.

References Books

1.	Modern Control Systems, Richard C. Dorf, Robert H. Bishop, 12th Edition
2.	Automatic Control Systems, Farid Golnaraghi and Benjamin C Kuo, 9th Edition, John Wiley and Sons
3.	Feedback Systems: An Introduction for Scientists and Engineers, by Karl Astrom and Richard
4.	M.Murray.(http://www.cds.caltech.edu/~murray/books/AM05/pdf/am08 complete_22Feb09.pdf)
5.	MATLAB Tutorials

U15MC605R	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Develop Python programs to implement basic concepts
CO2:	Develop Python programs to implement advanced concepts
CO3:	Develop Python programs for database handling

Pre-requisite

Programming in C

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	3	3	2	1	3	3	3
CO2	3	3	3	3	3	1	1	3	3	2	1	3	3	3
CO3	3	3	3	3	3	1	1	3	3	2	1	3	3	3

Course Assessment methods

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

List of Experiments

1.	Write a Python program to print the calendar of a given month and year.
2.	Write a Python program to count the number 5 in a given list of numbers.
3.	Write a Python program to remove and print every second number from a list of numbers
4.	until the list becomes empty.
5.	Write a Python program to get a single string from two given strings, separated by a space and swap the first two characters of each string. Sample String: 'Python' 'Java', Output: String: 'Jython' ' Pava'.
6.	Write a Python function to check whether a string is a pangram or not. (Note: Pangrams are words or sentences containing every letter of the alphabet at least once. For example: "The quick brown fox jumps over the lazy dog"
7.	Write a Python program to check whether an element exists within a tuple.
8.	Write a Python program to get a list, sorted in increasing order by the last element in each tuple from a given list of non-empty tuples. Sample List: [(2, 5), (1, 2), (4, 4), (2, 3), (2,1)], Expected Result: [(2, 1), (1, 2), (2, 3), (4, 4), (2, 5)].
9.	Write a Python script to check if a given key already exists in a dictionary.
10.	Write a Python function that accepts a string and calculate the number of uppercase letters and lowercase letters. Sample String: 'Sona College of Technology' Expected Output: No. of Uppercase characters: 3 No. of Lower case Characters: 20.
11.	Write a Python program to find the greatest common divisor (gcd) of two integers using recursion.
12.	Write a Python program to combine each line from first file with the corresponding line in second file

13.	Write a Python class to find validity of a string of parentheses, '(', ')', '{', '}', '[' and ']. These brackets must be close in the correct order, for example "()" and "()[]{}" are valid but "[)", "({[)]" and "{{{" are invalid.
14.	Write a Python program to execute SQL queries like create, insert, delete, update and select in any of the database like MySQL, SQLite etc.
	Total Hours: 60 Hrs

U15MC606R	MINI PROJECT-II	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Frame a real world problem, identify the requirement and develop the design solutions. Express the technical ideas, strategies and methodologies.
CO2:	Apply the new tools, algorithms, techniques that contribute to obtain the solution of the project. Examine and validate through conformance of the developed prototype and analysis the cost effectiveness.
CO3:	Prepare report and present the oral demonstrations.

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	2	2	2	2	2	1	1	3	2
CO2	3	3	3	3	3	2	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	2	3	3	3	3	1	1	3	2

Course Assessment methods

Direct		Indirect
Review- I (10 marks) Review- II (10 marks) Review- III (10 marks) Project report (20 marks)	End semester Examination (50 marks)	Course end survey

1. The students formed into a team of convenient groups of not more than 3 members on a project are not allowed to change their team members.
2. Every project team should report to their faculty guide for discussion from the day of beginning of 6^{th} semester.
3. The group has to analyze the selected problem addressed in their project work to draw solution.
4. A project report has to be submitted by each student group at the end of the 6^{th} semester.
5. Three reviews have to be conducted by a team of faculty (minimum of 1 and maximum of 2) along with their faculty guide as a member of faculty team (for monitoring the progress of project planning and implementation).

Total Hours: 30 Hrs

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.

MCT

U15MC1001R	AUTOMATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Know the requirements of industrial Automation
CO2:	Identify the configuration and components of PLC devices
CO3:	Select the I/O devices interfacing with PLC
CO4:	Analyse the networking requirements and visualization of the industries
CO5:	Automate the real time industries

Pre-requisite

Electronic Devices and circuits

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	P09	PO10	PO1 1	PO1 2	PSO1	PSO2
CO1	3	3	3	2			2			2			3	2
CO2	3	3	3	2			2			2			3	2
CO3	3	2	3	2	3		2			2			3	2
CO4	3	3	3	2			2			2			3	2
CO5	3	3	3	2			2			2			3	2

Course Assessment methods

Direct		Indirect
Internal test I (6) Internal test II (6) Internal test III (6) Assignment (5)	Seminar/ Assignment (5) Moodle test (7) Attendance (5) End semester Examination (60)	Course end survey

UNIT I INTRODUCTION TO INDUSTRIAL AUTOMATION	**9 Hours**

Need of automation in industries – Evolution of PLC – Construction and working of Mechanical relay – Relay logic – simple relay ladder diagram for real time examples – relay interlocking - Advantages over relay logic.

UNIT II PLC HARDWARE	**9 Hours**

PLC configuration and various components of the PLC – PLC inputs and outputs modules – Power Supplies – Programming format – Construction of PLC Ladder Diagrams – CPU, I/O cards – Processor less PLCs.		
UNIT III	**PLC I/O Devices**	**9 Hours**
Input devices : Manually operated switches - Mechanically operated switches – Temperature and proximity switches – Analog I/P devices. Output devices: Stepper and servomotors - hydraulic and pneumatic actuators – Analog valves.		
UNIT IV	**PLC NETWORKING and SCADA**	**9 Hours**
Networking of PLCs-Data Communication-Fieldbus, PROFI bus, and Mod bus-OSI Model types-OPC function. Human Machine Interface - Supervisory Control and Data Acquisition-Architecture-Remote terminal unit-Master terminal unit-Data storage.		
UNIT V	**APPLICATION IN REAL TIME INDUSTRIES**	**9 Hours**
Automatic Bottle Filling Systems- Traffic Light Control – Hydraulic press control system – car washing system – Automation in power plants.		
Theory: 45 Hrs	**Tutorial: --**	**Total Hours: 45 Hrs**

Text Books

1.	Frank D Petruzella, "Programmable Logic Controllers", McGraw Hill Publishers, 3 rd Edition, 2010.
2.	John W. Webb and Ronald A. Reis "Programmable Logic Controllers", Prentice – Hall of India Publishers, 2007.

REFERENCES

1.	John R Hackworth, "Programmable Logic Controllers: Programming Methods and Applications", Pearson education, 1st Edition, 2003.
2.	Siemens PLC Hand book for total automation
3.	Allen – Bradley hand book for total automation
4.	GE – Fanuc hand book for total automation

U15MC1002R	3D PRINTING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Explain steps involved in Rapid tooling and Addictive manufacturing.
CO2:	Discuss various fabrication & modelling techniques.
CO3:	Analyse the working principle of various precision instruments based on laser, Electron beam machine.
CO4:	Describe the concept of 3D printing, Direct and Indirect tooling techniques.
CO5:	Identify the suitable AM process to fabricate physical components.

Pre-requisite

1. Engineering Physics
2. Manufacturing Technology

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Introduction **9 Hours**

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats – Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems

Unit 02: Liquid Polymer and Solid Based Systems **9 Hours**

Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Photo polymerization process, Solid Ground Curing (SGC), Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) -

Working Principle, Construction, Materials and Applications.				
Unit 03: POWDER BASED SYSTEMS				**9 Hours**
Selective Laser Sintering (SLS), Three-dimensional Printing (3DP), 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 04: OPEN SOURCE PRINTER AND RAPID TOOLING				**9 Hours**
Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications				
Unit 05: APPLICATIONS OF ADDITIVE MANUFACTURING				**9 Hours**
Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems				
Theory: 45 Hrs	**Tutorial: --**	**Practical: Hr**		**Total Hours: 45 Hrs**

	Text Books
1.	C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
2.	D. T.Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
	REFERENCES
1.	I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
2.	L.W. Liou, F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
3.	A. K. Kamrani, E. A. Nasr, Rapid Prototyping: Theory and practice, Springer, 2006

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for B.E/B.Tech. Semester VII 2015R (CBCS)
Branch: Mechatronics 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	U15MC701R	Robotics		3	0	0	3	45
3	U15MC702R	Micro Electro Mechanical Systems		3	0	0	3	45
4	U15MC904R	**Elective**	Image Processing and Computer vision	3	0	0	3	45
5	U15MC905R	**Elective**	Industrial Engineering	3	0	0	3	45
	U15MC906R		Total quality management					
6	U15CS1004R	**Open Elective**	Mobile Application Development	3	0	0	3	45
	U15EC1008R		Mobile Technology and its Applications					
	U15EE1004R		Energy Conservation and Management					
	U15EE1006R		Renewable Energy Systems					
	U15EE1007R		Innovation, IPR and Entrepreneurship Development					
	U15IT1003R		Problem Solving Techniques Using Java Programming					
	U15ME1004R		Industrial Safety					
	U15ME1005R		Maintenance Engineering					
	U15ME1010R		3D Printing					

Practical							
7	U15MC703R	Robotics Laboratory	0	0	4	2	60
8	U15MC704R	Image Processing Laboratory	0	0	3	1.5	45
9	U15MC705R	Technical Seminar	0	0	3	1.5	45
					Total Credits	**23**	

Approved By

Chairperson, Mechatronics Engineering BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/ Mechatronics Engineering, Seventh Semester BE MCT Students and Staff, COE

U15GE701R	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
		3	0	0	3

Course Outcomes

After successful completion of this course, the students should 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

Pre-requisite:

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CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodletest (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: HUMAN VALUES — **9 Hours**

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 02: ENGINEERING ETHICS — **9 Hours**

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 03: ENGINEERING AS SOCIAL EXPERIMENTATION — **9 Hours**

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

Unit 04: ENGINEER'S RESPONSIBILITY FOR SAFETY — **9 Hours**

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 05: GLOBAL ISSUES				**9 Hours**
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.				
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**		**Total Hours: 45 Hrs**

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.

REFERENCES	
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.

U15MC701R	ROBOTICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Express the basic concepts, laws, components and parameters of robots
CO2:	Explain the types of grippers and its functions.
CO3:	Evaluate the kinematic calculations and apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of robots
CO4:	Describing the various programming techniques used in industrial robots
CO5:	Basis of machine vision and apply the concept of image processing

Pre-requisite

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CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodletest (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: FUNDAMENTALS OF ROBOTICS — **9 Hours**

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracyresolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives.

Unit 02: ROBOT END EFFECTORS — **9 Hours**

Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

Unit 03: ROBOT MECHANICS — **9 Hours**

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformationforward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

Unit 04: ROBOT PROGRAMMING	9 Hours
Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.	
Unit 05: MACHINE VISION FUNDAMENTALS	**9 Hours**
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology. Communication between robots-Case studies.	

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

TEXT BOOKS

1.	M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.

REFERENCES

1.	John.J.Craig, " Introduction to Robotics: Mechanics & control"Pearson Publication, Fourth edition, 2018.
2.	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010.
3.	K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.
4.	Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

U15MC702R	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Retrieve the scaling laws used in conceptual design of microsystems.
CO2:	Select a suitable micro manufacturing technique for the fabrication of a specific MEMS device.
CO3:	Summarize the materials and working principles of micro sensors.
CO4:	Design and working of Micro actuators.
CO5:	Intrepret concepts of quantum mechanics and nano systems.

Pre-requisite

1. Engineering Physics
2. Sensors and Instrumentation

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: MICROSYSTEMS AND MINIATURIZATION — **9 Hours**

Introduction to Microsystems and microelectronics - Applications of micro system in automotive , bio medical,aerospace - telecommunication industries. Trimmer's scaling vector and scaling laws - scaling in geometry- scaling in rigid body dynamics- scaling in electrostatic forces-scaling in electricity.

Unit 02: MEMS FABRICATION TECHNOLOGIES — **9 Hours**

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology.

Unit 03: MICRO SENSORS	9 Hours
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors.	
Unit 04: MICRO ACTUATORS	**9 Hours**
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps.	
Unit 05: MICROSYSTEMS PACKAGING AND APPLICATIONS	**9 Hours**
Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials. Other Applications: Optical MEMS: Micro mirrors, optical switches, RF-MEMS: RF resonators for filters, frequency sources, Power MEMS: micro power sources, batteries and solar cells vs. MEMS based devices, energy harvesting, NEMS -sensors.	

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

TEXT BOOKS

1. Marc Madou, "Fundamentals of Micro fabrication", CRC press 1997.
2. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017.

REFERENCES

1. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011.
2. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010.
3. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002.

U15MC904R	Elective: IMAGE PROCESSING AND COMPUTER VISION	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Implement image enhancement algorithms.
CO2:	Apply image transforms for different image applications.
CO3:	Perform different segmentation and restoration.
CO4:	Implement different compression techniques.
CO5:	Develop algorithms for computer vision problems.

Pre-requisite

--

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodletest (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: IMAGE ENHANCEMENT — **9 Hours**

Digital Image fundamentals - Types of Images – Relationship between pixels-Image sampling - Quantization - Spatial domain filtering - Image negative - Contrast stretching, Gray level slicing - Histogram equalization - Smoothing filters, Sharpening filters, Maximum filter, Minimum filter, Median filter.

Unit 02: IMAGE TRANSFORM — **9 Hours**

2D transforms - DFT - DCT - Walsh - Hadamard - Slant - Haar - KLT - SVD - Wavelet transform.

Unit 03: IMAGE RESTORATION AND SEGMENTATION — **9 Hours**

Image restoration - degradation model - Unconstrained and Constrained restoration - Inverse filtering - Wiener filtering - Image segmentation - Thresholding - Edge detection - Region based segmentation.

Unit 04: IMAGE COMPRESSION	9 Hours
Need for data compression - Huffman - Arithmetic coding - LZW technique – Compression. standards JPEG – MPEG.	
Unit 05: COMPUTER VISION	**9 Hours**
Image classification - Feature extension - Markov Random Field Matrix – Gray Level Co – occurrence Matrix – Gray Level Weight Matrix , Multi Resolution Combined Statistical and Spatial Frequency method, character recognition- zoning approaches, Medical Image Analysis – Diabetic Retinopathy – Glaucoma.	

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

TEXT BOOKS

1.	Rafael C.Gonzalex, Richard E.Woods, "Digital Image Processing, Pearson Education. Inc"., Forth Edition, 2018.
2.	Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2004.

REFERENCES

1.	Richard Szeliski, "Computer Vision Algorithms and Applications", Springer Verlag London Limited, 2011.
2.	Sabeenian R.S., "Digital Image Processing", Sonaversity publication, Second Edition, 2010.
3.	Annadurai S., R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education India, 2007.
4.	Sridhar.S, "Digital Image Processing", Oxford University Press, First Edition, 2011.
5.	Kenneth R. Castleman, "Digital Image Processing", Pearson, 2009

U15MC905R	Elective: INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Select proper plant layout for the required production system.
CO2:	Plan the resources required for the production and to perform the control methods.
CO3:	Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
CO4:	Analyze the inventory required based on production needs and material handling.
CO5:	Explain the system and different types of maintenance process for smooth operations.

Pre-requisite

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks)	Seminar/ Assignment (5 marks)	Course end survey
Internal test II (6 marks)	Moodletest (7 marks)	
Internal test III (6 marks)	Attendance (5 marks)	
Assignment (5 marks)	End semester Examination (60 marks)	

Unit 01: INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM — **9 Hours**

Industrial engineering - Concept, History and Development, Applications, Roles of Industrial engineer. Production management, Industrial engineering versus Production management, Operations management. Production system Analysis, Input-output model, Productivity, Factors affecting productivity. Plant layout, Criteria for a good layout, Types of layout - Process layout, Product layout, Combination layout, and Fixed position layout. Material flow pattern, Workstation design.

Unit 02: PROCESS PLANNING AND PRODUCTION CONTROL — **9 Hours**

Introduction to Process planning- Definition, Procedure, Process selection, Machine capacity, Process sheet, Process analysis. Group technology - Definition, Classification and coding system, Formation of component family. Production planning - Introduction, Functions, Loading, Scheduling. Production control - Dispatching, Routing. Progress control - Bar, Curve, Gantt chart, Route and Schedule chart.

Unit 03: WORK STUDY AND ERGONOMICS	9 Hours
Work study - Definition, Need, Advantages, Objectives of method study and work measurement, Method study procedure. Process chart - symbols, outline process chart, flow process chart. The flow diagram, String diagram, Multiple activity chart, Principles of motion economy, Therbligs, SIMO chart, Stopwatch procedure. Ergonomics- applications of ergonomic principles in the shop floor- work benches- seating arrangement.	
Unit 04: INVENTORY MANAGEMENTAND MATERIAL HANDLING	**9 Hours**
Inventory - Definition, Objectives, Classification, Functions, Economic order quantity, Economic batch quantity, Inventory models, ABC analysis. Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, Just in Time manufacturing system, KANBAN technique, Material handling - Definition, Functions, Principles, Equipment selection, and Equipment types.	
Unit 05: SYSTEM ANALYSIS AND MAINTENANCE	**9 Hours**
System concept, System analysis, System engineering, Techniques, Applications. Value analysis/ Engineering - Definition, Types of values, Aim, Technique, Procedure, Advantages, Applications, Value engineering versus Value control. Plant maintenance department - Objectives, Importance, Duties, Functions, and Responsibilities. Types of maintenance - Breakdown, Scheduled, Preventive and Predictive. Plant maintenance schedule - Introduction, Procedure.	

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

Text Books

1.	Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications, 2010.
2.	Panneerselvam R., Production and operations management, Heritage Publishers, 2006.

REFERENCES

1.	Martand T. Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006.
2.	Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009.
3.	Jan Dul, Bernard Weerdmeester, Ergonomics for Beginners: A Quick Reference Guide, CRC Press, Taylor and Francis group, 2008.
4.	Lee J. Krajewski, Larry P. Ritaman, Operations Management, Addison Wesley, 2007.

U15MC906R	Elective: TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Justify their philosophies/ contributions in Quality Management.
CO2:	Manage quality improvement teams.
CO3:	Justify the tools of quality and four levels of benchmarking.
CO4:	Explain the concept of Six Sigma and its DMAIC process.
CO5:	Understand the need for ISO and its implementation methods.

Pre-requisite

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3				3	3			3	3	3
CO2		3	3	3			3	8					3	3
CO3			3	3		3		3	3			3	3	3
CO4	3	3	3		3								3	3
CO5	3	3	3		3								3	3

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: INTRODUCTION — **9 Hours**

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Costs of quality.

Unit 02: TQM PRINCIPLES — **9 Hours**

Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

Unit 03: TQM PRACTICES — **9 Hours**

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT– Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

Unit 04: TQM TOOLS AND TECHNIQUES	9 Hours
Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function–Lean manufacturing – TPM – Concepts, improvement needs – Performance measures.	
Unit 05: QUALITY SYSTEMS	**9 Hours**
Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.	

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

TEXT BOOKS

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

U15MC703R	ROBOTICS LABORATORY	L	T	P	C
		0	0	4	2

Course Outcomes

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

CO1:	Identify different parts and components robots.
CO2:	Use robotic simulation software and demonstrate.
CO3:	Write programming for simple operations.

Pre-requisite

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CO/PO, PSO Mapping

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

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

Course Assessment methods

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

List of Experiments

1.	Determination of maximum and minimum position of links
2.	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3.	Estimation of accuracy, repeatability and resolution.
4.	Robot programming and simulation for pick and place
5.	Robot programming and simulation for Colour identification
6.	Robot programming and simulation for Shape identification
7.	Robot programming and simulation for machining (cutting, welding)
8.	Robot programming and simulation for writing practice
9.	Robot programming and simulation for any industrial process (Packaging, Assembly)
10.	Robot programming and simulation for multi process.
	Total Hours: 60 Hrs

U15MC704R	IMAGE PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

Course Outcomes

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

CO1:	Write a MATLAB code to demonstrate and perform various operations related to image processing.
CO2:	Generate a LABVIEW code to demonstrate and perform various operations related to image processing.
CO3:	Write a MATLAB code or Generate a LABVIEW code to extract features from Images.

Pre-requisite

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CO/PO, PSO Mapping

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

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

Course Assessment methods

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

List of Experiments

Using Lab VIEW

1.	Displaying the Image Properties and Pixel Distance.
2.	Extraction of planes from a given image - RGB and HIS.
3.	Image Arithmetic (Addition, Subtraction, Multiplication and division of two image).
4.	Scalar processing of an image (Addition, Subtraction, Multiplication and division of a scalar quantity on an image).
5.	Computing the DWT of an image and displaying the LL, LH, HL and HL images.

Using MATLAB

6.	Demonstrating False Contour Effect.
7.	Extraction and display of each bits as an image for a given 8 bit gray scale image.
8.	Frequency Domain Image Enhancement.
9.	Spatial Domain Image Enhancement.
10.	Demonstrating JPEG Compression using DCT.
11.	Creating a degradation model for a given image and applying Wiener Filter.
12.	Edge Detection Algorithms.
	Total Hours: 45 Hrs

U15MC705R	TECHNICAL SEMINAR	L	T	P	C
		0	0	3	1.5

Course Outcomes

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

CO1:	Select a topic relevant to analysis, design and management of a Mechatronics engineering system.
CO2:	Carry out a critical review of the literature on the chosen topic.
CO3:	Prepare and present a technical report.

Pre-requisite

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1		2	2	2	2	2	2	2	3	2
CO2	2	1	1	1		2	2	2	2	2	2	2	3	2
CO3			1	1		2	3	3	3	3	2	2	3	2

Course Assessment methods

Direct		Indirect
Relevance of the topic and literature survey (15) Presentation and discussion(30) Regularity in the class and Active Participation in the seminar(15)	End semester Examination (40)	Course end survey

To kindle as well as measure the ability of the student to study a topic in Mechatronics Engineering, of current relevance, from technical literature and present a seminar on that topic. Arousing their field of interest in Mechatronics engineering, individual students are guided to choose a topic. Give a seminar on that topic for about fifteen minutes. It enables the students to gain knowledge in any of the technically relevant current topics and imparts confidence in the students in presenting the topic. The student will undertake a detailed study on the chosen topic under the supervision of a faculty member, by referring to papers published in reputed journals and conference proceedings. The seminar coordinator for the respective class is appointed by the Head of the Department. Respective seminar coordinator of the section will monitor the attendance for the technical seminar hours. With the approval of the Head of the Department, the respective seminar coordinator will arrange for reviewing the seminar. Each student has to submit a seminar report, based on the papers he/she has studied; the report should not be a reproduction of any original paper. Instead the student should evolve and construct his/her own ideas and enrich the seminar presentation and report. The candidate is expected to submit the seminar report on or before the last working day of the semester. The report will be duly acknowledged by Head of the Department. Final evaluation will be conducted in the form of project viva voce and also seminar will be evaluated on an internal assessment basis.

Total Hours: 45 Hrs

U15MC1002R	3D PRINTING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO6:	Explain steps involved in Rapid tooling and Addictive manufacturing.
CO7:	Discuss various fabrication & modelling techniques.
CO8:	Analyse the working principle of various precision instruments based on laser, Electron beam machine.
CO9:	Describe the concept of 3D printing, Direct and Indirect tooling techniques.
CO10:	Identify the suitable AM process to fabricate physical components.

Pre-requisite

3. Engineering Physics
4. Manufacturing Technology

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (6 marks) Internal test II (6 marks) Internal test III (6 marks) Assignment (5 marks)	Seminar/ Assignment (5 marks) Moodle test (7 marks) Attendance (5 marks) End semester Examination (60 marks)	Course end survey

Unit 01: Introduction **9 Hours**

Needs - Impact of AM and Rapid Tooling on Product Development - Distinction between AM and CNC Machining- The Generalized AM Process chain - CAD Model - Input file formats – Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - RP Benefits - Classification of RP systems

Unit 02: Liquid Polymer and Solid Based Systems **9 Hours**

Stereolithography Apparatus (SLA), Digital Light Projection (DLP), Photo polymerization process, Solid Ground Curing (SGC), Fused Deposition Modeling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Materials and Applications.

Unit 03: POWDER BASED SYSTEMS **9 Hours**

Selective Laser Sintering (SLS), Three-dimensional Printing (3DP), 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 04: OPEN SOURCE PRINTER AND RAPID TOOLING	**9 Hours**
Concept of open source 3D printer - Structural details, Control mechanism - Materials and Applications. Introduction to rapid tooling (RT) - Direct and Indirect tooling - Silicone rubber moulding, Epoxy tooling, Spray Metal Coating, Electro Optical Sintering (EOS) - Working Principle, Materials and Applications	
Unit 05: APPLICATIONS OF ADDITIVE MANUFACTURING	**9 Hours**
Application of Rapid prototyping in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries. Leading manufacturer of RP systems	

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

	Text Books
3.	C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4.	D. T.Pham and S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
	REFERENCES
4.	I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010
5.	L.W. Liou, F.W. Liou, Rapid Prototyping and Engineering applications: A toolbox for prototype development, CRC Press, 2013.
6.	A. K. Kamrani, E. A. Nasr, Rapid Prototyping: Theory and practice, Springer, 2006

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	U15MC801R	Project Work	0	0	24	12	360
					Total Credits	**12**	

Approved By

Chairperson, Fashion Technology BoS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.P.Suresh	Dr.R.Shivakumar	Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/ Mechatronics Engineering, Eighth Semester BE MCT Students and Staff, COE