SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

B.E-Mechatronics Engineering

CURRICULUM and SYLLABI

[For students admitted in 2021-2022]

B.E / B.Tech Regulation 2019

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem

(An Autonomous Institution)

Courses of Study for B.E/B.Tech. Semester I under Regulations 2019 (CBCS)

Branch: Mechatronics Engineering

S.No.	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
Theory								
1	U19ENG101B	English for Engineers-I	1	0	2	2	HS	45 (15L+30P)
2	U19MAT102A	Linear Algebra and Calculus	3	1	0	4	BS	60
3	U19PHY103B	Engineering Physics	3	0	0	3	BS	45
4	U19CHE104G	Engineering Chemistry	3	0	0	3	BS	45
5	U19PPR105	Problem solving using Python Programming	3	0	0	3	ES	45
6	U19EGR106	Engineering Graphics	2	0	2	3	ES	60 (30L+30P)
Practical								
7	U19PCL108B	Physics and Chemistry Laboratory	0	0	2	1	BS	30
8	U19PPL111	Python Programming Laboratory	0	0	2	1	ES	30
9	U19GE101	Basic aptitude-I	0	0	2	0	EEC	30
		Total Credits				**20**		
Optional Language Elective*								
10	U19OLE1101	French	0	0	2	1	HS	30
11	U19OLE1102	German						30
12	U19OLE1103	Japanese						30

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

Approved By

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

Copy to:-

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

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

S.N	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
Theory								
1	U19ENG201B	English for Engineers -II	1	0	2	2	HSMC	45 (15L+30P)
2	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BSC	60
3	U19PHY203F	Physics for electron devices	3	0	0	3	BSC	45
4	U19CHE204E	Modern materials	3	0	0	3	BSC	45
5	U19MCT201	Engineering Mechanics	3	0	0	3	ESC	45
6	U19MCT202	Basic Electrical Engineering	3	0	0	3	ESC	45
Practical								
7	U19WPL212	Workshop Practice	0	0	2	1	ESC	30
8	U19MCT203	Basic Electrical Engineering and Devices Laboratory	0	0	4	2	ESC	60
9	U19GE201	Basic Aptitude – II	0	0	2	0	EEC	30
Total Credits						**21**		
Optional Language Elective*								
10	U19OLE1201	French	0	0	2	1	HSMC	30
11	U19OLE1202	German						
12	U19OLE1203	Japanese						

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

Approved by

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

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

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MC301	Fluid Mechanics and Machinery	3	0	0	3	45
2	U19MC302	Strength of Materials	3	0	0	3	45
3	U19MC303	Manufacturing Technology	3	0	0	3	45
4	U19MC304	Electrical Drives and Control	3	0	0	3	45
5	U19MC305	Digital Electronics	3	0	0	3	45
6	U19GE304	**Mandatory course:** Constitution of India	2	0	0	0	30
Practical							
7	U19MC306	Fluid Mechanics and Strength of Materials Laboratory	0	0	4	2	60
8	U19MC307	Manufacturing Technology Laboratory	0	0	3	1.5	45
9	U19MC308	Electrical Drives and Control Laboratory	0	0	3	1.5	45
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1	30
					Total Credits	**21**	

Approved By

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

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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 Regulations 2019
Branch: Mechatronics Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MAT401B	Probability and Statistical Methods	3	1	0	4	60
2	U19MC401	Fluid Power Systems	3	0	0	3	45
3	U19MC402	Thermodynamics and Heat Transfer	3	0	0	3	45
4	U19MC403	Microprocessors and Microcontroller	3	0	0	3	45
5	U19MC902	**Professional Elective:** Sensors, Transducers and Instrumentation	3	0	2	4	75
6	U19GE402	**Mandatory course:** Environment and Climate Science	2	0	0	0	30
Practical							
7	U19MC404	Fluid Power Systems Laboratory	0	0	4	2	60
8	U19MC405	Microprocessor and Microcontroller Laboratory	0	0	4	2	60
9	U19GE401	Soft Skill and Aptitude – II	0	0	2	1	30
					Total Credits	**22**	

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

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

MCT V

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MC501	CAD/CAM	3	0	0	3	45
2	U19MC502	Theory of Machines	3	0	0	3	45
3	U19MC503	Data Structure using Python	3	0	2	4	75
4	U19MC504	Industrial Automation	3	0	0	3	45
5	noc23_me105	NPTEL: Automation in Manufacturing	3	0	0	3	45
Practical							
6	U19MC505	CAD/CAM Laboratory	0	0	3	1.5	45
7	U19MC506	Industrial Automation Laboratory	0	0	3	1.5	45
8	U19MC507	Mini Project-I	0	0	2	1	30
9	U19GE501	Soft Skill and Aptitude – III	0	0	2	1	30
					Total Credits	**21**	**405**

Approved By

5/7/23		17/7/23
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, Fifth Semester BE MCT Students and Staff, COE

MCT VI

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

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory								
1	U19MC601	Artificial Intelligence and Machine Learning		3	0	0	3	45
2	U19MC602	Image Processing and Computer Vision		3	0	0	3	45
3	U19MC603	Robotics		3	0	0	3	45
4	U19MC903	**Professional Elective:**	Embedded Systems and Internet of Things	3	0	0	3	45
	U19MC909		Agriculture Automation					
5	U19MC906	**Professional Elective:**	Drone Technology	3	0	0	3	45
	U19MC907		Design Thinking and Product Innovation					
6	U19CS1002	**Open Elective:**	Cloud Computing	3	0	0	3	45
	U19CS1003		Internet of Things					
	U19EE1003		Innovation, IPR and Entrepreneurship Development					
	U19ME1002		Industrial Safety					
	U19ME1004		Renewable Energy Sources					
Practical								
7	U19MC604	Image Processing Laboratory		0	0	2	1	30
8	U19MC605	3D Modelling and Analysis Laboratory		0	0	2	1	30
9	U19MC606	Mini Project-II		0	0	2	1	30
10	U19GE601	Soft Skills and Aptitude – IV		0	0	2	1	30
Total Credits							**22**	**390**

Approved By

Chairperson, Mechatronics Engineering BoS
Dr.P.Suresh
26/12/23

Member Secretary, Academic Council
Dr.R.Shivakumar
28/12/23

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

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

Sona College of Technology, Salem-5

List of Professional Electives B.E/B.Tech under Regulation 2019

Department:-Mechatronics Engineering

S.No	Course Code	Course Name	L	T	P	C
1.	U19MC901	Sensors and Instrumentation	3	0	2	4
2.	U19MC902	Sensors, Transducers and Instrumentation	3	0	2	4
3.	U19MC903	Embedded Systems and Internet of Things	3	0	0	3
4.	U19MC904	Electric and Hybrid Vehicles	3	0	0	3
5.	U19MC905	Digital Manufacturing	3	0	0	3
6.	U19MC906	Drone Technology	3	0	0	3
7.	U19MC907	Design Thinking and Product Innovation	3	0	0	3
8.	U19MC908	Virtual Instrumentation	3	0	0	3
9.	U19MC909	Agriculture Automation	3	0	0	3
10.	U19MC910	Medical Mechatronics	3	0	0	3
11.	U19MC911	Metrology and Measurements	3	0	0	3
12.	U19MC912	Automatic Control System	3	0	0	3
13.	U19MC913	Automation in HVAC	3	0	0	3
14.	U19MC914	Energy Storage System and Management	3	0	0	3
15.	U19MC915	Industrial Electronics and Applications	3	0	0	3
16.	U19MC916	Internet Tools and Java Programming	3	0	0	3
17.	U19MC917	Internet of Things	3	0	0	3
18.	U19MC918	Micro Electro Mechanical Systems	3	0	0	3
19.	U19MC919	Nanotechnology	3	0	0	3
20.	U19MC920	Smart Manufacturing Equipments	3	0	0	3
21.	U19MC921	Software Project Management	3	0	0	3

SONA COLLEGE OF TECHNOLOGY, SALEM-5

DEPARTMENT OF MECHATRONICS ENGINEERING

LIST OF PROFESSIONAL ELECTIVES FOR HONORS Degree **Date: 3.5.2023**

S.No	Vertical 1: APPLIED ROBOTICS	Vertical 2: SMART MANUFACTURING	Vertical 3: SMART MOBILITY SYSTEMS	Vertical 4: INTELLIGENCE SYSTEMS	Vertical 5: AUTOMATION	Vertical 6: AVIONICS AND DRONE TECHNOLOGY
1.	Robots and Systems in Smart Manufacturing	Robot and Machine Elements Design	Fundamentals of Mobility Systems	Applied Signal Processing	Cyber Physical Systems	Avionics
2.	Autonomous Mobile Robots	Design for X	Electric and Hybrid Vehicles	Applied Image Processing	Power Electronics and Drives	Control Engineering
3.	Soft Robotics	Computer Integrated Manufacturing	Automotive Mechatronics	Machine Learning for Intelligent Systems	Process Control	Guidance and Control
4.	Agricultural and Medical Robotics	Advanced Manufacturing Systems	Intelligent Vehicle Technology	Condition Monitoring and Fault Diagnostics	Total Integrated Automation	Navigation and Communication System
5.	Collaborative and Humanoid Robotics	Additive Manufacturing	Advanced Driver Assistance Systems	Immersive Technologies and Haptic	Industrial Internet of Things	Design of UAV
6.	Robot Operating Systems	Computer Aided Inspection and Testing	Drone Technology	Computer Vision and Deep Learning	Digital Twin and Industry 5.0	Aerodynamics

SONA COLLEGE OF TECHNOLOGY, SALEM-5

Department of Mechatronics Engineering

Honours Degree- Verticals & Courses

(Offered to UG students admitted during AY 2021- 2022 onwards, Regulation 2019)

Vertical 1: APPLIED ROBOTICS

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2001	Robots and Systems in Smart Manufacturing	3	0	0	3
2	U19MC2002	Autonomous Mobile Robots	3	0	0	3
3	U19MC2003	Soft Robotics	3	0	0	3
4	U19MC2004	Agricultural and Medical Robotics	3	0	0	3
5	U19MC2005	Collaborative and Humanoid Robotics	3	0	0	3
6	U19MC2006	Robot Operating Systems	3	0	0	3

Vertical 2: SMART MANUFACTURING

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2007	Robot and Machine Elements Design	3	0	0	3
2	U19MC2008	Design for X	3	0	0	3
3	U19MC2009	Computer Integrated Manufacturing	3	0	0	3
4	U19MC2010	Advanced Manufacturing Systems	3	0	0	3
5	U19MC2011	Additive Manufacturing	3	0	0	3
6	U19MC2012	Computer Aided Inspection and Testing	3	0	0	3

Vertical 3: SMART MOBILITY SYSTEMS

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2013	Fundamentals of Mobility Systems	3	0	0	3
2	U19MC904	Electric and Hybrid Vehicles	3	0	0	3
3	U19MC2014	Automotive Mechatronics	3	0	0	3
4	U19MC2015	Intelligent Vehicle Technology	3	0	0	3
5	U19MC2016	Advanced Driver Assistance Systems	3	0	0	3
6	U19MC906	Drone Technology	3	0	0	3

Vertical 4: INTELLIGENCE SYSTEMS

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2017	Applied Signal Processing	3	0	0	3
2	U19MC2018	Applied Image Processing	3	0	0	3
3	U19MC2019	Machine Learning for Intelligent Systems	3	0	0	3
4	U19MC2020	Condition Monitoring and Fault Diagnostics	3	0	0	3
5	U19MC2021	Immersive Technologies and Haptic	3	0	0	3
6	U19MC2022	Computer Vision and Deep Learning	3	0	0	3

Vertical 5: AUTOMATION

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2023	Cyber Physical Systems	3	0	0	3
2	U19MC2024	Power Electronics and Drives	3	0	0	3
3	U19MC2025	Process Control	3	0	0	3
4	U19MC2026	Total Integrated Automation	3	0	0	3
5	U19MC2027	Industrial Internet of Things	3	0	0	3
6	U19MC2028	Digital Twin and Industry 5.0	3	0	0	3

Vertical 6: AVIONICS AND DRONE TECHNOLOGY

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2029	Avionics	3	0	0	3
2	U19MC2030	Control Engineering	3	0	0	3
3	U19MC2031	Guidance and Control	3	0	0	3
4	U19MC2032	Navigation and Communication System	3	0	0	3
5	U19MC2033	Design of UAV	3	0	0	3
6	U19MC2034	Aerodynamics	3	0	0	3

SONA COLLEGE OF TECHNOLOGY, SALEM-5

Department of Mechatronics Engineering

Minor Degree- Verticals & Courses

(Offered to UG students admitted during AY 2021- 2022 onwards, Regulation 2019)

Minor Vertical: Robotics

S.No	Course Code	Course Name	L	T	P	C
1	U19MC2035	Introduction to Robotics	3	0	0	3
2	U19MC2036	Fundamentals of Robot Programming and Applications	3	0	0	3
3	U19MC2037	Machine Vision System	3	0	0	3
4	U19MC2038	Sensors and Actuators	3	0	0	3
5	U19MC2039	Fundamentals of Drones	3	0	0	3
6	U19MC2040	Industrial Robotics and Material Handling Systems	3	0	0	3
7	U19MC2041	Humanoid Robots and Collaborative Robotics	3	0	0	3

Sona College of Technology, Salem

(An Autonomous Institution)

Courses of Study for B.E/B.Tech. Semester I under Regulations 2019 (CBCS)

Branch: Mechatronics Engineering

S.No.	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
Theory								
1	U19ENG101B	English for Engineers-I	1	0	2	2	HS	45 (15L+30P)
2	U19MAT102A	Linear Algebra and Calculus	3	1	0	4	BS	60
3	U19PHY103B	Engineering Physics	3	0	0	3	BS	45
4	U19CHE104G	Engineering Chemistry	3	0	0	3	BS	45
5	U19PPR105	Problem solving using Python Programming	3	0	0	3	ES	45
6	U19EGR106	Engineering Graphics	2	0	2	3	ES	60 (30L+30P)
Practical								
7	U19PCL108B	Physics and Chemistry Laboratory	0	0	2	1	BS	30
8	U19PPL111	Python Programming Laboratory	0	0	2	1	ES	30
9	U19GE101	Basic aptitude-I	0	0	2	0	EEC	30
		Total Credits				**20**		
Optional Language Elective*								
10	U19OLE1101	French	0	0	2	1	HS	30
11	U19OLE1102	German						30
12	U19OLE1103	Japanese						30

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

Approved By

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

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

U19ENG101B - ENGLISH FOR ENGINEERS – I
COMMON TO CSE, ECE, EEE, MCT, BME

L	T	P	C
1	0	2	2

Course Outcomes: At the end of 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 email, formal letters and descriptions of graphics
5. Develop skills for writing reports and proposals, and for general purpose and technical writing.

S.No	Course outcomes	Programme outcomes													
		1	2	3	4	5	6	7	8	9	10	11	12	Pso1	Pso2
1	Frame sentences correctly with accuracy	2	1	1	1	1	2	3	2	2	3	3	3	3	3
2	Write emails and formal letters	3	2	2	3	3	3	3	2	3	3	3	3	3	3
3	Speak effectively in real time and business situations	3	3	2	3	3	3	3	2	3	3	3	3	3	3
4	Write email, formal letters and descriptions of graphics	1	1	1	2	2	1	2	2	1	3	1	1	1	1
5	Develop skills for writing reports and proposals, and for general purpose and technical writing.	2	1	1	3	2	2	3	3	3	3	2	3	3	3

UNIT I

- General Vocabulary, Parts of speech
- 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.
- Instructions, Email - fixing an appointment, cancelling appointments, conference details, hotel accommodation, order for equipment, training programme details, paper submission for seminars and conferences
- Paragraph writing – Describing – defining – providing examples or evidences

UNIT II

- Tenses, active and passive voice
- Welcome address, vote of thanks, special address on specific topic.
- Checklists, letter writing - business communication, quotations, placing orders, complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations

UNIT III

- Prefixes and Suffixes
- Mini presentation in small groups of two or three, on office arrangements, facilities, office functions, sales, purchases, training recruitment, advertising, applying for financial assistance, applying for a job, team work, discussion, presentation.
- Job application letter and resume, recommendations,

UNIT IV

- Modal verbs and probability, concord
- 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
- Note making, Proposal

UNIT V

- If conditionals
- Situational Role Play - 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.
- Memo, technical report writing, feasibility reports, accident report, survey report

TOTAL: 45 hours

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

TEXT BOOK:

- Technical English I & II, Dr. M. Renuga et al. Sonaversity, 2016

Extensive Reading

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

Reference

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

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

L	T	P	C
3	1	0	4

COURSE OUTCOMES

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

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

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2							2	2	
CO2	3	3	2	3	2							2	2	
CO3	3	3	2	3	2							2	2	
CO4	3	3	2	3	2							2	2	
CO5	3	3	2	3	2							2	2	

UNIT – I LINEAR SYSTEM OF EQUATIONS 12

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

UNIT – II VECTOR SPACES 12

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

UNIT – III EIGEN VALUES AND EIGEN VECTORS 12

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

UNIT – IV MULTIVARIABLE CALCULUS **12**

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

UNIT – V MULTIPLE INTEGRALS **12**

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U19PHY103B - ENGINEERING PHYSICS
(For BE Mechatronics Engineering)

L	T	P	C
3	0	0	3

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

CO1: Discuss the dual nature of matter and radiation and the application of wave nature of particles.

CO2: Describe the basic components of lasers.

CO3: Analyse the relation between arrangement of atoms and material properties.

CO4: Deduce Maxwell's equations using the fundamentals of electromagnetism.

CO5: Elucidate the different modes of heat transfer.

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

UNIT I - QUANTUM PHYSICS 9

Origin of quantum mechanics – Limitations of classical theory - Dual nature of matter and radiation.

Particle nature of radiation - Compton effect - Explanation based on quantum theory - Expression for Compton shift (no derivation).

Wave nature of matter - de Broglie waves - Schrödinger's time independent and time dependent wave equations - Physical significance of wave function - Energy and wave function of an electron trapped in one dimensional box.

Application of wave nature of particles - Electron microscope - Comparison of optical and electron microscope - Scanning electron microscope - Limitations of electron microscope.

UNIT II - LASERS 9

Basic terms - Energy level - normal population - induced absorption (pumping) - population inversion - meta stable state - spontaneous emission - stimulated emission.

Basic *components* of a laser - Active medium - pumping technique - optical resonator **Einstein's theory** - stimulated absorption - spontaneous emission and stimulated emission.

Types of lasers - Solid lasers (Nd:YAG) - Gas lasers (CO_2 laser) - semiconductor laser (homojunction and hetero junction laser)

Holography - Construction and reconstruction of hologram.

UNIT III - CRYSTAL PHYSICS **9**

Importance of crystals - Types of crystals - Basic definitions in crystallography (Lattice –space lattice - unit cell - lattice parameters – basis - crystallographic formula) - Seven crystal systems and fourteen Bravais lattices – Lattice planes and Miller indices – Interplanar distance - 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.

UNIT IV – ELECTROMAGNETISM **9**

Electrostatics - Electric field - Electric field intensity – Field due to discrete and continuous charges – Electric lines of forces – Electric flux – Gauss's law – Divergence of E – Applications of Gauss's law – Curl of E.

Magnetostatics – Magnetic fields – Magnetic Lorentz force – Force experienced by current carrying conductor in magnetic field **–** Steady currents – Magnetic field due to steady current - Biot - Savart Law - Straight line currents – Ampere's circuital law – Divergence and curl of B – Applications of Ampere's circuital law - Comparison of Magneto statics and Electrostatics.

UNIT V - THERMAL PHYSICS **9**

Heat and temperature - Modes of heat transfer (Conduction, convection and radiation) - Specific heat capacity - thermal capacity and coefficient of linear thermal expansion.

Thermal conductivity - Measurement of thermal conductivity of good conductor - Forbe's method - Measurement of thermal conductivity of bad conductor - Lee's disc method - Radial flow of heat - Cylindrical flow of heat - Practical applications of conduction of heat.

Thermal radiations - Properties of thermal radiations - Applications of thermal radiations.

TOTAL: 45 Hours

TEXT BOOKS

- M.N.Avadhanulu, 'Engineering Physics' S.Chand & Company Ltd, New Delhi (2015)
- D. K. Bhattacharya, Poonam Tandon "Engineering Physics" Oxford University Press 2017.

REFERENCES

- Engineering Physics, Sonaversity, Sona College of Technology, Salem (Revised Edition 2018).
- B. K. Pandey and S. Chaturvedi, Engineering Physics , Cengage Learning India Pvt. Ltd., Delhi, 2019
- Rajendran, V, and Marikani A, 'Materials science' TMH Publications, (2004) New Delhi.
- Palanisamy P.K, 'Materials science', SciTech Publications (India) Pvt. Ltd., Chennai, Second Edition (2007)

U19CHE104G - ENGINEERING CHEMISTRY
(For Mechatronics and Biomedical Engineering)

L	T	P	C
3	0	0	3

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

CO1: Analyze the impurities of water, their removal methods and explain the conditioning methods for industrial uses.

CO2: Outline the principles and applications of electrochemistry to engineering and technology.

CO3: Analyze the types of corrosion and describe the methods of corrosion control.

CO4: Discuss the principle and applications of surface chemistry and catalysis in engineering and technology.

CO5: Describe the basics of nano chemistry, synthesis, properties and applications of nano materials in engineering and technology.

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

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.

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 – 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

- P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi, 2010 (15^{th} Edition).
- T. Maruthavanan *et al.*, "Engineering Chemistry", Sonaversity, Sona College of Technology, Salem, Revised Edition 2019.

REFERENCE BOOKS

- H.K. Chopra, A. Parmer, "Chemistry for Engineers", Narosa Publishing House, New Delhi, 110 002, 2016.
- Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd., Chennai, 2009.
- B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2008.
- Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

U19PPR105 - PROBLEM SOLVING USING PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

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

- Develop algorithmic solutions to simple computational problems
- Write simple Python programs
- Write programs with the various control statements and handling strings in Python
- Develop Python programs using functions and files
- Analyze a problem and use appropriate data structures to solve it.

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	PSO3
CO1	3	3	3	3	3	3	1	1	2	2	1	3	2	3	3
CO2	3	3	3	3	3	2	1	1	1	1	1	3	1	3	3
CO3	3	3	3	3	3	3	2	1	1	1	1	3	1	3	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3	1	3	3
CO5	3	3	3	3	3	3	3	1	1	1	1	3	2	3	3

UNIT I - ALGORITHMIC PROBLEM SOLVING 9

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

UNIT II - BASICS OF PYTHON PROGRAMMING 9

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

UNIT III - CONTROL STATEMENTS AND STRINGS 9

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

UNIT IV - FUNCTIONS AND FILES **9**

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

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

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

TOTAL: 45 Hours

TEXT BOOK

- Reema Thareja, "Problem Solving and Programming with Python", Oxford University Press, 2018.
- Allen B. Downey, "Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

REFERENCES

- Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education, 2018.
- Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
- Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
- Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
- Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus", Wiley India Edition, 2013.

U19EGR106 - ENGINEERING GRAPHICS

L	T	P	C
2	0	2	3

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

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

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

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

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

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

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

CONCEPTS AND CONVENTIONS (Not for Examination) L 3

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

COMPUTER AIDED DRAFTING (Not for Examination) L 3

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

UNIT I - PLANE CURVES (Manual drafting) L 6

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

UNIT II - PROJECTION OF POINTS, LINES AND PLANE SURFACES L 12

(CAD Software)

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

UNIT III - PROJECTION OF SOLIDS L 12

(CAD Software)

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

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

UNIT IV - SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES L 12

(CAD Software)

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

UNIT V - CONVERSION OF ISOMETRIC VIEWS TO ORTHOGRAPHIC VIEWS L 12

(Manual drafting)

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

TOTAL: 60 Hours

TEXT BOOKS

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

REFERENCE BOOKS

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

U19PCL108B - PHYSICS AND CHEMISTRY LABORATORY
(For Mechatronics Engineering)

L	T	P	C
0	0	2	1

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

CO1: Apply the principles of Optics, Thermal Physics, Electricity and Elasticity to determine the Engineering properties of materials.

CO2: Identify hardness and suggest the quality of water suitable for domestic purpose and analyze the concentration of carbonate, bicarbonate and hydroxide present in the given sample of water.

CO3: Determine the resistivity of the given copper turn used for house hold applications and determine the amount of pH of house hold water sample and suggest the remedial measures.

Pre-requisite: Capable of using Screw guage, Vernier calliper, Travelling microscope, Spectrometer, able to handle burette and pipette

	CO/PO, PSO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1		1					1			2
CO2	3			1		1					1			2
CO3	3			1		1					1			2

LIST OF EXPERIMENTS (PHYSICS PART)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid using ultrasonic interferometer.
2. Determination of dispersive power of the prism for various pairs of colors in the mercury spectrum using a spectrometer.
3. Determination of laser wavelength, particle size of lycopodium powder, acceptance angle and numerical aperture of an optical fibre using diode laser.
4. Determination of specific resistance of a given wire using Carey Foster's bridge.
5. Determination of the thermal conductivity of a bad conductor using Lee's Disc apparatus.
6. Determination of band gap of the given semiconductor diode.

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

List of Experiments (CHEMISTRY PART)

1. Estimation of hardness of water sample by EDTA method.
2. Estimation of alkalinity of water sample by indicator method.
3. Estimation of HCl by pH metry.
4. Estimation of HCl by conductometry. (HCl vs NaOH)
5. Estimation of ferrous ion by potentiometric titration.

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

Total: 30 Hours

U19PPL111 - PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	2	1

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

1. Implement the algorithms using basic control structures in Python
2. Develop Python programs to use functions, strings and data structures to solve different types of problems
3. Implement persistent storing information through file operations

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	0	1	2	2	1	2	3	3	3
CO2	3	3	3	3	2	2	0	1	2	2	1	2	3	3	3
CO3	3	3	3	3	2	2	0	1	2	2	1	3	3	3	3

LIST OF EXPERIMENTS

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

TOTAL: 30 Hours

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

L	T	P	C
0	0	2	0

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

CO1: Solve fundamental problems in specific areas of quantitative aptitude

CO2: Solve basic problems in stated areas of logical reasoning

CO3: Demonstrate rudimentary verbal aptitude skills in English with regard to specific topics

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

1. Quantitative Aptitude and Logical Reasoning

Solving simple problems with reference to the following topics:

a. Numbers – HCF & LCM
b. Decimal fractions
c. Square roots & cube roots
d. Surds & Indices
e. Logarithms
f. Percentage
g. Averages
h. Coding and Decoding & Visual language

2. Verbal Aptitude

Demonstrating plain English language skills with reference to the following topics:

a. Synonyms
b. Antonyms
c. Verbal analogy
d. Editing passages
e. Sentence filler words

TOTAL: 24 hours

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

S.N	Course Code	Course Title	L	T	P	C	Category	Total Contact Hours
Theory								
1	U19ENG201B	English for Engineers -II	1	0	2	2	HSMC	45 (15L+30P)
2	U19MAT202A	Differential Equations and Vector Calculus	3	1	0	4	BSC	60
3	U19PHY203F	Physics for electron devices	3	0	0	3	BSC	45
4	U19CHE204E	Modern materials	3	0	0	3	BSC	45
5	U19MCT201	Engineering Mechanics	3	0	0	3	ESC	45
6	U19MCT202	Basic Electrical Engineering	3	0	0	3	ESC	45
Practical								
7	U19WPL212	Workshop Practice	0	0	2	1	ESC	30
8	U19MCT203	Basic Electrical Engineering and Devices Laboratory	0	0	4	2	ESC	60
9	U19GE201	Basic Aptitude – II	0	0	2	0	EEC	30
Total Credits						**21**		
Optional Language Elective*								
10	U19OLE1201	French	0	0	2	1	HSMC	30
11	U19OLE1202	German						
12	U19OLE1203	Japanese						

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

Approved by

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

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

U19ENG201B- English for Engineers – II

First year II semester

MCT

Course Outcome: At the end of 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.

	COURSE OUTCOMES	PROGRAMME OUTCOMES													
		1	2	3	4	5	6	7	8	9	10	11	12	Pso1	Pso2
1	Frame sentences correctly, both in written and spoken forms of language with accuracy and fluency	2	1	2	3	2	3	3	3	3	3	3	3	3	3
2	Develop and demonstrate listening skills for academic and professional purposes	2	2	2	3	2	3	3	3	3	3	3	3	3	3
3	Draw conclusions on explicit and implicit oral information	3	2	2	3	2	3	3	3	3	3	3	3	3	3
4	Develop effective reading skills and reinforce language skills required for using grammar and building vocabulary	3	3	2	3	2	3	3	3	3	3	3	3	3	3
5	Read for gathering and understanding information, following directions and giving responses.	3	3	2	3	2	3	3	3	3	3	3	3	3	3

UNIT –I

- Cause and effect expressions, adjectives, comparative adjectives
- 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 notices, messages, timetables, advertisements, graphs, etc.
- Reading passages for specific information transfer

UNIT – II

- Prepositions and dependent prepositions
- Understanding short conversations or monologues
- Taking down phone messages, orders, notes etc
- Listening for gist, identifying topic, context or function
- Reading documents for business and general contexts and interpreting graphical representations

UNIT – III

- Collocations
- Listening comprehension, entering information in tabular form
- Error correction, editing mistakes in grammar, vocabulary, spelling, etc.
- Reading passage with multiple choice questions, reading for gist and reading for specific information, skimming for comprehending the general idea and meaning and contents of the whole text

UNIT – IV

- Articles, adverbs
- Intensive listening exercises and completing the steps of a process.
- Listening exercises to categorise data in tables.
- 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.

UNIT – V

- Pronouns
- Listening to extended speech for detail and inference
- Listening and developing hints
- 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

The listening test will be conducted for 20 marks and reading for 20 marks internally and evaluated along with English for Engineers – II in the End Semester Valuation.

Textbook:

Technical English I & II, Dr. M. Renuga et al. Sonaversity, 2016

Extensive Reading

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

Reference

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

B. E. / MECHATRONICS ENGINEERING

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

COURSE OUTCOMES

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

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

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

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

UNIT – I ORDINARY DIFFERENTIAL EQUATIONS 12

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

UNIT – II NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

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

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

UNIT – III LAPLACE TRANSFORMS 12

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

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

UNIT – IV PARTIAL DIFFERENTIAL EQUATIONS **12**

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

UNIT – V VECTOR CALCULUS **12**

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Prof. S. JAYABHARATHI
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Course Code:	**U19PHY203F**	**L T P C**
Course Name:	**Physics for Electron Devices**	**3 0 0 3 100**

(for Mechatronics Engineering)

COURSE OUTCOMES:

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

CO1 Differentiate the electrical and thermal conductivity of metals.

CO2 Elucidate the classification and theory of semiconducting materials.

CO3 Discuss the applications of diode as rectifier, photodiode, LED and solar cell.

CO4 Elucidate the application of bipolar transistor as amplifier.

CO5 Evaluate the novel properties of metallic glasses, shape memory alloys and nanomaterials.

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

Unit 1 Conducting materials **9**

Usage of conducting materials - basic definitions (electrical resistance - conductance -resistivity - conductivity).

Classical free electron theory of metals - postulates of classical free electron theory - microscopic form of Ohm's law - Electrical conductivity - definition and expression for electrical conductivity - thermal conductivity - definition and expression for thermal conductivity - Wiedemann - Franz law and Lorentz number - Success and failure of classical free electron theory.

Quantum free electron theory - Drawbacks of quantum free electron theory - origin of energy bands - band theory of solids (qualitative treatment only) - Fermi energy and Fermi distribution function - Effect of temperature on Fermi function - Density of energy states - carrier concentration in metals.

Unit 2 Semiconducting Materials 9

Properties of semiconductors - Classification of semiconductors - Intrinsic and extrinsic semiconductors - Elemental and compound semiconductors.

Intrinsic semiconductor - two types of charge carriers - Energy band diagram of intrinsic semiconductors (at T= 0 K and T > 0 K) - Expression for number of electrons in conduction band - Expression for number of holes in valence band - Law of mass action and intrinsic carrier concentration - Fermi level - Variation of Fermi level with temperature - electrical conductivity - band gap determination.

Extrinsic semiconductors - Draw backs of intrinsic semiconductors – Types of extrinsic semiconductors – 'n'-type and 'p'-type semiconductors – Energy band diagram of 'n' type and 'p' type semiconductors (at T= 0 K and T > 0 K) – Carrier concentration of extrinsic semiconductors (Qualitative Treatment only) – Hall effect –Determination of Hall coefficient – Applications.

Unit 3 PN junction diode and optoelectronic devices **9**

PN junction diode - Formation of p-n junction - p-n junction diode- p-n junction diode under forward bias- p-n junction diode under reverse bias-Application of junction diode as rectifier- Half wave rectifier- full wave rectifier- bridge rectifier-Zener diode- Zener diode as voltage regulator.

Optoelectronic devices - Photo diodes- types of photo diodes- Photo detector-PIN diode- Avalanche photo diode-Light emitting diode (LED) - LED- principle –construction- working- Solar cell- principle –construction- working.

Unit 4 Bipolar junction transistors and amplifiers **9**

Bipolar junction transistors - npn and pnp transistors- Unbiased npn transistor – Biased npn transistor –Transistor currents-Transistor configuration- common base configuration-common emitter configuration-common collector configuration.

Amplifiers - Transistor as amplifier-introduction to Field effect transistors (FET) - Types of field effect transistors- Junction field effect transistor (JFET) –Metal oxide field effect transistor (MOSFET).

Unit 5 New Engineering Materials: **9**

Metallic glasses -Preparation, properties and applications.

Shape memory alloys (SMA) - Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA.

Nanoscience and Nanotechnology - Significance of nanoscale - different types of nanostructures (0-D, 1-D, 2-D and 3-D) – Fabrication of nanomaterials - Ball milling and Chemical vapour deposition technique (CVD).

Carbon nanotubes – structure - properties and applications – fabrication - pulsed laser deposition method.

Lecture: 45, Tutorial: 00, Total: 45 Hours

Text Book:

1. M.N.Avadhanulu, 'Engineering Physics' S.Chand &Company Ltd, New Delhi (2015)
2. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning India Pvt. Ltd., Delhi, 2012.

References:

1. Physics for Electrical and Electronics Engineering, Sonaversity, Sona College of Technology, Salem (Revised Edition 2016).
2. Rajendran, V, and Marikani A, 'Materials science' TMH Publications, (2004) New Delhi.
3. Palanisamy P.K, 'Materials science', SciTech Publications (India) Pvt. Ltd., Chennai, Second Edition (2007)
4. M. Arumugam, 'Materials Science' Anuradha Publications, Kumbakonam, (2006).

COURSE CODE	U19CHE204E	L T P C
COURSE NAME	MODERN MATERIALS	3 0 0 3

COURSE OUTCOMES

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

CO1: Analyze the types of polymers, polymerization reactions, polymerization techniques and fabrication methods of polymers for engineering applications.

CO2: Analyze the types and methods of preparing conducting polymers.

CO3: Explore different methodologies to synthesize nanostructured composites materials.

CO4: Analyze the different types of electrochemical processes carried out in electronic industries.

CO5: Compare the working principles of various organic electronic devices.

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

UNIT I: POLYMER CHEMISTRY **09**

Nomenclature of Polymers – Functionality – Types of Polymerization-addition-condensation and copolymerization – Classification of Polymers – Free Radical mechanism of addition polymerization – Properties of Polymers- Tg – tacticity - Methods of Polymerization: emulsion and suspension – Plastics: Moulding constituents of plastic – Moulding of plastics into articles-Injection-Compression and Blow moulding – Thermoplastic and Thermosetting Resins.

UNIT II: CONDUCTING POLYMERS **09**

Introduction – Structural characteristics and doping concept in metals and metal oxide nanoparticles - Charge carriers and conducting mechanism – Classification of conducting polymers: Intrinsic and extrinsic conducting polymers – Synthesis of conducting polymers - bulk and solution polymerization – Applications of conducting polymers in corrosion protection and sensors.

UNIT III: NANOSTRUCTURED COMPOSITES **09**

Definition of nanocomposites – Nanofillers: Classification of nanofillers, Synthesis and properties of nanofillers – Synthesis of nanocomposites by physical methods - direct mixing and solution mixing - Chemical methods - Microemulsion synthesis, Microwave assisted synthesis and Sonochemical assisted synthesis - Types of nanocomposites - Core-Shell nanostructure, Organic-Inorganic hybrid nanocomposites, Quantum dot (QDs) synthesis.

UNIT IV: ELECTROCHEMICAL PROCESSES IN THE FABRICATION OF ELECTRONIC DEVICES 09

Electroplating – Principle and process - plating parameters- current and energy efficiency - Electroplating of Nickel - Fundamentals of electro less deposition – electro less plating of Nickel, fabrication of PCB's - Electrochemical etching of copper from PCBs - Anodizing - definition, principle and working methodology of anodized aluminium - Chemical sensors - optical and heat sensors – definitions and applications.

UNIT V: ORGANIC ELECTRONIC MATERIALS 09

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 material – definition - working principle and examples - Polystyrene – PMMA – Organic Light Emitting Diodes (OLEDs): construction, working principle and applications – Organic transistors: construction, working principle and applications in electronic industries.

TOTAL: 45 HOURS

Text Books

1. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley – VCH. 2006.
2. A.P. Uthirakumar et.al, "Modern Materials", Sonaversity, Sona College of Technology, 2019.

Reference Books

1. H.K. Chopra, A. Parmer, "Chemistry for Engineers", Narosa Publishing House, New Delhi, 110 002, 2016.
2. Nanostructured Materials and Nanotechnology – II, Eds. Sanjay Mathur and Mrityunjay Singh, Willey, 2008.
3. Gowariker V.R, Viswanathan N.V. and Jayadev Sreedhar, Polymer Scinece, New age International P (Ltd), Chennai, 2006.
4. Nanostructured Materials and Nanotechnology – II, Eds. Sanjay Mathur and Mrityunjay Singh, Willey, 2008.

U19MCT201	ENGINEERING MECHANICS	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 forces in statically determinate structures using scalar and vector analytical techniques.
CO2:	Examine the condition for equilibrium of rigid body using free body diagram.
CO3:	Evaluate the effect of friction of bodies under equilibrium condition.
CO4:	Determine the centroid, moment of inertia and polar moment of inertia of simple and composite sections.
CO5:	Analyse the motion of a body with force and without force causing the motion.

Pre-requisite

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	2			1		1	3	2
CO2	3	3	3	2		2	2			1		2	3	2
CO3	3	3	3	2		2	2			1		2	3	2
CO4	3	3	3	2		2	2			1		1	3	2
CO5	3	3	3	2		2	2			1		2	3	2

Course Assessment methods

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

Unit 01: BASICS & STATICS OF PARTICLES	**9 Hours**

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 02: EQUILIBRIUM OF RIGID BODIES IN 2 DIMENSIONS	**9 Hours**

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 03: FRICTION	**9 Hours**

Frictional force – Laws of Coulomb friction – Angle of friction – cone of friction – Equilibrium of bodies on inclined plane.

Unit 04: PROPERTIES OF SURFACES AND SOLIDS	**9 Hours**

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.

Unit 05: DYNAMICS OF PARTICLES	**9 Hours**

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.

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

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers: Statics and Dynamics", McGraw–Hill International 10th Edition, 2013.
2. Dr. N. Kottiswaran, "Engineering Mechanics (Statics and Dynamics)" ,Sri Balaji Publications 10th edition 2010.

REFERENCES

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2011).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2015).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw–Hill, (2004).
4. MeriamJ.L,KraigeL.G,"Engineering Mechanics-Statics"6th Edition, Wiley, 2017.
5. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition– Pearson Education Asia Pvt. Ltd., (2006).
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi (2008)

U19MCT202	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Evaluate the behaviour of circuit elements in electric circuits.
CO2:	Explain the principles of operation of magnetics circuits and transformers
CO3:	Outline the construction and working principles of DC machines and synchronous machines.
CO4:	Evaluate the electromagnetic energy conversion and operating principle of three phase induction motors.
CO5:	Explain the principles of operations of single-phase induction and stepper motors.

Pre-requisite

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

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

Electric Current – Coulomb's Law – Ohm's Law – Faraday's Law of Electromagnetic Induction – Kirchhoff's Laws–Energy and Power – Resistance Parameter – Inductance Parameter –Capacitance Parameter – Series and Parallel Combinations of Resistances —RLC Series-Parallel Circuits – Resonance

UNIT II MAGNETIC CIRCUITS AND TRANSFORMERS	**9 Hours**

Ampere's Law – Basic Definition: Flux, Flux Density, Field Strength, Permeability, Reluctance, Permeance – Theory of Magnetism –Hysteresis and Eddy-Current Losses - Magnetic Circuit -Self Inductance, Mutual inductance, Co-efficient of Coupling- Transformers – Equivalent Circuit–Parameters from No-Load Tests – Efficiency and Voltage Regulation.

UNIT III DC MACHINES AND THREE PHASE SYNCHRONOUS MACHINES	**9 Hours**

DC Machines- DC Generator-construction–working principle- EMF equation-Types of DC Generator, DC motor-working principle –Types of DC Motor-Motor Speed torque Characteristics-starters for DC Motors -Generation of a Three Phase Voltage– Synchronous Generator-construction and working principle.

UNIT IV ELECTROMAGNETIC ENERGY CONVERSION AND THREE PHASE INDUCTION MOTOR	**9 Hours**

Introduction-Basic Analysis of Electromagnetic Torque - Three Phase Induction Motor – Revolving Magnetic Field – Construction- Working Principle- Types- Speed-Torque Characteristic – Parameters from No Load and Blocked rotor Tests – Equivalent Circuit – Applications of Three phase Induction Motors.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	**9 Hours**

Single Phase Induction Motor-Construction-working principle- Switched reluctance motor- Stepper Motors –working principle- Stepper Motors -PM Brushless DC motors - Servo motor- Applications

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

Text Books

1. B.L. Theraja and A. K. Theraja, "A Text Book of Electrical Technology", S.Chand Publication, Vol 2, 2014.
2. A. Sudhakar and S.P Shyam Mohan, "Circuits, Network Analysis and Synthesis", Tata McGraw Hill, Fifth Edition, 2015.

REFERENCES

1. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Fourth Edition, 2011.
2. V.K.Metha, Rohit Metha, "Principles of Electrical Engineering and Electronics", Second edition, S.Chand Publication, 2015.
3. S.K.Bhattacharya "Basic Electrical and Electronics Engineering" Pearson Education India, 2012.
4. V.N. Mittle and Aravind Mittal "Basic Electrical Engineering", Tata McGraw Hill, Second edition, 2005.

U19WPL212 – WORKSHOP PRACTICE

L	T	P	C
0	0	2	1

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

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

CO2 fabricate the different simple products in above trades.

CO3 produce different joining of metals.

List of Experiments

SECTION 1: FITTING

Tools and Equipment's- Practice in filling. Making of Vee joint and square (T-fitting) joint.

SECTION 2: SHEET METAL

Tools and Equipment's- PracticeMaking of Dust Pan and Funnel.

SECTION 3: WELDING

Tools and Equipment's – Practice

Arc welding of Butt joint and Lap Joint.

SECTION 4: CARPENTRY

Tools and Equipment's- Planning Practice Making of Half Lap joint and Dovetail Joint.

TOTAL: 30 Hours

U19MCT203	BASIC ELECTRICAL ENGINEERING AND DEVICES 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 usage of common electrical measuring instruments and basic characteristics of transformers and electrical machines.
CO2:	Evaluate the characteristics of semiconductor devices.
CO3:	Interpret the solutions for real time applications of electrical machines and semiconductor devices.

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	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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20)	Quiz-II (5) RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

1. Measuring the steady-state and transient time-response of R-L, R-C, and RLC circuits.
2. Sinusoidal steady state response of R-L, and R-C circuits impedance
3. Calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
5. Three-phase transformers: Star and Delta connections.
6. Torque Speed Characteristic of dc shunt motor.
7. Synchronous speed of two and four-pole, three-phase induction motors.
8. Torque-Slip Characteristic of an induction motor.
9. Verify the VI Characteristics of PN diode
10. Verify the VI Characteristics of Zener diode
11. Verify the VI Characteristics of SCR.
12. Verify the VI Characteristics of MOSFET.

Total Hours: 60 Hours

U19GE201 - BASIC APTITUDE - II

L	T	P	C
0	0	2	0

Course Outcomes: At the end of the course, the students will be able to CO1 solve more elaborate problems than those in BA-I in specific areas of quantitative aptitude.

CO2 solve problems of greater intricacy than those in BA-I in stated areas of logicalreasoning.

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

List of Experiments

1. **QUANTITATIVE APTITUDE AND LOGICAL REASONING**

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

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

2. **VERBAL APTITUDE**

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

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

TOTAL : 24 Hours

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MC301	Fluid Mechanics and Machinery	3	0	0	3	45
2	U19MC302	Strength of Materials	3	0	0	3	45
3	U19MC303	Manufacturing Technology	3	0	0	3	45
4	U19MC304	Electrical Drives and Control	3	0	0	3	45
5	U19MC305	Digital Electronics	3	0	0	3	45
6	U19GE304	**Mandatory course:** Constitution of India	2	0	0	0	30
Practical							
7	U19MC306	Fluid Mechanics and Strength of Materials Laboratory	0	0	4	2	60
8	U19MC307	Manufacturing Technology Laboratory	0	0	3	1.5	45
9	U19MC308	Electrical Drives and Control Laboratory	0	0	3	1.5	45
10	U19GE301	Soft Skills and Aptitude – I	0	0	2	1	30
					Total Credits	**21**	

Approved By

Chairman, 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, Third Semester BE MCT Students and Staff, COE

U19MC301	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 of fluid and analyse the pressure measurement.
CO2:	Evaluate the fluid flow problems using continuity equation and Bernoulli's equation with their applications. Distinguish laminar and turbulent flow through circular pipes.
CO3:	Perform the dimensional analysis by using Buckingham's ∏ theorem.
CO4:	Analyze the performances of the hydraulic turbines.
CO5:	Describe the working principle of centrifugal pumps & reciprocating pumps and analyze their performances.

Pre-requisite

1. Engineering Physics
2. Differential equations and vector calculus

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

Unit 01: FLUID PROPERTIES AND PRESSURE MEASUREMENT — **09 Hours**

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

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

Types of fluid flow- application of continuity equation, Euler's equation-Bernoulli's equation- Orifice meter, Venturi meter.

Boundary layer concept-Laminar flow though circular pipes -Hagen-Poiseuille equation- Turbulent

flow though circular pipes- Darcy Weisbach equation –friction factor-Energy losses in flow through pipes (description only)-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- Pelton turbine - Francis turbine -Kaplan turbine - working principles - velocity triangles - work done - efficiencies and performance calculations-specific speed.	
Unit 05: HYDRAULIC PUMPS	**09 Hours**
Pumps: Definition and classifications. Centrifugal pump- working principle, velocity triangle, head and efficiencies, performance calculations. Reciprocating pump – classification, working principle-performance calculations, function of air vessel-Rotary pumps- gear and vane pump- working principle.	

Theory: 45Hrs	**Practical: -**	**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. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2011

U19MC302	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:	Apply the 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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz(5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: 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: columns and 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: 45 Hrs	**Practical: -**	**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

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
2. Singh D.K "Mechanics of Solids" Pearson Education 2002.
3. Ryder G.H, "Strength of Materials", Macmillan India Ltd., Third Edition, 2002.
4. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.

U19MC303	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

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

Unit 01: 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.

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, 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	Practical: -	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. Magendran parashar & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. P.N. Rao, Manufacturing Technology", Tata McGraw-Hill Publishing Limited, II Edition, 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. Serope Kalpajian, 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.

U19MC304	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	To learn the General characteristics of different types of electrical AC & DC Motors with respect to the applications.
CO2:	Explain the nature of speed torque characteristic of various types of loads and drive motor
CO3:	Describe the different starting methods of AC & DC motors.
CO4:	Explain various solid-state speed controls of single and three phase DC drives.
CO5:	Explain the working of various 3 phase induction motor drives for precise variable speed control.

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	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	1	1	2	1	1	2			3	2
CO2	3	3	3	2	1	1	2	1	1	2			3	2
CO3	3	3	3	2	1	1	2	1	1	2			3	2
CO4	3	3	3	2	1	1	2	1	1	2			3	2
CO5	3	3	3	2	1	1	2	1	1	2			3	2

Course Assessment methods

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

Unit 01: INTRODUCTION OF ELECTRIC DRIVES — **09 Hours**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors. Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills

Unit 02: STARTING AND SPEED CONTROL OF DRIVES	09 Hours
Types of D.C Motor starters – Braking of Electrical motors –Induction Motor starters- Speed control of DC series and shunt motors – Armature and field control, Ward- Leonard control system applications. Conventional Speed Control of Induction Motors: Stator Voltage Control, Stator Frequency Control, Rotor Resistance Control	
Unit 03: CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF DC DRIVES	**09 Hours**
Single Phase and Three Phase Fully Controlled Converter: Principle of operation and waveforms of single phase and three phase fully controlled converter fed DC drive – Choppers Fed DC Motor Drive – Applications.	
Unit 04: CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF AC DRIVES	**09 Hours**
Speed control of three phase induction motor-Voltage control, Voltage/ frequency control, Slip power recovery scheme- VSI fed Three Phase Induction Motors–CSI Fed Three Phase Induction Motors- and AC voltage regulators-Applications.	
Unit 05: SPECIAL MOTOR DRIVES	**09 Hours**
Speed control of Stepper motors – Permanent magnet, Variable reluctance, Single and multi-stack configurations, Hybrid motor. Speed control of Switched reluctance motor – AC & DC Servo motors – Brushless DC motors	

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

TEXT BOOKS

1. U.A.Bakshi, M.V.Bakshi, "Electrical Drives and Control", Technical Publications, 2009.
2. G.K dubey , "Fundamentals of Electrical Drives ",Narosa Publishing House, New Delhi ,2 nd Edition, 2001

REFERENCES

1. M. D. Singh, "Power electronics", Tata McGraw-Hill Education, 2011.
2. Bimbhra, P.S., "Power Electronics", Second edition, Khanna Publishers, New Delhi 5 th Edition, 2015.
3. P.C.Sen "Principles of Electric Machines and Power Electronics" John Wiley & Sons, 2007.
4. Vedam Subramaniam "Electric drives", Tata McGraw-Hill.2001.

U19MC305	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Discuss the different number systems, error correcting codes and implement Boolean functions using logic gates.
CO2:	Design and analyse the combinational logic circuits.
CO3:	Design and analyse sequential circuits using flip flops.
CO4:	Design and implement various logic functions using ROM, PLA and PAL.
CO5:	Discuss the different types of basic electronics circuits.

Pre-requisite

Physics for Electron devices

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	PO 3	PO4	PO5	PO6	PO7	PO 8	P0 9	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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: BINARY SYSTEMS AND BOOLEAN ALGEBRA — **09 Hours**

Number systems – Base conversion – Binary codes – Parity and hamming code – Logic gates – Boolean laws and theorems – Minimization of Boolean expressions – SOP and POS forms, minterms and maxterms – Karnaugh map minimization (up to 5 variables) – Realization of circuits using logic gates.

Unit 02: COMBINATIONAL CIRCUITS	**09 Hours**
Design of Half and Full Adder, Half and Full Subtractor, Parallel Adder / Subtractor, Comparator, Parity generator and checker – Priority Encoder, Decoder, Demultiplexer and Multiplexer – Implementation of combinational logic circuits using decoder, de-multiplexer and multiplexer.	
Unit 03: **SEQUENTIAL CIRCUITS**	**09 Hours**
Flip flops – SR, JK, D and T – Master-Slave flip-flop – Realization of one flip flop using other flip flops – Asynchronous Up / Down counter – Design of synchronous counters: Binary counters, Modulo–n counter, Decade Counter, Ring counter and Johnson counter - Shift registers.	
Unit 04: **MEMORIES AND PLDs**	**09 Hours**
Classification of memories – Random Access Memory (RAM) – Read Only Memory (ROM) – Memory decoding– Programmable Array Logic (PAL) – Programmable Logic Array (PLA) – Field Programmable Gate Arrays (FPGA) – Implementation of logic functions with PROM, PLA and PAL.	
Unit 05: DIGITAL CIRCUIT APPLICATIONS	**09 Hours**
Digital to analog and Analog to digital convertors: R-2R Ladder and Successive approximation techniques – Operational amplifier: Inverting, Non-inverting, Integrator, Differentiator - Schmitt trigger- Multivibrators using Op-amp –555 timer	

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

TEXT BOOKS

1. M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education, 6th edition, 2018.
2. D.P. Kothari and J.S. Dhillon, "Digital Circuits and Design", Pearson Education, 2015.

REFERENCES

1. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI India, 4th edition, 2016.
2. Charles H.Roth and Larry L. Kinney "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014.
3. Donald D. Givone, "Digital Principles and Design", McGraw Hill Education, 2016

U19GE304	Mandatory course: Constitution of India	L	T	P	C
		2	0	0	0

Course Outcomes	
After successful completion of this course, the students should be able to	
CO1:	Demonstrate a capacity to work efficiently and with critical engagement with complex and sophisticated primary constitutional law texts
CO2:	Exhibit the capacity to craft coherent and persuasive constitutional law arguments in an adversarial context ,also recognizing the limitations of such argumentation
CO3:	Apply a contextual understanding of (i) the function of the High Court as the final arbiter of constitutionality and (ii) the techniques of judicial review as applied
CO4:	Practice a thorough and contextual knowledge of constitutional law doctrine particularly in its application to real or hypothetical constitutional law problems
CO5:	Demonstrate a high level of skill on academic and professional legal writing

Course Assessment methods

Direct	Indirect
Internal test I Internal test II Internal test III (Total of 100 marks)	Course end survey

Unit 01: Introduction to Constitution of India	**06 Hours**

Constitutional law – meaning – importance

Constitutionalism – features – elements

Constitution of India – concept – importance – historical perspective – characteristics

Unit 02: Fundamental Rights and Equality	**06 Hours**

Fundamental rights – scheme – benefits

Fundamentals duties – importance – and its legal status

Unit 03: **Structure, Policies, Principles**	**06 Hours**

State policy – the directive principles and its importance-The implementation of directive principles- Parliamentary form of government in India- Constitution power and status of the President- Federal structure and distribution of legislative

Unit 04: **Emergency rule**	**06 Hours**

Financial powers between the union and the states- Amendment of the constitutional powers – procedure- Emergency provisions : articles of Indian constitution that has provisions to proclaim emergency- Emergency powers of President – national emergency President rule, financial emergency

Unit 05: Types and Concepts of Local Self Government		06 Hours
The concept of local self –government and its types Comparison of the Indian constitutional scheme Directive principles of state policy and fundamental duties noted in the Indian constitution Scheme of the fundamental rights to certain freedom under Article 19 Scope of the right to life and personal liberty under Article 21		
Theory: 30 Hrs	**Practical: -**	**Total Hours: 30 Hrs**
REFERENCE BOOKS		
1. The Constitution of India, 1950 (Bare Act), Government Publication.		
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.		
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.		
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.		

U19MC306	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, determine the Coefficient of discharge of orifice/venturi meters and evaluate the fluid machines performance.
CO2:	Investigate the mechanical properties of materials.
CO3:	Evaluate the real time problems in the fluid flow and material strength analysis.

Pre-requisite

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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20) Quiz-II (5)	RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

Part-A: Fluid Mechanics laboratory

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

Part-B: Strength of Materials laboratory

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

U19MC307	MANUFACTURING TECHNOLOGY 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:	Demonstrate the working of general purpose machine tools and do turning process for a given job
CO2:	Work on drilling machine and make drilling on steel plate.
CO3:	Perform an ARC welding equipment and make various joints

Pre-requisite

1. Workshop 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	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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20)	Quiz-II (5) RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

1. Exercise on simple facing & Turning.
2. Exercise on Step turning.
3. Exercise on taper turning.
4. Exercise on thread cutting operation.
5. Exercise on Knurling and Grooving.
6. Exercise on Drilling, Boring and Chamfering.
7. Exercise on radial drilling (Drilling, Tapping, Reaming and Counter Sink).
8. Exercise on surface machining using shaper.
9. Exercise on Gear milling.
10. Exercise on cylindrical grinding.

Total Hours: 45 Hrs

U19MC308	ELECTRICAL DRIVES AND CONTROL 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:	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 speed torque performance curves. Discuss the Speed and torque control of DC motors and AC motors.
CO3:	Give the solution for real time problems in electrical machines.

Pre-requisite

1.Basic Electrical Engineering 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	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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20)	Quiz-II (5) RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

1. Speed control of DC shunt motor (Armature, Field control).
2. Study of V/f control operation of induction motor drive.
3. Speed control of three phase slip ring Induction Motor.
4. Speed control of chopper-controlled DC series motor.
5. Speed control of Chopper controlled DC shunt motor.
6. Speed control of PWM inverter-based induction motor drive.
7. PLC based Speed control of induction motor.
8. Speed control steeper motor.
9. DSP controller-based speed control of induction motor drive.
10. Speed control of controlled rectifier-based DC motor drive.
11. Speed control of Brushless Dc Motor.

Total Hours: 45 Hrs

Semester-III	U19 GE301- SOFT SKILLS AND APTITUDE – I	L T P C Marks 0 0 2 1 100
Course Outcomes **At the end of the course the student will be able to:**		
1. Demonstrate capabilities in specific soft-skill areas using hands-on and/or case-study approaches		
2. Solve problems of greater intricacy in stated areas of quantitative aptitude and logical reasoning		
3. Demonstrate higher levels of verbal aptitude skills in English with regard to specific topics		
1.Soft Skills	**Demonstrating soft-skill capabilities with reference to the following topics**: a. Attitude building b. Dealing with criticism c. Innovation and creativity d. Problem solving and decision making **e.** Public speaking **f.** Group discussions	
2. Quantitative Aptitude and Logical Reasoning	**Solving problems with reference to the following topics:** a. **Vedic Maths:** Fast arithmetic, multiplications technique, Criss cross, Base technique, Square root, Cube root, Surds, Indices, Simplification. b. **Numbers:** Types, Power cycle, Divisibility, Prime factors & multiples, HCF & LCM, Remainder theorem, Unit digit, highest power. c. **Averages:** Basics of averages and weighted average. d. **Percentages**: Basics of percentage and Successive percentages. e. **Ratio and proportion:** Basics of R &P, Alligations, Mixture and Partnership. f. **Profit ,Loss and Discount**: Basic & Advanced PLD g. **Data Interpretation**: Tables, Bar diagram, Venn diagram, Line graphs, Pie charts, Caselets, Mixed varieties, Network diagram and other forms of data interpretation. h. **Syllogism:** Six set syllogism using Venn diagram and tick and cross method	
3. Verbal Aptitude	**Demonstrating English language skills with reference to the following topics:** a. Verbal analogy b. Tenses c. Prepositions d. Reading comprehension e. Choosing correct / incorrect sentences f. Describing pictures g. Error spotting	

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

U19GE3014 - Constitution of India

Course Outcomes **2 0 0 0**

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

CO 1 Demonstrate a capacity to work efficiently and with critical engagement with complex and sophisticated primary constitutional law texts

CO 2 Exhibit the capacity to craft coherent and persuasive constitutional law arguments in an adversarial context ,also recognizing the limitations of such argumentation

CO 3 Apply a contextual understanding of (i) the function of the High Court as the final arbiter of constitutionality and (ii) the techniques of judicial review as applied

CO 4 Practice a thorough and contextual knowledge of constitutional law doctrine particularly in its application to real or hypothetical constitutional law problems

CO 5 Demonstrate a high level of skill on academic and professional legal rights.

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

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

UNIT – I Introduction to Constitution of India **6**

- Constitutional law – meaning – importance
- Constitutionalism – features – elements
- Constitution of India – concept – importance – historical perspective – characteristics

UNIT – II Fundamental Rights and Equality **6**

- Fundamental rights – scheme – benefits
- Fundamentals duties – importance – and its legal status

UNIT – III Structure, Policies, Principles **6**

State policy – the directive principles and its importance-The implementation of directive principles- Parliamentary form of government in India- Constitution power and status of the President- Federal structure and distribution of legislative

29.08.2022 B.E. / B.Tech. Regulations 2019

UNIT –IV Emergency rule 6

Financial powers between the union and the states- Amendment of the constitutional powers – procedure- Emergency provisions : articles of Indian constitution that has provisions to proclaim emergency- Emergency powers of President – national emergency President rule, financial emergency

UNIT – V Types and Concepts of Local Self Government 6

- The concept of local self –government and its types
- Comparison of the Indian constitutional scheme
- Directive principles of state policy and fundamental duties noted in the Indian constitution
- Scheme of the fundamental rights to certain freedom under Article 19
- Scope of the right to life and personal liberty under Article 21

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Total: 30 hours

29/8/22

Dr. M. Raja
Course Coordinator / Sciences

29/8/2022

Dr. C. Shanthi
HOD / Sciences

29/8.

Dr. M. Renuga
Chairperson BOS,
Science and Humanities

29.08.2022

B.E. / B.Tech. Regulations 2019

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MAT401B	Probability and Statistical Methods	3	1	0	4	60
2	U19MC401	Fluid Power Systems	3	0	0	3	45
3	U19MC402	Thermodynamics and Heat Transfer	3	0	0	3	45
4	U19MC403	Microprocessors and Microcontroller	3	0	0	3	45
5	U19MC902	**Professional Elective:** Sensors, Transducers and Instrumentation	3	0	2	4	75
6	U19GE402	**Mandatory course:** Environment and Climate Science	2	0	0	0	30
Practical							
7	U19MC404	Fluid Power Systems Laboratory	0	0	4	2	60
8	U19MC405	Microprocessor and Microcontroller Laboratory	0	0	4	2	60
9	U19GE401	Soft Skill and Aptitude – II	0	0	2	1	30
					Total Credits	**22**	

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

B. E / MECHATRONICS ENGINEERING

SEMESTER – IV	PROBABILITY AND STATISTICAL METHODS	L	T	P	C
U19MAT401B		3	1	0	4

COURSE OUTCOMES

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

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

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

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

UNIT – I BASIC STATISTICS 12

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

UNIT – II RANDOM VARIABLES 12

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

UNIT – III THEORETICAL DISTRIBUTIONS 12

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

UNIT – IV TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions, marginal and conditional distributions – covariance – correlation – central limit theorem.

UNIT – V TESTING OF HYPOTHESIS **12**

Sampling distributions – testing of hypothesis for proportion, mean, standard deviation and differences using normal distribution– t-test for single mean and difference between means - χ^2- tests for independence of attributes and goodness of fit and F-test for equality of two variances.

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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13. 01. 2021 **B. E. / B. Tech. Regulations 2019**

U19MC401	FLUID POWER SYSTEMS	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	PSO1	PSO2
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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO FLUID POWER — **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: 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 Hrs	**Tutorial: -**	**Total Hours: 45 Hrs**

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.

U19MC402	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 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	PSO1	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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: LAWS OF THERMODYNAMICS **9 Hours**

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

Unit 02: AIR STANDARD CYCLES AND VAPOUR POWER CYCLE **9 Hours**

Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - vapour power cycle: Rankine cycle- cycle efficiency

Unit 03: 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-introduction to transient heat conduction.

Unit 04: CONVECTION	9 Hours
Boundary layer concept - heat transfer coefficient - types of convection - forced convection - external flow: flow over plates, cylinders and spheres - internal flow introduction to free convection.	
Unit 05: RADIATION	**9 Hours**
Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law -black body radiation- radiation shield-radiation between surfaces.	

Theory: 45 Hrs	Tutorial: --	Practical: --	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

U19MC403	MICROPROCESSORS AND MICROCONTROLLER	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

Digital electronics

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: 8085 MICROPROCESSOR — **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 MICROPROCESSOR**	**09 Hours**
8086 architecture – 8086 addressing modes – memory organization instruction set – 8086 assembly language programming – 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 Hrs	**Tutorial: -**	**Practical: -**	**Total Hours: 45 Hrs**

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.

U19MC902	Professional Elective: SENSORS, TRANSDUCERS AND INSTRUMENTATION	L	T	P	C
		3	0	2	4

Course Outcomes

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

CO1:	Analyse the characteristics of a sensor or transducer.
CO2:	Identify the different types of mechanical sensors.
CO3:	Predict the different types of sensors for Industrial variables.
CO4:	Design a signal conditioning circuit and data acquisition system
CO5:	Implement smart sensors in digital Industries.

Pre-requisite

1. Basic Electrical and Electronics 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			2			2			3	2
CO2	3	2	3	2			2			2			3	2
CO3	3	2	3	2			2			2			3	2
CO4	3	3	2	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) Internal test IV (6)	Assignment/Seminar/Quiz (5) Online test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO MEASUREMENT SYSTEMS — **09 + 06 Hours**

Sensors & Transducer: Definition – Classification – selection of sensors – Static and Dynamic Characteristics – Errors in Measurements – Problems on error measurements – Transduction principles: Resistive, Inductive and Capacitive.

Unit 02: SENSORS FOR AUTOMATION I — **09 + 06 Hours**

Measurement of displacement using Potentiometer, LVDT & Optical Encoder – Measurement of force using strain gauge – Measurement of pressure using LVDT based on diaphragm & piezoelectric sensor – Position sensors – Angular rate sensors.

Unit 03: SENSORS FOR AUTOMATION II — **09 +06 Hours**

Measurement of temperature using Thermistor, Thermocouple & RTD – Concept of thermal imaging – Measurement of position using Hall effect sensors – Proximity sensors: Inductive & Capacitive, Inertial sensors – Flow Sensors: Ultrasonic & LASER – Level Sensors: Ultrasonic & Capacitive.

Unit 04: **SIGNAL CONDITIONING AND DATA ACQUISITION**	**09 +06 Hours**
Signal Conditioning: Basic block diagram of Signal conditioning Analog and Digital IO – Types of ADC: successive approximation and sigma-delta – Types of DAC: Weighted Resistor and R-2R Ladder type – Data acquisition: Elements of data acquisition and control - Overview of I/O process - single channel & multichannel data acquisition.	
Unit 05: INTELLIGENT SENSORS	**09 +06 Hours**
Intelligent Sensors: General Structure of smart sensors & its components – Characteristic of smart sensors: Self calibration, Self-testing & self-communicating – Application of smart sensors: Automatic robot control, automobile engine control & Digital industries.	

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

TEXT BOOKS

1. D Patranabis, "Sensors and Transducers", PHI 2nd Edition, 2015.
2. DVS Murthy, "Transducers and Instrumentation", PHI 2nd Edition 2013.

REFERENCES

1. Sawney A K and Puneet Sawney, "Measurements and Instrumentation and control", 12th edition, Dhanpat Rai and Co, New Delhi, 2013.
2. S. Gupta, J.P. Gupta "PC interfacing for Data Acquisition & Process Control", 2nd ED Instrument Society of America, 1994.
3. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation & Measurement Techniques", PHI, 2001.
4. Deoblin E.O. "Measurement Systems - Application and Design", McGraw Hill, 4th Edition, 2005.

U19MC404	FLUID POWER SYSTEMS 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)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P09	PO 10	PO 11	PO 12	PS O1	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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20)	Quiz-II (5) 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

U19MC405	MICROPROCESSOR 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 some basic arithmetic operations and to interface various devices using 8085 instructions.
CO2:	Write an assembly language program to execute basic arithmetic operations using 8086 processor and 8051 microcontroller.
CO3:	Solve the real time problems using microprocessor and microcontroller.

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	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3						2		2	3	2
CO2	3	3	3	3						2		2	3	2
CO3	3	3	3	3						2		2	3	2

Course Assessment methods

Direct		Indirect
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20)	Quiz-II (5) 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 Code converter (BCD to Binary and Binary to BCD) using 8085 processor.
6. Assembly Language Programming of Interface Experiments (A/D and D/A interface) using 8085 processor.
7. Interfacing and Programming of Stepper Motor control using 8085 processor.
8. Assembly Language Programming of 16-bit binary addition and subtraction using 8086 processor.
9. Assembly Language Programming of 16-bit binary multiplication and division using 8086 processor.
10. Assembly Language Programming of 8-bit binary addition and subtraction using 8051 microcontrollers.
11. Study and Interface of Arduino board.
12. Study and Interface of raspberry board.

Total Hours: 60 Hrs

Semester – IV	U19GE401-SOFT SKILLS AND APTITUDE – II	L	T	P	C	Marks
		0	0	2	1	100

Course Outcomes

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

1. Demonstrate capabilities in additional soft-skill areas using hands-on and/or case-study approaches
2. Solve problems of increasing difficulty than those in SSA-I in given areas of quantitative aptitude and logical reasoning and score 65-70% marks in company-specific internal tests
3. Demonstrate greater than SSA-I level of verbal aptitude skills in English with regard to given topics and score 65-70% marks in company-specific internal tests

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

06/01/2023

Dr.S.Anita

Head/Training

Department of Placement Training
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MANDATORY COURSE

SEMESTER – IV

MANDATORY COURSE

U19GE402 - ENVIRONMENT AND CLIMATE SCIENCE

(Common for MCT, IT,FT,ECE and BME)

L	T	P	C
2	0	0	0

Course Outcomes:

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

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

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 6

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

UNIT II ECOSYSTEMS AND BIODIVERSITY 6

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

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

UNIT III ENVIRONMENTAL POLLUTION 6

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

UNIT IV CLIMATE CHANGE ON THE ENVIRONMENT 6

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

UNIT V EFFECT OF CLIMATE CHANGE ON POLLUTION 6

Fungal diseases in forests and agricultural crops due to climatic fluctuations - Growing energy needs - effect of climate change due to non-renewable energy resources. Renewable energy resources in the prevention of climatic changes- Effect of climatic changes in ground water table, garments, monuments, buildings, consumption of energy, agriculture and in electric power sector - Carbon credit - carbon footprint - disaster management -Role of an individual to reduce climate change.

TOTAL: 30 HOURS

Text Books:

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

References:

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

23/1/21
Dr. M. Raja
Course Coordinator / Sciences

23/1/2021
Dr. C. Shanthi
HOD / Sciences

Dr. M. Renuga
Chairperson BOS,
Science and Humanities

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

MCT V

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

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	U19MC501	CAD/CAM	3	0	0	3	45
2	U19MC502	Theory of Machines	3	0	0	3	45
3	U19MC503	Data Structure using Python	3	0	2	4	75
4	U19MC504	Industrial Automation	3	0	0	3	45
5	noc23_me105	NPTEL: Automation in Manufacturing	3	0	0	3	45
Practical							
6	U19MC505	CAD/CAM Laboratory	0	0	3	1.5	45
7	U19MC506	Industrial Automation Laboratory	0	0	3	1.5	45
8	U19MC507	Mini Project-I	0	0	2	1	30
9	U19GE501	Soft Skill and Aptitude – III	0	0	2	1	30
					Total Credits	**21**	**405**

Approved By

5/7/23		17/7/23
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, Fifth Semester BE MCT Students and Staff, COE

U19MC501	CAD/CAM	L	T	P	C
		3	0	0	3

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

Unit 01: COMPUTER AIDED DESIGN — **9 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 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 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 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 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	Tutorial: --	Practical:--	Total Hours: 45 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.

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U19MC502	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	PO11	PO 12	PSO1	PSO2
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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Online test (6) Attendance (5) End semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO MECHANISMS — **9 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 — **9 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	**9 Hours**
Static force analysis: 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).Introduction to vibration.	
Unit 04: BALANCING OF ROTATING & RECIPROCATING MASSES	**9 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	**9 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: --	Practical:--	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.

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U19MC503	DATA STRUCTURE USING PYTHON	L	T	P	C
		3	0	2	4

Course Outcomes

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

CO1:	Implement Class using python.
CO2:	Implement abstract data types for linear data structures and Solve real world problems using stack and queue linear data structures.
CO3:	Design algorithms to solve common graph problems.
CO4:	Apply various non-linear tree data structures in real time applications.
CO5:	Analyze various sorting, searching and hashing techniques.

Pre-requisite

Python programming

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	1			2	2	1	3	3	2
CO2	3	3	2	2	2	1			3	1	1	3	3	2
CO3	3	3	3	2	2	1			3	2	1	3	3	2
CO4	3	3	3	2	2	1			3	2	1	3	3	2
CO5	3	3	3	2	2	1			3	2	1	3	3	2

Course Assessment methods

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

Unit 01: ABSTRACT DATA TYPES — **9+6 Hours**

Introduction to programming, algorithms and data structures - Abstract Data Types (ADTs) – ADTs and classes – Introduction to OOP – classes in Python - Basic algorithmic analysis: input size, asymptotic notations.

Suggested Activities for practical:

- Implement Class using python

Unit 02: LINEAR DATA STRUCTURES — **9+6 Hours**

List ADT – array-based implementation – linked list implementation - Applications of lists - Stack ADT – Queue ADT - Applications of Stacks and queues.

Suggested Activities for practical:

- Implementation of Lists

- Implementation of Stacks
- Implementation of Queues

Unit 03: NON LINEAR DATA STRUCTURES - 1	**9+6 Hours**

Introduction to Non Linear Data Structures - Tree ADT – Binary Tree ADT – Tree traversals - Expression trees - Binary search trees - Heap – Applications of heap

Suggested Activities for practical:

- Implementation of Binary Trees
- Implementation of Tree Traversal
- Implementation of Binary Search Trees
- Implementation of Heap

Unit 04: NON LINEAR DATA STRUCTURES - 2	**9+6 Hours**

Graph ADT: representations of graph – graph traversals: BFS - DFS - shortest paths – Minimum Spanning Trees: Prim's algorithm, Kruskal's algorithm - – Shortest path algorithms: Dijkstra's algorithm - Applications of Graphs.

Suggested Activities for practical:

- Implementation of graphs using BFS and DFS
- Implementation of Prim's algorithm
- Implementation of Kruskal's algorithm
- Implementation of Dijkstra's algorithm

Unit 05: SORTING, SEARCHING AND HASHING	**9+6 Hours**

Sorting: Selection Sort - Bubble Sort – Insertion Sort - Merge Sort - Quick Sort – Searching: Linear Search - Binary Search – Hashing.

Suggested Activities for practical:

- Implementation of Sorting Techniques
- Implementation of Searching Techniques
- Implementation of Hashing and Collision Resolution Technique

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

TEXT BOOKS

1.	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", John Wiley & Sons Inc., 2013.
2.	Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015.

REFERENCES

1.	https://infosysheadstart.onwingspan.com/
2.	Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011.

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U19MC504	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:	Acquire an adequate knowledge about PLC and working of its components.
CO2:	Understanding the concepts of various instructions in PLC programming language.
CO3:	Identify the sensors and actuators for the various Industrial applications.
CO4:	Understand the communication requirements and programming for real time applications.
CO5:	The need of SCADA, DCS and its advantages with PLC.

Pre-requisite

1. Basic Electrical Engineering
2. Sensors, Transducers 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			2		3	2
CO2	2	3	3		2		3		3			2	2	3
CO3	3	2	3		3		2				2		3	3
CO4	3	2	3		3					3			3	2
CO5	3	3	2		2			2				2	3	3

Course Assessment methods

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

Unit 01: INTRODUCTION TO INDUSTRIAL AUTOMATION — **9 Hours**

Programmable Logic Controllers: Introduction, Relay based automation, Evolution of PLC's, Parts of PLC, Principles of operation, Advantages over relay logic, PLC sizes, PLC hardware components, I/O section, Discrete and Analog Module, CPU processor and memory module, Programming devices, PLC Programming Languages, Ladder diagram, Function Block Diagram, Latching relays, Converting simple relay ladder diagram in to PLC relay ladder diagram.

Unit 02: PLC INSTRUCTIONS	9 Hours
Timer Instructions: On Delay, Off Delay And Retentive Timers, Up Counter, Down Counter And Up Down Counters, Relay – Type Instructions, Data Manipulating Program, Data Handling Instructions - Control Instruction, Math Instructions - Sequencer And Shift Register Instructions.	
Unit 03: PLC I/O DEVICES	**9 Hours**
Input devices: Manually Operated Switches – Mechanically Operated Switches, Analog and discrete temperature switches, proximity switches, pressure switches NO and NC Push buttons and interlocking concepts. Ouput devices: Contactor for motors, Stepper and servo motors, starters, VFD, hydraulic and pneumatic cylinders, Analog valves.	
Unit 04: PLC COMMUNICATION DEVICES AND APPLICATIONS	**9 Hours**
Networking of PLC, Fieldbus, PROFI bus, and Mod bus, mechatrolink, ControlNet, DeviceNet and Profinet protocols. Controlling a Robot with PLC, Conveyor belt motor control, Automatic car washing machine, PLC in quality inspection, Traffic light control system, Application of PLC in power plants.	
Unit 05: SUPERVISORY CONTROL AND DATA ACQUISITION	**9 Hours**
Introduction, Evolution of SCADA, Interfacing PLC with SCADA, features of SCADA, SCADA Architecture, Components of SCADA, Master Terminal Unit, Remote terminal Unit, alarm logging, Trend on line, off line, HMI and Introduction to DCS.	

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

TEXT BOOKS

1.	F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2.	Stuart A Boyer, "SCADA supervisory control and data acquisition"2010.

REFERENCES

1.	K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition, 2011.
2.	Hughes .T, "Programmable Logic Controllers", ISA Press, 1989.
3.	Mdhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation, An Introduction" Penram International Publishing Limited,2012.

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noc23_me105	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

Course Outline :

Manufacturing industry contributes a major share in the GDP of our country. Application of automated systems is certainly improving the productivity of the manufacturing industry. In view of this, a course on "Automation in Manufacturing" is designed with the primary focus on the design and development of automated systems in the manufacturing. Initially the course introduces various automated systems being used in the manufacturing industry. Then the building blocks of a typical automated system are described. It presents a study on the principle of operation and construction details of sensors/transducers, actuators, drives and mechanisms, hydraulic and pneumatic systems. It also covers up the microprocessor technology, programming and CNC technology. The contents are lucidly presented with real-life examples. Case studies based on manufacturing industry applications are presented.

Intended audience :

UG, PG students of Mechanical, Production, Industrial Engineering, Mechatronics Engineering. Practicing engineers.

Pre requisites: Knowledge of basic electronics and electrical engineering.

Course layout:

Week 1: Introduction: Importance of automation in the manufacturing industry. Use of mechatronics. Systems required.

Week 2: Design of an automated system: Building blocks of an automated system, working principle and examples.

Week 3: Fabrication: Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues.

Week 4: Sensors: study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors

Week 5: Microprocessor Technology: signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working.

Week 6: Drives: electrical drives – types, selection criteria, construction and operating principle.

Week 7: Mechanisms: Ball screws, linear motion bearings, cams, systems controlled by camshafts. **Week 8:** Mechanisms: Electronic cams, indexing mechanisms, tool magazines, and transfer systems. **Week 9:** Hydraulic systems: hydraulic power pack, pumps, valves. **Week 10:** Hydraulic systems: designing of hydraulic circuits. **Week 11:** Pneumatic systems: configurations, compressors, valves, distribution and conditioning. **Week 12:** CNC technology: basic elements, interpolators and programming			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS

1.	HMT Ltd. Mechatronics, Tata McGraw-Hill, New Delhi, 1988.
2.	Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore,1999.

REFERENCES

1.	Regtien, P. P. L., Sensors for mechatronics, Elesevier, USA,2012
2.	Tonshoff, H.K. and I. Inasaki, Sensors in manufacturing,Wiley-VCH, 2001.
3.	Gaonkar, R. S., Microprocessor architecture, programming,and applications with the 8085, Penram International Publishing (India), Delhi, 2000
4.	Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J.,Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.
5.	Rothbart, H. A., CAM Design Handbook, McGraw-Hill, 2004.
6.	Norton, R. L., Cam Design and Manufacturing Handbook,Industrial press Inc, 2002.

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U19MC505	CAD/CAM 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:	Perceive working knowledge in Computer Aided Design methods and procedures.
CO2:	Construct solid modelling using 3D modelling standard software.
CO3:	Interpret simple CNC programs.

Pre-requisite:

Engineering Graphics

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					2	2
CO2	3	3	3		3		2					2	2
CO3	3	3	3		3		3					3	3

Course Assessment methods

Direct		Indirect
CIE Test-I (20) Quiz-I (5) CIE Test-II (20)	Quiz-II (5) Real Time Problem Solving (10) End semester Examination (40)	Course end survey

List of Experiments

1. Drawing Standards Code of practice for Engineering Drawing, BIS specifications. Drawing, Editing, Dimensioning and Plotting Commands-Layering concepts-Limits, Fits and Tolerances.
2. Orthographic views of standard machine components: Brackets, V Blocks, Stop Block, Screw threads and Threaded fasteners.
3. [A] Solid modelling & assembly
   [B] Surface modelling & assembly & BOM.

4. CNC lathe introduction to basic programming & operations.
5. Part Programming of facing operation.
6. Part Programming of turning operation.
7. Part Programming of thread cutting operation. (Internal/External)
8. Part Programming of Grooving operation.
9. Part Programming of Drilling and Boring operation. (Internal/External)
10. Part programming using Canned Cycle operations.
Total Hours: 45 Hrs

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U19MC506	INDUSTRIAL AUTOMATION 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:	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	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
CIE Test-I (20) Quiz-I (5) CIE Test-II (20)	Quiz-II (5) Real Time Problem Solving (10) End semester Examination (40)	Course end survey

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: 45 Hrs

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U19MC507	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 (10 marks)	End semester Examination (60 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).
Total Hours: 30 Hrs

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V Sem

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

Course Outcomes

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

1. Demonstrate capabilities in supplementary areas of soft-skills and job-related selection processes using hands-on and/or case-study approaches
2. Solve problems of advanced levels than those in SSA-II in specified areas of quantitative aptitude and logical reasoning and score 70-75% marks in company-specific internal tests
3. Display effective language knowledge to construct sentences with subject verb agreement and select the best alternative for the underlined parts of the sentences, and fill in the blanks in the given passages with suitable forms of words and their synonyms.

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

S. Anit 31/07/2023.

Dr.S.Anita

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Syllabi for

B.E/B.Tech Honours (Specialization in the same Discipline)

B.E/B.Tech Honours

B.E/B.Tech Minor

courses

I Honors

MCT

U19MC2001	ROBOTS AND SYSTEMS IN SMART MANUFACTURING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Identify various Industrial robots and their load handling capacity.
CO2:	Compare and select suitable robot for real-time application.
CO3:	Select suitable material handling system for Industrial applications.
CO4:	Develop a robot welding system with required programs.
CO5:	Apply the robot welding process in various applications.

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		2	2	3							2	3	3
CO2	3	3	3	2	3	2					2	2	3	3
CO3	3	2	3	3	3	2					2	2	3	3
CO4	3	2	3	3	3	2					2	2	3	3
CO5	3	3	3	3	3	2					2	2	3	3

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION — **9 Hours**

Types of industrial robots - Load handling capacity - general considerations in Robotic material handling-material transfer - machine loading and unloading - CNC machine tool loading - Robot centered cell.

Unit 02: SELECTION OF ROBOTS AND OTHER APPLICATIONS	9 Hours
Factors influencing the choice of a robot - robot performance testing - economics of robotisation - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting -assembly operation - cleaning - robot for underwater applications.	
UNIT 03: TOOL CONDITION MONITORING USING NEURAL NETWORKS	**9 Hours**
Machine tool conditions: Tool wear mechanisms, forms of tool wear – Sensors and signal processing: Dynamic force, Acoustic emission, Wavelet packet analysis of AE and force signals – Neural network architectures- Tool condition identification using neural networks – MLP for force sensor with simple pre-processing.	
Unit 04: ROBOTIC WELDING	**9 Hours**
Robotic welding system, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding, Welding simulation, Welding sequences, Profile welding.	
Unit 05: APPLICATIONS OF ROBOTS IN WELDING AND ALLIED PROCESSES	**9 Hours**
Application of robot in manufacturing: Exploration of practical application of robots in welding: Robots for car body's welding, robots for box fabrication, robots for microelectronic welding and soldering – Applications in nuclear, aerospace and ship building, case studies for simple and complex applications.	

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

TEXT BOOKS

1.	Richard D Klafter, Thomas Achmielewski, MickaelNegin , "Robotic Engineering – An integrated Approach", Prentice Hall India, New Delhi, 2006.
2.	Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, New York, 2021.
3.	Cotsaftis, M.; Vernadat, F. (Editors). "Advances in Factories of the Future, CIM and Robotics." 1st Edition, March 23, 1993. eBook ISBN: 9781483291505.

REFERENCES

1.	Parmar R S, "Welding Processes and Technology", Khanna Publishers, New Delhi, 2nd Edition, 2013.
2.	Cornelius Leondes , "Artificial Intelligence and Robotics in Manufacturing"CRC press 2001.
3.	Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, Ashish Dutta, "Industrial Robotics (SIE): Technology, Programming and Applications", 2nd Edition, McGraw Hill Education India Pvt Ltd, 2017.
4.	Architecture Technology Corporation. "Robotics." 3rd Edition, 1st Edition - November 15, 1991. eBook ISBN: 9781483285047.
5.	Hunt, V. Daniel. "Understanding Robotics." 1st Edition, August 28, 1990. eBook ISBN: 9780323156813.

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U19MC2002	AUTONOMOUS MOBILE ROBOTS	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 basics of mobile robotics, including locomotion, stability, and control.
CO2:	Analyze robot configurations, kinematic models, and motion control.
CO3:	Classify and characterize sensors used in mobile robotics and perform feature extraction.
CO4:	Acquire knowledge and skills in mobile robot localization and mapping techniques.
CO5:	Develop competences in path planning, obstacle avoidance, and navigation architectures for mobile robots, including collaborative and swarm robotics.

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	2	2	3	3	2					2	2	3	3
CO2	3	2	2	3	3	2					2	2	3	3
CO3	3	2	2	3	3	2					2	2	3	3
CO4	3	2	2	3	3	2					2	2	3	3
CO5	3	2	2	3	3	2					2	2	3	3

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO MOBILE ROBOTICS — **9 Hours**

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles – Teleportation and Control – Autonomous Mobile robot – UAV.

Unit 02: KINEMATICS — **9 Hours**

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots – Open Loop and Feedback Motion Control – Humanoid Robot - Kinematics Overview.

UNIT 03: PERCEPTION	9 Hours
Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Vision Based Sensors – Uncertainty - Statistical Representation - Error Propagation - Feature Extraction Based on Range Data (Laser, Ultrasonic, Vision-Based Ranging) - Visual Appearance based Feature Extraction.	
Unit 04: LOCALIZATION	**9 Hours**
Localization challenges - Sensor noise and aliasing - Effector noise - Localization-based navigation - Belief representation - Map representation - Decomposition strategies - Probabilistic map-based localization - Markov localization - Kalman filter localization - Landmark-based navigation - Positioning beacon systems - Route-based localization - Autonomous map building - Stochastic map technique.	
Unit 05: PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS	**9 Hours**
Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Modularity for Code Reuse and Sharing - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.	

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

TEXT BOOKS

1.	Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004

REFERENCES

1.	Richard D Klafter, Thomas A Chmielewski, Michael Negin,"Robotics Engineering–An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2.	Klancar, Gregor; Zdesar, Andrej; Blazic, Saso; Skrjanc, Igor. "Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems." 1st Edition, January 10, 2017. Paperback ISBN: 9780128042045. eBook ISBN: 9780128042380.
3.	Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011
4.	Jaulin, Luc. "Mobile Robotics." 1st Edition, October 1, 2015. Hardback ISBN: 9781785480485. eBook ISBN: 9780081004814.
5.	Mohanta Jagadish Chandra, "Introduction to Mobile Robots Navigation", LAP Lambert Academic Publishing, 2015.
6.	Xiao Qi Chen, Y.Q. Chen and J.G. Chase, "Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions", Intec Press, 2009.

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U19MC2023	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Identify the basic elements required for mechatronics and cyber physical systems.
CO2:	Apply exact drives and actuators in real time mechatronics systems.
CO3:	Analyze various sensors and signal conditioning circuits for cyber physical systems.
CO4:	Select optimistic communication protocols.
CO5:	Design a cyber physical system for any real time application.

Pre-requisite

NIL

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

UNIT 01: INTRODUCTION TO MECHATRONIC SYSTEMS AND CYBER PHYSICAL SYSTEM — **9 Hours**

Architecture of mechatronics and Cyber physical systems- Key elements - Processors, Sensors, Drives and Actuators, Controller, Electronics devices-Communication Protocols. Case study: SW controllers for ABS, ACC, Lane Departure Warning.

UNIT 02: BASICS OF DRIVES AND ACTUATORS — **9 Hours**

Construction, Principle of Operation, Basic Equations and Applications of electrical motors-DC, AC motors, stepper motor, servo motor. Pneumatic and hydraulic actuators-Valves-Flow, control, cylinder, Filter.-Applications in Automation.

UNIT 03: SENSORS AND SIGNAL CONDITIONING CIRCUITS	9 Hours
Transduction principles of peizo, resistive, capacitive, ultrasonic, IR sensors-Examples-Thermo couples, strain gauge, pressure sensor-Analog to Digital conversion, Data acquisition-Filter circuits.	
UNIT 04: NETWORKING AND COMMUNICATION PROTOCOLS	**9 Hours**
Principles of Modulation and Demodulation: Principles of Amplitude and Frequency Modulations- CPS Network - WirelessHart, CAN, Ethernet, CPS Sw stack – RTOS, Scheduling Real Time control tasks CPS.	
UNIT 05: SYSTEMS ENGINEERING FOR DESIGN OF MECHATRONIC SYSTEM AND CPS	**9 Hours**
V Model and its variants - System boundary definition- Multi-view and multi-level modelingTopological modeling- Semantic interoperability modeling- Multi-agent modelling Collaboration modeling- internal block diagrams- multi-agent development platform – Software tools-Java, Modelica. Case Study: Suspension Control, Healthcare : Pacemaker, Green Buildings : automated lighting.	

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

	TEXT BOOKS
1.	Rajeev Alu, "Principles of Cyber-Physical Systems", The MIT Press, 2016.
2.	Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", Second edition, MIT press, 2011.
	REFERENCES
1.	Song, H., Rawat, D. B., Jeschke, S., &Brecher, C. "Cyber-physical systems: foundations, principles and applications", Morgan Kaufmann, 2016
2.	Rodrigues, Joel Jose PC, Ivan Stojmenovic, and Danda B. Rawat. "Cyber-physical systems: from theory to practice". CRC Press, 2015.
3.	Rajeev Alur , "Principles of Cyber-Physical Systems", MIT Press, 2015.
4.	DevdasShetty, Richard A. Kolk, "Mechatronics System Design", Cengage Learning, Second Edison, 2011.

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U19MC2024	POWER ELECTRONICS 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:	Elaborate the construction and working of power semiconductor devices.
CO2:	Apply the converters in real time applications.
CO3:	Analyze the role of inverters in industrial applications.
CO4:	Select choppers for required automation applications.
CO5:	Implement selected drives for optimistic applications.

Pre-requisite

NIL

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

UNIT 01: POWER SEMICONDUCTOR DEVICES — **9 Hours**

Power diodes - Power transistors - Characteristics of SCR - TRIAC – Power MOSFET- IGBT - Thyristor protection circuits - Thyristor triggering circuits- Selection of device.

UNIT 02: CONVERTERS — **9 Hours**

Single phase - Three phase - Fully controlled rectifiers - Effect of source and load inductance - single phase- Three phase AC voltage controller -Control Circuits for AC to DC and AC to AC converters

UNIT 03: INVERTERS — **9 Hours**

Voltage Source inverters - bridge inverters- 120° and 180° conduction - Pulse Width Modulation - Single

and Multiple PWM - SPWM - Generation of pulses for SPWM.			
UNIT 04: CHOPPERS			**9 Hours**
DC choppers : Buck- Boost - Generation of timing pulses for DC choppers - Applications (Block diagram approach) Uninterrupted power supplies -SMPS - Basics of Magnetic design for power electronics.			
UNIT 05: DRIVES FOR AUTOMATION			**9 Hours**
Closed loop control of DC drives. Stator and rotor voltage control - frequency and voltage control - Current Control - Basics of vector control- Block diagram - Stepper Motor Drive - BLDC Motor Drive - PMSM Drive- protection devices for drives.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

	TEXT BOOKS
1.	Rashid M H , "Power Electronics –Circuits, Devices and Applications", PHI, 2014
2.	Ramu Krishnan , "Electric Motor Drives: Modeling, Analysis, and Control", Prentice Hall, 2001
	REFERENCES
1.	Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2002.
2.	Roger C Dugan, Surya Santoso, Mark F McGranaghan , "Electrical Power Systems Quality", McGraw Hill, 2003
3.	Mohan, Undel, "Power Electronics", John Wiley and sons, 2003.
4.	Robbins Mohan, Undeland, "Power Electronics: Converters Applications and Design", Wiley, 2007.

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U19MC2009	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Discuss the basics of computer aided engineering.
CO2:	Choose appropriate automotive tools and material handling systems.
CO3:	Discuss the overview of group technology, FMS and automation identification methods.
CO4:	Design using computer aided process planning for manufacturing of various components
CO5:	Acquire knowledge in computer process control techniques.

Pre-requisite

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	2	2	1	2				1			1	3	2
CO2	3	2	2	1	2				1			1	3	2
CO3	3	2	2	1	2				1			1	3	2
CO4	3	2	2	1	2				1			1	3	2
CO5	3	2	2	1	2				1			1	3	2

Course Assessment methods

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

Unit 01: INTRODUCTION — **9 Hours**

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM

Unit 02: AUTOMATED MANUFACTURING SYSTEMS — **9 Hours**

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features.

Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing

Unit 03: GROUP TECHNOLOGY AND FMS	**9 Hours**

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits.

Unit 04: PROCESS PLANNING	**9 Hours**

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

Unit 05: PROCESS CONTROL AND DATA ANALYSIS	**9 Hours**

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology
–Automatic data capture technologies.- Quality management (SPC) and automated inspection

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

TEXT BOOKS

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

REFERENCES

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Ronald D. Weill, Principles of Process Planning‖, Chapman Hall, 1995.
3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing‖, Pearson Education, Asia,3rdEdition,2004.
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.
5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

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U19MC2011	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:	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2:	Acquire knowledge on process of transforming a concept into the final product in AM technology.
CO3:	Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4:	Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5:	Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

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	2	1			1				1	3	3
CO2	3	3	3	2	2			1				1	3	3
CO3	3	3	3	3	3			1				1	3	3
CO4	3	3	3	3	3			1				1	3	3
CO5	3	3	3	3	3			1				1	3	3

Course Assessment methods

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

Unit 01: INTRODUCTION — **9 Hours**

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare.

Unit 02: DESIGN FOR ADDITIVE MANUFACTURING (DfAM)	9 Hours
Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.	
Unit 03: VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION	**9 Hours**
Photopolymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.	
Unit 04: POWDER BED FUSION AND MATERIAL EXTRUSION	**9 Hours**
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.	
Unit 05: OTHER ADDITIVE MANUFACTURING PROCESSES	**9 Hours**
Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.	

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

TEXT BOOKS

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States
5. ,2006, ISBN: 978-1-4614-9842-1.

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U19MC2013	FUNDAMENTALS OF MOBILITY SYSTEMS	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 essential characteristics of the automobile system
CO2:	Categorize the various types of transmission systems used in the mobility system
CO3:	Interpret the use of the front axle and steering system
CO4:	Assess the performance of brakes and suspension systems in modern mobility systems
CO5:	Formulate the rules to control vehicle emission control

Pre-requisite

NIL

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

Unit 01: INTRODUCTION TO AUTOMOBILE SYSTEMS — **9 Hours**

General characteristics of Automobiles – Layout of an Automobile – Components and functions – Chassis: Conventional construction – Frame types – Frame construction – Engine: Classification – Components – Valve Mechanism.

Unit 02: TRANSMISSION SYSTEMS — **9 Hours**

Necessary of transmission – Types – Clutch: function, Parts, Types, Operation – Construction – Gear Box: Types – Gear shifting mechanism – Epicyclic gearbox – Propeller shaft – Universal Joints – Drive line -Rear

axle drives- Case Study: Maruti 800 gear box.	
Unit 03: FRONT AXLE AND STEERING SYSTEM	**9 Hours**
Front axle – wheel alignment – Steering geometry – Steering mechanism – Adjusting steering angles – Power Steering – Understeer and oversteer – Steering linkage – Steering gears – Four-wheel steering- Steering lock.	
Unit 04: BRAKES AND SUSPENSION SYSTEM	**9 Hours**
Brakes types- Drum brakes – Disc brakes – Power brakes - Pneumatic and Hydraulic braking system– Air brake system- Antilock Braking system- Suspension system: Types- elements – leaf springs – shock absorbers – Independent suspension.	
Unit 05: AUTO ELECTRIC SYSTEM AND EMISSION CONTROL	**9 Hours**
Components of the auto-electric system – Ignition system – Timing – Spark plug – Electronics Ignition and switching system- Complete combustion – Constituents of exhaust – Pollutant formation – Vehicle pollution and emission rules and regulation – Source -Emission control – Emission Test – Alternative automobile Fuel.	

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

TEXT BOOKS

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, "Automobile Engineering - Volume 1", Thirteen Edition, Standard Publishers, New Delhi, 2014.

REFERENCES

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Gupta.S.K. " A Textbook of Automobile Engineering", Second edition, S.Chand Publisher, 2020.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Jack Erjavec, "A Systems Approach to Automotive Technology", Seventh Edition, Cengage Publishing, 2019.
5. Ginzburg, Lekhtman and Malov , "Fundamentals of Automation and Remote Control" Pergamon,1966.

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U19MC904	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Classify the precise battery types for electric vehicles
CO2:	Discuss the working concepts of various motors used in electric vehicles
CO3:	Choose the proper control methods for electric vehicles
CO4:	Identify the different types of hybrid vehicles for commercial applications
CO5:	Examine the performance characteristics of fuel cell

Pre-requisite

1. Electrical Drives and Control

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	3					2	3	2
CO2	3	3	2			2	3					2	3	2
CO3	3	3	2			2	3					2	3	3
CO4	3	3	2			2	3					3	3	3
CO5	3	3	2			2	3					3	3	3

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO ELECTRIC VEHICLES — **9 Hours**

Electric vehicle: Need, Types, Cost and Emissions, End of life – Electric vehicle technology: Layouts, Cables, Components, – Controls: Power control, sensors, Battery charger, Battery Management System- Batteries: Overview, Types, Battery plug-in and life, Ultra-capacitor charging – Charging standards and methods – Alternate charging sources: Wireless and Solar.

Unit 02: ELECTRIC VEHICLE MOTORS — **9 Hours**

BLDC Motor: Principle, Construction, working- BLDC converter design and control (speed and torque) – Switched Reluctance Motors (SRM) drives: Basic structure, Drive converter design- – Vibration and Acoustic noise in SRM - Safety: Risks and Guidance, Precautions, Hazard management.

Unit 03: CONTROL METHODS IN ELECTRIC VEHICLES — **9 Hours**

Sensors: Autonomous EV cars, Self-Drive Cars – Sensorless control methods of SRM: Phase flux linkage

method, Phase inductance method, Modulated signal injection, Mutually induced voltage, Observer method – Sensorless control methods of BLDC- Measurables & Math and Observer - Regenerative braking: Series brake and parallel brake.			
Unit 04: HYBRID VEHICLES			**9 Hours**
Hybrid electric vehicles classification: Micro, Mild, Full – HEV Layout and Architecture: Series HEDT Parallel HEDT: Torque coupling and speed coupling, Series-Parallel HEDT– Power Transmission System for Electric Vehicles - Control strategies: Max. SOC of PPS and Engine on-off – Series HEDT Design: Traction motor, Engine/ Generator, PPS - Parallel HEDT drive train design.			
Unit 05: FUEL CELLS FOR ELECTRIC VEHICLES			**9 Hours**
Fuel cell Technologies operation principles: Proton exchange membrane fuel cell, Alkaline fuel cell, Phosphoric acid fuel cell, Molten Carbonate fuel cell, Solid Oxide fuel cell - Potential and I-V curve, Fuel and oxidation consumption – Control Strategy- Lifetime Cost of Fuel Cell Vehicle.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS	
1.	Mehrdad Ehsani,Yimin Gao, Stefano Longo and Kambiz Ebrahimi", Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", Third Edition, CRC Press,2018.
2.	Tom Denton,"Electric and Hybrid Vehicles",CRC Press, Second Edition, 2020.
REFERENCES	
1.	Gianfranco Pistoia ,"Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure, and the Market", Elsevier Publications, 2010.
2.	Simona ," Hybrid Electric Vehicles", First Edition, Springer India , 2019.
3.	Teresa Donateo,"Hybrid Electric Vehicles",First Edition, Intech Open Limited ,2017.
4.	Ron Hodkinson, John Fenton," Lightweight Electric/Hybrid Vehicle Design", Butterworth-Heinemann, 2000.
5.	Sandeep Dhameja," Electric Vehicle Battery Systems," Newnes Print, 2002 .

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MCT VI

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

S. No	Course Code	Course Title		Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory								
1	U19MC601	Artificial Intelligence and Machine Learning		3	0	0	3	45
2	U19MC602	Image Processing and Computer Vision		3	0	0	3	45
3	U19MC603	Robotics		3	0	0	3	45
4	U19MC903	**Professional Elective:**	Embedded Systems and Internet of Things	3	0	0	3	45
	U19MC909		Agriculture Automation					
5	U19MC906	**Professional Elective:**	Drone Technology	3	0	0	3	45
	U19MC907		Design Thinking and Product Innovation					
6	U19CS1002	**Open Elective:**	Cloud Computing	3	0	0	3	45
	U19CS1003		Internet of Things					
	U19EE1003		Innovation, IPR and Entrepreneurship Development					
	U19ME1002		Industrial Safety					
	U19ME1004		Renewable Energy Sources					
Practical								
7	U19MC604	Image Processing Laboratory		0	0	2	1	30
8	U19MC605	3D Modelling and Analysis Laboratory		0	0	2	1	30
9	U19MC606	Mini Project-II		0	0	2	1	30
10	U19GE601	Soft Skills and Aptitude – IV		0	0	2	1	30
Total Credits							**22**	**390**

Approved By

Chairperson, Mechatronics Engineering BoS
Dr.P.Suresh
26/12/23

Member Secretary, Academic Council
Dr.R.Shivakumar
28/12/23

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

Copy to:-

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

MCT
VI

U19MC601	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Identify suitable Artificial Intelligent agent for the real time problem.
CO2:	Solve real time design problems using heuristic based algorithms.
CO3:	Construct knowledge base through various inference rules.
CO4:	Outline the machine learning concepts.
CO5:	Apply supervised learning algorithms to various classification problems.

Pre-requisite

1. Probability and statistics

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	3	2		2	2	2					2	3	2
CO3	3	3	2		2	2	2					2	3	2
CO4	3	3	3		2		2					2	3	3
CO5	3	3	3		2		3					2	3	3

Course Assessment methods

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

Unit 01: INTRODUCTION OF AI — **9 Hours**

Foundations of AI – History of AI – Applications – Components of AI – Intelligent agents: Terminology, Structure, Attributes – Types of agents – Problem solving – Problem formulation: Examples – Searching techniques: Types – Uniformed search strategies: Breadth first search , Depth first search – Iterative deepening – Bi-directional search – Comparing search strategies

Unit 02: PROBLEM SOLVING STRATEGIES	9 Hours
Informed/Heuristic search: Hill climbing search, A* search, Branch and Bound search – Adversarial search: Optimal strategies, Minimax algorithm, Alpha-Beta pruning – Constrained satisfaction problems: Crypto arithmetic problem	
Unit 03: KNOWLEDGE REPRESENTATION AND REASONING	**9 Hours**
Agent – knowledge representation issues – Predicate logic: Representation, Unification and resolution – Representation knowledge using rules: Propositional logic – First order logic – Inference – Forward and backward chaining	
Unit 04: MACHINE LEARNING	**9 Hours**
Introduction – Classification – Regression – Types of Learning: Supervised, Unsupervised, Reinforcement learning – Machine learning applications – Dimensionality reduction: Subset selection, Principle Component Analysis (PCA), Linear discriminate analysis – Clustering: Iterative distance based clustering, k-Means clustering	
Unit 05: CLASSIFICATION ALGORITHMS	**9 Hours**
Decision Tree: Introduction, Basic learning tree learning algorithm, steps, issues in decision trees – Support Vector Machine (SVM) – Bayesian classification: Naive Bayes classifier, K-Nearest Neighbor (KNN)	

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

TEXT BOOKS

1. Nilakshi Jain, "Artificial Intelligence - Making a system intelligent", First Edition, Wiley Publisher, 2019.
2. Anuradha Srinivasaraghavan, Vincy Joseph ,"Machine learning", First Edition , Wiley publisher , 2019.
3. Rajiv Chopra, "Artificial Intelligence", Second Edition ,S.Chand publisher, 2016

REFERENCES

1. Elaine Rich, Kevin Knight and S B Nair," Artificial Intelligence", Third Edition, Tata McGraw Hill , 2019
2. Masashi Sugiyama, Introduction to Statistical Machine Learning, Morgan Kaufmann Publishers, 2016.
3. David Pool and Alan Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University, 2011.

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U19MC602	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:	Familiarize the fundamental concepts of digital image processing.
CO2:	Apply Image enhancement techniques in spatial domain.
CO3:	Identify the features and region of interest for a given image using segmentation approaches.
CO4:	Implement different compression techniques.
CO5:	Develop algorithms for computer vision problems with focus on Robotics.

Pre-requisite

1. Linear algebra and calculus

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	2	3	2
CO4	2	2	3		2					3		2	3	2
CO5	3	3	2		2			2				2	3	2

Course Assessment methods

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

Unit 01: IMAGE PROCESSING FUNDAMENTALS — **9 Hours**

Fundamental Steps in Digital Image Processing – Elements of Visual Perception – Some Basic Relationship Between Pixels – Connectivity – Distance Measure – Brightness – Contrast – Hue – Saturation – Mach Band Effect – Types of Image – Image sampling – Quantization – False Contouring – Colour Image Fundamentals RGB – HSI Models – Conversion from RGB to HSI.

Unit 02: IMAGE ENHANCEMENT	9 Hours
Spatial domain filtering: Image negative, Contrast stretching, Gray level slicing – Histogram equalization – Smoothing filters – Sharpening filters – Maximum filter – Minimum filter – Median filter – Bit Plane Slicing – Frequency domain filtering: Low-pass filter, High-pass filter, Butterworth High-pass filter, Low-pass and High-pass Gaussian filter	
Unit 03: IMAGE SEGMENTATION	**9 Hours**
Image segmentation: Point, line and edge detection – Basics of intensity thresholding – Region based segmentation : Region growing, Region splitting and merging – Thresholding – Standard Binary Morphological Operations – Dilation and Erosion based Operations	
Unit 04: IMAGE COMPRESSION	**9 Hours**
Image Compression – Lossless Compression – Huffman Coding –Arithmetic Coding – LZW Coding – Lossy Compression – Compression Standards: JPEG Image Compression Standards and MPEG Video Compression Standards – H.244 Compression Standards	
Unit 05: COMPUTER VISION	**9 Hours**
Feature extraction: 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 – Computer vision for Autonomous Robots	

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

TEXT BOOKS

1.	Jayaraman S., Esakkirajan and Verrakumar, "Digital Image Processing", TMH New Delhi, 2nd edition, 2020.
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.	Rafael C.Gonzalex, Richard E.Woods, "Digital Image Processing", Pearson Education, Forth Edition, 2018.

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U19MC603	ROBOTICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Understand the fundamentals of Robotics.
CO2:	Illustrate the kinematic relationships in robot motion.
CO3:	Compute Lagrange formulation of Robot dynamics
CO4:	Learn the types of grippers and its functions.
CO5:	Understand the economic and social implications of Robotics.

Pre-requisite :

1. Theory of Machines
2. 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	2	2		3			2		2			3	2
CO2	3	3	3		3					2			3	2
CO3	3	3	3		3					2			3	2
CO4	3	2	3		2					3		2	3	2
CO5	2	3	3	2	2			2	3	2	2	3	3	2

Course Assessment methods

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

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

Introduction – Automation and Robotics – History of Robotics – Robot anatomy - Major components of a robot – Robot subsystems: Motion subsystem, Recognition subsystem, Control subsystem – Classification of robots: Classification by coordinate system, Classification by control method, Classification by actuation method – Joint notation scheme

Unit 02: ROBOT MOTION ANALYSIS — **9 Hours**

Links and Joints: Types of Joints – Kinematic chain – Degree of freedom – Robot kinematics –

Position representation - Forward transformation of 2 DOF arm – Reverse transformation of 2 DOF arm – Adding orientation – Homogeneous transformations – D-H conventions			
Unit 03: ROBOT DYNAMICS			**9 Hours**
Introduction – Manipulator path control - Static analysis – Compensating for gravity – Robot arm dynamics: Joint velocities, Kinetic energy, Potential energy – Lagrange formulation of Robot dynamics - Configuration of a Robot controller			
Unit 04: ROBOT END EFFECTORS			**9 Hours**
Introduction – Types of end effectors – Mechanical grippers: Types of gripper mechanisms ,Gripper force analysis – Vacuum cups – Magnetic grippers – Adhesive grippers – Tools as end effectors – End effector interface – Remote Center Compliance – Considerations in gripper selection and design			
Unit 05: ECONOMIC ANALYSIS AND SOCIAL IMPLICATIONS			**9 Hours**
Type of Robot Installation – Cost data required for analysis – Methods of economic analysis – Subsequent use of the robot – Differences in production rate – Factors more difficult to quantify – Robot project analysis form – Sociological consequences of robot			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS

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

REFERENCES

1.	Richard D.Klafter, " Robotics Engineering" PHI Learning Private Limited, 2009.
2.	Ganesh S.Hedge, "A text book in Industrial Robotics", Laxmi Publications, 2006.
3.	S K Saha, "Introduction to Robotics", Tata McGraw-Hill Publication,2012.
4.	Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

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U19MC903	Professional Elective: 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:	Discuss the embedded system hardware capabilities and embedded design process.
CO2:	Select the communication devices and Buses for real time embedded design.
CO3:	Illustrate the concepts of real time operating systems.
CO4:	Outline the basic architecture of Internet of Things.
CO5:	Develop the real time IOT applications through programming.

Pre-requisite

1. Digital Electronics
2. Microprocessors and Microcontroller

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

Unit 01: EMBEDDED SYSTEMS — **9 Hours**

Introduction to embedded systems – Hardware and software components – Classifications – Characteristics – Embedded system on chip – Design process in embedded system – Challenges in embedded computing system design

Unit 02: COMMUNICATION DEVICES AND BUSES — **9 Hours**

Serial and parallel communication devices – Wireless devices – Timer and Counting devices – Distributed network embedded systems – Serial communication using I²C, CAN and USB buses – Parallel communication using ISA, PCI and PCI/X buses-Wireless and mobile system protocol.

Unit 03: REAL TIME OPERATING SYSTEMS — **9 Hours**

Multiple processes – Multiple threads – Tasks and Thread states – Inter process communication and synchronisation – Signals – Concept of Semaphores – Queues and Mailboxes – Shared data problem.

Unit 04: IOT ARCHITECTURES — **9 Hours**

Introduction and features of IOT – Physical design – Logical design – IOT enabled technology –

simplified IoT Architecture – Core IoT functional Stack – Architecture for IoT using mobile technologies – Mobile technologies for supporting IoT ecosystem				
Unit 05: IOT PROGRAMMING AND DATA ANALYTICS				**9 Hours**
Raspberry Pi board – Raspberry Pi interfaces – Programming Raspberry Pi with Python – Developing code for writing to actuators, blinking Led, reading from sensors – Data standards – IoT information Security and challenges – Data analytics for IoT : Role of machine learning – Big Data analytics tools and technology				
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**		**Total Hours: 45 Hrs**

TEXT BOOKS	
1.	Rajkamal, "Embedded system-Architecture, Programming and Design", Third edition Tata McGraw-Hill, 2015.
2.	Arshdeep Bahga, Vijay Madisetti , "Internet of Things: A Hands-on Approach", Universities press, 2014.
3.	Frank Vahid, "Embedded System Design–A Unified Hardware & Software Introduction", Third Edition, Wiley Publishers, 2009.
REFERENCES	
1.	Daniel W. Lewis, "Fundamentals of Embedded Software", First Edition, Prentice Hall of India, 2013.
2.	Wayne Wolf , "Computers as components: Principles of Embedded Computing System Design", Third Edition, Elsevier, 2013.
3.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
4.	Pethuru Raj, Anupama C. Raman , "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC, 2017

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U19MC909	Professional Elective: AGRICULTURE AUTOMATION	L	T	P	C
		3	-	-	3

Course Outcomes

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

CO1:	Explain the basic principle of smart agriculture
CO2:	Demonstrate various Sensors and actuators for farming tools
CO3:	Illustrate the Telemetry and Plant health monitoring used in Agriculture automation
CO4:	Construct the advanced technologies for smart farming
CO5:	Develop a machine for smart irrigation system

Pre-requisite

1. 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	3	3	2	2	2	-	-	2	2	3	3	3
CO2	3	3	3	3	1	2	2	-	-	2	2	3	3	3
CO3	2	3	3	3	1	2	2	-	-	2	2	3	3	3
CO4	3	3	3	3	1	2	3	-	-	2	2	3	3	3
CO5	3	3	2	3	1	3	3	-	-	3	2	3	3	3

Course Assessment methods

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

Unit 01: INTRODUCTION	**9 Hours**

Overview of smart agriculture: Nature and origin of soil, Soil minerals, Classification and composition, soil properties including structure, PH, Surface tension and Soil nutrients – Standards for agriculture – Need for agriculture digitalization

Unit 02: SENSORS, ACTUATORS AND CONTROLS IN AGRICULTURE	**9 Hours**

Sensors: Smart sensors, Colorimetry based detection, MEMS Electrochemical Sensors, Dielectric Soil Moisture Sensors, ISFET, Weather sensors, Proximity Sensors, Air flow sensors, Thermal camera, Image processing – Actuators and Controls: AC & DC Motors, Stepper motor, Solenoid actuators, Piezoelectric motors, Electric drives, Hydraulic and Pneumatic actuators	
Unit 03: TELEMETRY AND PLANT HEALTH MONITORING	**9 Hours**
Wireless communication modules and topology – Zig-bee – Bluetooth – LORA – Zero power devices – Energy Harvesting technology – GIS enabled smart technology – Measurement of leaf health – Chlorophyll detection = Ripeness level – Crop mapping –Fertilizing	
Unit 04: TECHNOLOGIES FOR FARMING	**9 Hours**
Water quality monitoring – Smart water management – Micro-irrigation system – Solar pump and lighting system – Fencing – Android based automation – AI and IOT in farming – Drone technology for soil field analysis and Assistive operations	
Unit 05: APPLICATIONS OF AGRICULTURE AUTOMATION	**9 Hours**
Case studies: Sorting, Seeding and Weeding machine, Fruit picking robots, Autonomous unmanned ground vehicles and Drones	

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

TEXT BOOKS

1.	Ramesh C. Poonia, Xiao-Zhi Gao, Linesh Raja, Sugam Sharma and Sonali Vyas, "Smart Farming Technologies for Sustainable Agricultural Development", IGI Global, 2018
2.	Pradeep Tomar and Gurjit Kaur, "Artificial Intelligence and IoT-Based Technologies for Sustainable Farming and Smart Agriculture", IGI Global, 2021

REFERENCES

1.	Annamaria Castrignano, Gabriele Buttafuoco, Raj Khosla, Abdul Mouazen, Dimitrios Moshou and Olivier Naud, "Agricultural internet of things and decision support for precision smart farming", Elsevier, 2020
2.	Manoj Karkee, Qin Zhang, "Fundamentals of Agricultural and Field Robotics", Springer, 2021
3.	Yong He, Pengcheng Nie, Qin Zhang, Fei Liu, "Agricultural Internet of Things Technologies and Applications", Springer, 2021
4.	Hazem Shawky Fouda, "Agricultural Automation: Fundamentals and Practices", Arcler Education Inc, 2019

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U19MC906	Professional Elective: DRONE TECHNOLOGY	L	T	P	C
		3	-	-	3

Course Outcomes

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

CO1:	Explain the basic knowledge about the development and potential of UAV in professional activities
CO2:	Illustrate the features and characteristics of an Unmanned Aerial System
CO3:	Demonstrate the basic concepts and features of flight
CO4:	Utilize the drone equipment maintenance and repair
CO5:	Develop the Regulatory measures and regulations

Pre-requisite

1. Electrical Drives and Controls
2. Digital Electronics

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

Unit 01: INTRODUCTION TO UNMANNED AERIAL VEHICLES (UAV) — **9 Hours**

Overview and background: History of UAVs, Classifications of UAVs, Lift generation and thrust generation method, working of an UAV, Contemporary applications like military and civil areas –Ethical implications LOS / BLOS, Advantages and disadvantages of an UAV.

Unit 02: UNMANNED AERIAL SYSTEM (UAS) COMPONENTS — **9 Hours**

Platforms – Configurations – Characteristics – Propulsion: Internal combustion engines, Turbine engines, Electric systems – On-board flight control – Payloads: Sensing/Surveillance. Communications: Command/Control, Telemetry, Launch/recovery systems – Ground control stations

Unit 03: BASIC CONCEPTS OF FLIGHT — **9 Hours**

Aerodynamics: Lift, weight, Thrust and drag – Flight performance: Climbing vs. Gliding flight, Range / Endurance – Stability and control: Flight axes, Flight controls, Autopilots – Fixed wing operations: Types of

fixed wing drones, Make, Parts, Terminology and Operation.			
Unit 04: DRONE EQUIPMENT MAINTENANCE AND APPLICATIONS			**9 Hours**
Maintenance of drone: Flight control box – Maintenance of ground equipment – Batteries – Fault finding and rectification –Weather and meteorology, Surveying & mapping, construction & Agriculture sector.			
Unit 05: REGULATORIES AND REGULATIONS			**9 Hours**
Homeland Regulatories: FCC, FAA and Foreign regulatory – Regulations: FCC compliance, European union regulations, UAS registration, Federal Aircraft Regulations (FARs) - Safety considerations			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45Hrs**

TEXT BOOKS	
1.	Reg Austin, "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2.	Paul Fahlstrom, Thomas Gleason, "Introduction to UAV Systems", 4th Edition, John Wiley & Sons, NA, 2016.
REFERENCES	
1.	P K Garg, "Introduction to Unmanned Aerial Vehicles", New Age International Private Limited, 2020
2.	Garvit Pandya, "Basics of Unmanned Aerial Vehicles", Notion press, 2021
3.	Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", 1st Edition, CRC press, Florida, 2017.
4.	Randal W. Beard & Timothy W. McLain, "Small Unmanned Aircraft: Theory and Practice", Princeton University Press, Newjersy, 2010.

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U19MC907	Professional Elective: DESIGN THINKING AND PRODUCT INNOVATION	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Relate the various systematic approach for innovative designs.
CO2:	Describe the product development process.
CO3:	Explain the need for product specification and concepts generation.
CO4:	Design principles to develop new products.
CO5:	Familiarize the concepts of Intellectual Property rights.

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	PO11	PO12	PSO1	PSO2
CO1	3	2	2			2	2	2	2			2	3	2
CO2	3	2	2			3	2	2	3		2	2	3	2
CO3	3	3	2			3	2	2	3		2	2	3	2
CO4	3	3	2			2	2	2	3		3	3	3	2
CO5	3	3	2			2	2	2				3	3	2

Course Assessment methods

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

Unit 01: DESIGN THINKING — **9 Hours**

Design thinking: Introduction, Principles, Process, Innovation in design thinking, benefits of design thinking – Idea generation: Introduction, Techniques, Conventional methods, Intuitive methods, Brainstorming – Methods for combining solution – Decision making for new design

Unit 02: PRODUCT DEVELOPMENT PROCESS — **9 Hours**

Introduction to design – Fundamentals of systematic approach – Product planning – Product development process – Opportunity identification – Innovation in product development – Cost estimation

Unit 03: PRODUCT SPECIFICATION AND CONCEPTS GENERATION — **9 Hours**

Product Specification – Concepts generation – Concepts selection: Methods, Concept screening, Concept Scoring – Concept testing – Prototyping: Types and Principles

Unit 04: CASE STUDY IN PRODUCT DEVELOPMENT — **9 Hours**

Agriculture: Development of machines for separation of corn seeds, Peeling of groundnut shells, Husk removing from paddy – Electrical: Design of burglar alarm, Speedometer, Water level indicator, Smart gates, and Smart lights – Design of electrical vehicles – Unmanned vehicles – Design principles in drones

Unit 05: INTELLECTUAL PROPERTY RIGHTS (IPR)			9 Hours
Basic concepts and need for Intellectual Property – Patents: Patent search, Patent applications, International code for Patents – Copyrights – Geographical Indications – Trademark – Preparing a disclosure			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS	
1.	Karl T. Ulrich, Steven D. Eppinger," Product Design and Development",Sixth Edition, Tata Mcgraw Hill Education,2016
2.	Hasso Plattner,Christoph Meinel and Larry Leifer,"Design Thinking",First Edition, Springer, 2011
REFERENCES	
1.	Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, "Exploring Engineering: An Introduction to Engineering and Design", Fouth edition, Elsevier, 2016
2.	G. Pahl, W.Beitz, J. Feldhusen, KH Grote, "Engineering Design: A Systematic Approach", Third Edition, Springer, 2007
3.	Gavin Ambrose , Paul Harris, "Basics Design - Design Thinking", First Edition, Bloomsbury Publishing India Private Limited,2009.
4.	Tom Kelley, Jonathan Littman, "Ten Faces in Innovation", Currency Books, 2006.

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U19MC604	IMAGE PROCESSING LABORATORY	L	T	P	C
		0	0	2	1

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 on a given text image.
CO2:	Write a MATLAB code to extract features from text images ,image segmentation and compression.
CO3:	Write a MATLAB code to image processing applications

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	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
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20) Quiz-II (5)	RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

Using MATLAB

1.	Demonstrating False Contour Effect.
2.	Extraction and display of each bits as an image for a given 8 bit gray scale image.
3.	RGB Plane extraction
4.	Conversion from RGB to HSI
5.	Histogram Mapping and Equalization
6.	Spatial Domain Image Enhancement.
7.	Edge Detection Algorithms.
8.	Pseudo Coloring.
9.	Morphological Operations on Binary Images.
10.	Computing the DWT of an image and displaying the LL, LH, HL and HL images.
	Total Hours: 30 Hrs

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U19MC605	3D MODELLING AND ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

Course Outcomes

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

CO1:	Construct the 2D views of standard machine components
CO2:	Create 3D model, assembling and detailing for the engineering components using solid works software.
CO3:	Analysis the structural components (Beams) using ANSYS software.

Pre-requisite

Engineering graphics

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	PO12	PSO 1	PSO 2
CO1	1	3	1		3	1		2		3	3	3	2	3
CO2	2	3	3	3	3	2			2	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	1	3	3	3	2	3

Course Assessment methods

Direct		Indirect
CIE TEST-I (20) Quiz-I (5) CIE TEST-II (20) Quiz-II (5)	RTPS (10) End semester Examination (40)	Course end survey

List of Experiments

1. Introduction of 3D Modelling software
2. Creation of 3D assembly model of Flange Coupling.
3. Creation of 3D assembly model of Plummer Block.
4. Creation of 3D assembly model of Screw Jack.
5. Creation of 3D assembly model of Universal Joint.
6. Creation of 3D assembly model of Machine Vice.
7. Creation of 3D assembly model of Safety Valves.
8. Creation of 3D assembly model of Non-return valves.
9. Structural analysis 2D components of Beam (Cantilever) with point load and torque.
10. Structural analysis 2D components of Beams (Simply supported) with UDL load.
11. Thermal analysis 2D components.

Total Hours: 30 Hrs

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U19MC606	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 analyse 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 (10 marks)	End semester Examination (60 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 6th 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 6th 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

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Semester –VI	U19GE601: SOFT SKILLS AND APTITUDE – IV (Common to all dept except Civil)	L	T	P	C	Marks
		0	0	2	1	100

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

1. Demonstrate capabilities in job-oriented company selection processes using the hands-on approach
2. Solve problems of any given level of complexity in all areas of quantitative aptitude and logical reasoning and score 70-75% marks in company-specific internal tests
3. Demonstrate advanced-level verbal aptitude skills in English and score 70-75% marks in company-specific internal tests

1. Soft Skills	**Demonstrating Soft -Skills capabilities with reference to the following topics:** a. Mock group discussions b. Mock interviews c. Mock stress interviews
2. Quantitative Aptitude and Logical Reasoning	**Solving problems with reference to the following topics:** a. Functions and Polynomials b. Clocks and Calendars c. Data Sufficiency: Introductions, 3 Options Data Sufficiency, 4 Options Data Sufficiency and 5 Options Data Sufficiency. d. Logical reasoning: Cubes, Non Verbal reasoning and Symbol based Reasoning. e. Decision making table and Flowchart Campus recruitment papers: Solving of previous year questions paper of all major recruiters f. Miscellaneous: Cognitive gaming Puzzles-(Picture, Word and Number based), IQ Puzzles, Calculation Techniques and Time Management Strategies. g. Trigonometry.- Concepts
3. Verbal Aptitude	**Demonstrating English language skills with reference to the following topics:** a. Writing captions for given pictures b. Reading comprehension c. Critical reasoning d. Theme detection e. Jumbled sentences f. Writing a story on given pictures g. Company specific verbal questions

30 Hours

S. Anita
18/12/2023

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U19CS1002 CLOUD COMPUTING 3 0 0 3

COURSE OUTCOMES:

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

1. Provide an overview of cloud computing
2. Explain the various tasks in developing cloud services
3. Analyze the provision of cloud computing services to different users
4. Configure the various cloud services according to the environment.
5. Analyze various ways to collaborate online

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	2	1	2	0	1	0	2	1	2	2	2
CO2	2	1	2	3	3	2	0	1	1	2	2	3	3	3
CO3	2	1	3	3	3	2	0	1	0	3	3	2	3	3
CO4	2	1	2	3	3	2	0	1	0	2	3	3	3	3
CO5	2	2	3	3	3	1	0	1	0	2	3	2	3	3

UNIT I Understanding Cloud Computing **6**

Cloud Computing – History of Cloud Computing – Cloud Architecture – Cloud Storage – Why Cloud Computing Matters – Advantages of Cloud Computing – Disadvantages of Cloud Computing – Companies in the Cloud Today – Cloud Services

UNIT II Developing Cloud Services **10**

Web-Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-Demand Computing – Discovering Cloud Services Development Services and Tools – Amazon – Google App Engine – IBM Clouds

UNIT III Cloud Computing for Everyone **10**

Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation

UNIT IV Using Cloud Services **10**

Collaborating on Calendars, Schedules and Task Management – Exploring Online Calendar Applications- Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Spread sheets- Collaborating on Databases – Storing and Sharing Files

UNIT V Other Ways to Collaborate Online **9**

Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis

Total:45 hours

TEXT BOOK:

1. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.

REFERENCE BOOK:

1. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

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PREAMBLE

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

The Internet of Things involves three distinct stages:

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

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

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

After completing the course the students will attain the following,

- Ability to build real time IoT applications by interfacing the sensors with minimal programming.
- Ability to associate sensor networks and communication modules for building IoT systems.

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U19CS1003 INTERNET OF THINGS 3 0 0 3

COURSE OUTCOMES:

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

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

UNIT I FUNDAMENTALS OF IOT **9**

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

UNIT II M2M AND IOT DESIGN METHODOLOGY **9**

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

UNIT III IOT COMPONENTS **9**

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

UNIT IV BUILDING IOT WITH HARDWARE PLATFORMS **9**

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

UNIT V CASE STUDY **9**

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

TOTAL: 45 PERIODS

TEXT BOOK:

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

REFERENCES:

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

2. Marco Schwartz, —Internet of Things with the Arduino Yunl, Packt Publishing, 2014.

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

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

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U19EE1003 INNOVATION, IPR AND ENTREPRENEURSHIP DEVELOPMENT 3 0 0 3

COURSE OUTCOMES

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

1. Acquire the knowledge for establishment of an enterprise and management,
2. Derivetheinnovative ideas, right approach to the problem and arrive solution for problem with IPR and its legal aspects.
3. Prepare the project report preparation and assessment of Business.
4. Acquire the knowledge on costing, Techno-economic aspects, find out the sources of finance and opportunities in business.
5. Identify the support system for Entrepreneurs by Government and venture capitals.

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	3	3	3	3		3
CO3			3			3	3	3	3	3	3	3		3
CO4			3			3	3	3	3	3	3	3		3
CO5			3			3	3	3	3	3	3	3		3

UNIT I ENTREPRENEURSHIP&MOTIVATION 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT II INNOVATION, CREATIVITY, DEVELOPMENT PROCESS AND LEGAL ASPECTS 9

Innovation and Creativity- An Introduction, Innovation in Current Environment, Types of Innovation Sources of new Ideas, Methods of generating innovative ideas, creating problem solving, product planning and development process. Legal aspects of business (IPR, Labor law).

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, GST.

S.P 23.12.23

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UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Lecture: 45; Tutorial: 0; Total: 45 Hrs

TEXT BOOKS:

1. Khanka. S.S., "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013. 99
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9 th Edition, Cengage Learning, 2014.

REFERENCES:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2 nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2 nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
5. Innovation and Entrepreneurship Book by Peter Drucker,
6. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons, 2003.

S. Padma 23.12.23

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COURSE CODE **U19ME1002** L T P C

COURSE NAME **INDUSTRIAL SAFETY** 3 - - 3

Course Outcomes

Upon completion of this course the students will be able to

CO1 Summarize various legal provisions available in safety regulation.

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

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

CO4 Develop Agronomical study of different work environment in industries.

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

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

	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
COs, POs PSOs Mapping	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO – 1	3	-	-	-	1	3	3	3	2	2	3	3	2	2
CO – 2	3	2	2	1	3	3	3	3	2	2	-	2	2	3
CO – 3	2	3	2	3	3	3	3	3	3	3	3	2	2	3
CO – 4	2	1	3	3	3	3	2	3	1	2	-	2	3	3
CO - 5	1	3	3	3	-	3	-	3	3	3	2	3	2	2

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

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

Unit II **OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE** L 9 T 0

(Basic concepts, related hazards and exposure limits)

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

Unit III FIRE ENGINEERING AND EXPLOSIVE CONTROL L 9 T 0

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

Unit IV ERGONOMICS L 9 T 0

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

Unit V SAFETY EDUCATION AND TRAINING L 9 T 0

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

Total Number of hours: 45

Learning Resources

Text Books

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

Reference Books

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

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COURSE CODE **U19ME1004** L T P C

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

Prerequisites- subject: Environmental Sciences.

Course Outcomes

Upon completion of this course the students will be able to

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

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

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

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

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

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

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

Unit I **INTRODUCTION** L 9 T 0

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

Unit II **SOLAR & BIO ENERGY** L 9 T 0

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

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

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

Unit IV WIND AND TIDAL ENERGY L 9 T 0

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

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

Unit V OTHER RENEWABLE ENERGY SOURCES L 9 T 0

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

Total Number of hours: 45

Learning Resources

Text Books

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

Reference Books

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

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Syllabi for

B.E/B.Tech Honours (Specialization in the same Discipline)

B.E/B.Tech Honours

B.E/B.Tech Minor

courses

U19MC2003	SOFT ROBOTICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Gain an understanding of bio-inspired designs and materials for soft robots.
CO2:	Identify the sensors and actuators to design a soft robot.
CO3:	Acquire knowledge in 3D printing of soft materials, stretchable electronics, and the fabrication of pneumatic artificial muscles.
CO4:	Explore the applications, size, and fabrication technologies of micro-robots.
CO5:	Develop practical skills in designing and implementing micro-robotic devices for various applications.

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				2	2						2	3	3
CO2	3				2	2						2	3	3
CO3	3	2	2		3	2						2	3	3
CO4	3	3	2		3	2						2	3	3
CO5	3	3	3		3	2						2	3	3

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO SOFT ROBOTICS	**9 Hours**

Introduction to Bio robotics - biomimetics - nature - inspired designs - materials for soft robot - biological analogy.

Unit 02: SENSORS AND ACTUATORS	**9 Hours**

Soft Actuators - Soft Sensors - Electroactive Polymer - Ionic Polymer Metal Composites - Shape Memory Alloy - Artificial Muscles based on Electric and Pneumatics - Thermal and Chemical Actuation.			
UNIT 03: RAPID DIGITAL MANUFACTURING OF MULTIFUNCTIONAL SOFT MATERIALS			**9 Hours**
Introduction to 3D Printing - 3D printing of Soft Materials - Hyper-elasticity - Finite Element Analysis - Stretchable Electronics - Soft Electrical Materials - Soft Mechanical Composite Materials - Gradient of Material Stiffness - Mechanical Soft Materials - Pneumatic Artificial Muscles.			
Unit 04: MICROROBOTICS			**9 Hours**
Introduction - Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro- robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.			
Unit 05: IMPLEMENTATION OF MICROROBOTS			**9 Hours**
Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators -Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices -Micro- grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - Multi- robot system: Micro-robot powering, Micro-robot communication.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS

1.	Matthew Borgatti, Kari Love, Christopher G. Atkeson, MAKE: Soft Robotics – A DIY Introduction to Squishy, Stretchy, and Flexible Robots, 2018.
2.	Alexander Verl, Alin Albu-Schaffer, Oliver Brock, Annika Raatz, Soft Robotics Transferring Theory to Application, Springer, 2015.
3.	Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019.
4.	Yves Bellouard, "MicroroboticsMethods and Applications", CRC Press, Massachusetts, 2019.

REFERENCES

1.	Kim, Minjun; Julius, Anak Agung; Cheang, U Kei. "Microbiorobotics: Biologically Inspired Microscale Robotic Systems." Second Edition, 2017.
2.	Nicolas Chaillet, Stephane Rangier, "Microrobotics for Micromanipulation", John Wiley & Sons, 2013.
3.	NadimMaluf and KirtWilliams, "An Introduction to Microelectromechanical systems Engineering", 2nd edition, Artech House, 2004.
4.	Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007.

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U19MC2004	AGRICULTURAL AND MEDICAL ROBOTICS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Understand the need of robot in agriculture purposes.
CO2:	Implement suitable Weed Management system.
CO3:	Classify the robot application in medical system.
CO4:	Develop mechanical linkages for medical usage.
CO5:	Describe about surgical robots and rehabilitation of limbs.

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		2	2	2	3	2					2	3	3
CO2	2	2	3	3	2	3	3					2	3	3
CO3	2		3	2	3	3						2	3	3
CO4	2	2	2	3	3	2						2	3	3
CO5	2		3	3	3	3						2	3	3

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: INTRODUCTION TO FARM AUTOMATION **9 Hours**

History of Mechanized Agriculture - Farming Operations and Related Machines - Tillage, Planting Cultivation, and Harvesting, Agricultural Automation - Agricultural Vehicle Robot.

Unit 02: SOIL TILLAGE AND WEED MANAGEMENT	9 Hours
Tillage Methods and Equipment, Mechanics of Tillage Tools, Performance of Tillage Implements, Hitching of Tillage Implements, Weed Management - Conventional Cropping Systems, Tools, Crop Rotation, Mechanical Cultivation.	
UNIT 03: INTRODUCTION TO MEDICAL ROBOTS	**9 Hours**
Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare-DICOM	
Unit 04: LOCALIZATION AND TRACKING	**9 Hours**
Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound based - Electromagnetic - Impedance- based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems.	
Unit 05: SURGICAL AND REHABILITATION ROBOTICS	**9 Hours**
Minimally invasive surgery and robotic integration - surgical robotic sub systems - synergistic control - Control Modes - Radiosurgery - Orthopaedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery - Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - case studies	

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

TEXT BOOKS

1.	Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster , "Engineering Principles of Agricultural Machines", ASAE Publication, 2006.
2.	Myer Kutz , "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2013
3.	Achim Schweikard, Floris Ernst , "Medical Robotics", Springer, 2015.
4.	Paula Gomes , "Medical robotics Minimally invasive surgery", Woodhead, 2012.

REFERENCES

1.	Qin Zhang, Francis J. Pierce , "Agricultural Automation Fundamentals and Practices", CRC Press, 2013.
2.	StephenL.Young, Francis J.Pierce , "Automation: The Future of Weed Control in Cropping Systems", Springer,
3.	Vanja Bonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.
4.	Manfredi, Luigi (Editor). "Endorobotics: Design, R&D and Future Trends." 1st Edition, January 4, 2022. Paperback ISBN: 9780128217504. eBook ISBN: 9780128217603.
5.	Azar Ahmad Taher (Editor). "Control Systems Design of Bio-Robotics and Bio-Mechatronics with Advanced Applications." 1st Edition, November 30, 2019. Paperback ISBN: 9780128174630. eBook ISBN: 9780128174647.

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U19MC2027	INDUSTRIAL 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:	Appreciate the Smart Factories, Smart cities, smart products and smart services.
CO2:	Identify the opportunities, challenges brought about by Industry 4.0.
CO3:	Articulate the concepts, key technologies, strengths and limitations of cloud computing.
CO4:	Learn the key and enabling technologies that help in the development of cloud.
CO5:	Implement the architecture of computing and storage cloud, service and delivery models.

Pre-requisite

NIL

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

UNIT 01: INTRODUCTION TO THE INDUSTRIAL INTERNET AND ITS DESIGN — **9 Hours**

Industrial Internet Use Cases-The Technical and Business Innovators of the Industrial Internet-IIoT Reference Architecture. Examining the Access Network Technology and protocols-Examining the Middleware Transport protocols -middleware Software Patterns.

UNIT 02: SOFTWARE DESIGN CONCEPTS AND CLOUD COMPUTING — **9 Hours**

Middleware Industrial Internet of things platforms-IIoT WAN Technologies and Protocols - Securing the Industrial Internet-Introducing Industry 4.0-Smart Factories. Cloud computing: General Benefits and Architecture, Business Drivers, Main players in the Field, Overview of Security Issues, XaaS Cloud Based

Service Offerings.			
UNIT 03: CLOUD ARCHITECTURE, SERVICES AND STORAGE			**9 Hours**
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.			
UNIT 04: RESOURCE MANAGEMENT AND SECURITY IN CLOUD			**9 Hours**
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.			
UNIT 05: CLOUD TECHNOLOGIES AND ADVANCEMENTS			**9 Hours**
Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

	TEXT BOOKS
1.	Gilchrist, Alasdair, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.
2.	Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
	REFERENCES
1.	Rittinghouse, John W., and James F. Ransome. "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.
2.	RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi. "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
3.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata Mcgraw Hill, 2009.
4.	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

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U19MC2028	DIGITAL TWIN AND INDUSTRY 5.0	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 basics concepts in digital twin
CO2:	Recognize the concepts in digital twin in a discrete Industry
CO3:	Recognize the concepts in digital twin in a process Industry
CO4:	Identify the need of industry 5.0
CO5:	Apply the advantages in industry 5.0 with various applications

Pre-requisite

NIL

CO/PO, PSO Mapping

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

COs	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2
CO1	3	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 (8) Internal test II (8) Internal test III (8) Assignment/seminar/Quiz (5)	Objective test (6) Attendance (5) End semester Examination (60)	Course end survey

UNIT 01: INTRODUCTION — **9 Hours**

Digital twin – Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin – Virtual CAD Models – control Parameters- Real time systems – control Parameters – Handshaking Through Internet – cyber physical systems

UNIT 02: DIGITAL TWIN IN A DISCRETE INDUSTRY — **9 Hours**

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection & analysis for

product & production improvements, Automation simulation, Digital Enterprise.			
UNIT 03: DIGITAL TWIN IN A PROCESS INDUSTRY			**9 Hours**
Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise.			
UNIT 04: INDUSTRY 5.0			**9 Hours**
Industrial Revolutions, Industry 5.0 – Definition, principles, Application of Industry 5.0 in process & discrete industries, Benefits of Industry 5.0, challenges in Industry 5.0, Smart manufacturing, Internet of Things 5.0, Industrial Gateways, Basics of Communication requirements – cognitive systems 5.0.			
UNIT 05: ADVANTAGES OF DIGITAL TWIN			**9 Hours**
Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

	TEXT BOOKS
1.	Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2018.
2.	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
	REFERENCES
1.	Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press, 2022.
2.	Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress., United States ,2015
3.	Christoph Jan Bartodziej, "The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics", Springer Gambler., Germany, 2017.
4.	Ibrahim Garbie, "Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0", Springer., Switzerland, 2016.

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U19MC2010	ADVANCED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Demonstrate on basic lean manufacturing.
CO2:	Integrate the knowledge on agile manufacturing. CO3: Formulate strategy in sustainable manufacturing.
CO3:	Apply artificial intelligence (AI) and fuzzy techniques to improve the efficiency of manufacturing systems.
CO4:	Exposure to smart manufacturing and its various techniques.
CO5:	Demonstrate on basic lean manufacturing.

Pre-requisite

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	-	2	-	-	2	2	2	-	2	2	2	3	2
CO2	3	-	-	-	-	2	2	-	-	2	2	2	3	2
CO3	3	-	-	-	-	2	2	3	-	2	2	2	3	2
CO4	3	-	3	-	-	2	2		-	2	2	2	3	2
CO5	3	-	3	-	-	2	2	2	-	2	2	2	3	2

Course Assessment methods

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

Unit 01: INTRODUCTION TO LEAN MANUFACTURING — **9 Hours**

Objectives of lean manufacturing-key principles and implications of lean manufacturing -traditional Vs lean manufacturing- flow-continuous improvement/Kaizen –worker involvement- 5S principles elements of JIT - uniform production rate - Kanban system - Lean implementation, Reconciling lean with other systems - lean six sigma- lean and ERP - lean with ISO 9001:2000.

Unit 02: AGILE MANUFACTURING	9 Hours
Agile Manufacturing Vs Mass Manufacturing - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices.	
Unit 03: SUSTAINABLE MANUFACTURING	**9 Hours**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.	
Unit 04: INTELLIGENT MANUFACTURING	**9 Hours**
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.	
Unit 05: SMART MANUFACTURING	**9 Hours**
Introduction to various Smart Manufacturing Techniques-Supply chain management-Block chain of inventory management-Plant digitization-Predictive maintenance-Supply chain visibility- Warehouse-Cost reduction-Waste management-Automated systems-Applications	

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

TEXT BOOKS

1. Lonnie Wilson, "How to Implement Lean manufacturing", McGraw-Hill Professional; 2nd edition, 2015.
2. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing., United States, 2016, ISBN-13: 978-3319293042.
3. Kusiak, Andrew, "Intelligent Manufacturing Systems", Prentice Hall, 1st edition, 1990.

REFERENCES

1. Black .J.T. and Kohser R.A, "DeGarmo's Materials and Processes in Manufacturing",Published by Wiley, 11th edition, 2011.
2. Christian N. Madu, "Handbook of environmentally conscious manufacturing", SpringerUS Publishers, 1st edition, 2001.
3. John Schey, "Introduction to Manufacturing Processes", Tata McGraw-Hill Education ,3rdedition,1999
4. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer,United States, 2012, ISBN 978-3-642-27289-9.
5. Rao R. V, "Advanced Modeling and Optimization of Manufacturing Processes", 2ndedition, 2006.
6. Ronald G. Askin and Jeffrey B. Goldberg, "Design and Analysis of Lean ProductionSystems", John Wiley and Sons, 2003.
7. Kutz M., "Environmentally Conscious Mechanical Design", John Wiley & Sons., UnitedStates, 2007, ISBN: 978-0-471-72636-4.

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U19MC2012	COMPUTER AIDED INSPECTION AND TESTING	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1:	Practice the standards in measurements and to avoid the various forms of errors in measurements.
CO2:	Use of basic and advanced metrology instruments for measurements.
CO3:	Acquire the knowledge on non-contact opto-electronics device for measurements.
CO4:	Describe various measurement techniques using laser metrology.
CO5:	Recognize the computer aided inspection and advances in metrology.

Pre-requisite

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	2	1	1								1	3	2
CO2	3	2	1	1								1	3	2
CO3	3	2	1	1								1	3	2
CO4	3	2	1	1								1	3	2
CO5	3	2	1	1								1	3	2

Course Assessment methods

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

Unit 01: FUNDAMENTALS AND CONCEPTS IN METROLOGY	**9 Hours**

Standards of Measurement – Analog and Digital Measuring Instruments - Comparators – Limits, Fits and Tolerances – Gauge Design –Surface Roughness – Form Errors and Measurements.

Unit 02: INSPECTION AND GENERAL MEASUREMENTS	9 Hours
Linear Measuring Instruments – Evolution – Types – Classification – Limit Gauges – Gauge Design – Terminology – Procedure – Concepts of Interchange Ability and Selective Assembly – Angular Measuring Instruments – Types – Bevel Protractor Clinometers Angle Gauges, Spirit Levels Sine Bar – Angle Alignment Telescope – Autocollimator – Applications - Inspection of Gears And Threads – Tool Makers' Microscope – Universal Measuring Machine.	
Unit 03: OPTO ELECTRONICS IN ENGINEERING INSPECTION	**9 Hours**
Use of Optoelectronics in Tool Wear Measurements – Microhole Measurement and Surface Roughness – Applications in In-Process Measurement and On-Line Inspection.	
Unit 04: LASER METROLOGY	**9 Hours**
Precision instrument based on Laser - Use of Lasers - Principle –Interferometers, Interference microscope - Optical flats - Laser Interferometer - Application in Linear and Angular measurements - Testing of machine tools using Laser Interferometer. Use of Laser Interferometer in Machine Tool Inspection – Uses of Laser in On-Line Inspection – Laser Micrometer – Laser Alignment Telescope.	
Unit 05: COMPUTER AIDED INSPECTION AND ADVANCES IN METROLOGY	**9 Hours**
Co-ordinate Measuring Machines - Constructional features - Types - Applications of CMM - CNC CMM applications - Measurement arms, Laser tracker - Fundamentals of Computer Aided Inspection - Introduction to Nano metrology.	

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

TEXT BOOKS

1. Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt. Ltd., 2006.
2. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 2002.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2014.

REFERENCES

1. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA,5th edition, 1996.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2012.
3. Robert G. Seippel, "Opto-Electronics for Technology and Engineering", Prentice Hall, 1989.
4. Robert J. Hocken, Paulo H. "Coordinate Measuring Machines and Systems", CRC Press, 2nd edition, 2016.

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U19MC2014	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:	Organize the typical plan for vehicle starting and charging system
CO2:	Examine the need for ignition and injection systems in the automobile system
CO3:	Criticize the various sensors and actuators in automotive control applications
CO4:	Formulate the control scheme procedure for engine fuel management
CO5:	Prioritize automobile safety through the suspension system

Pre-requisite

NIL

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

Unit 01: VEHICLE STARTING AND CHARGING SYSTEM — **9 Hours**

Vehicle electrical system- Starting system - Starting requirements – Starter motor: Construction, Types, Characteristics, Starter driver mechanism, Starter solenoid, Relay – Charging system – Alternating current charging system-Generator – Alternator: types, construction – Voltage regulator -Advanced charging and starting system Technology.

Unit 02: IGNITION AND INJECTION SYSTEMS — **9 Hours**

Ignition systems: Ignition fundamentals – Electronic ignition systems – Programmed Ignition – Distribution

less ignition - Direct ignition – Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection – Advanced ignition technology.			
Unit 03: SENSORS AND ACTUATORS			**9 Hours**
Automotive Control System Applications of Sensors and Actuators: Airflow Rate Sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall-Effect Position Sensor - Throttle Angle Sensor -Sensors for Feedback Control: Exhaust Gas Oxygen Sensor-Oxygen Sensor Improvements-Automotive Engine Control Actuators-Variable Valve Timing.			
Unit 04: ENGINE CONTROL SYSTEMS			**9 Hours**
Digital Engine Control – Features -Control Modes for Fuel Control-Electronic Ignition Control-Integrated Engine Control System - Engine management- Combined ignition and fuel management-Diagnostics engine management system – Vehicle CAN standard networks.			
Unit 05: CHASSIS AND SAFETY SYSTEMS			**9 Hours**
Active Suspension - Traction control system –Cruise control system –automatic transmission – antilock braking system – electronic suspension system – working of airbag and belt -role of MEMS in airbag systems –centralized door locking system – climate control of cars – Safety and comfort systems			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS

1. Willium B. Ribbens,"Understanding Automotive Electronics", Eight Edition, Elsevier Science Publisher, 2017.
2. Tom Denton, "Automobile Electrical and Electronics Systems", Fifth Edition, Routledge Publishers, 2018.

REFERENCES

1. Babu. A.K ," Automotive Electrical and Electronics", Khanna Publisher, First edition, Prentice Hall, 2016.
2. Jack Erjavec, "A Systems Approach to Automotive Technology", Seventh Edition, Cengage Publishing, 2019.
3. Konrad Reif, "Automotive Mechatronics -Automotive Networking, Driving Stability Systems, Electronics", Springer Gabler,2014.
4. Willima H. Crouse, Donald L. Anglin," Automotive Mechanics", Tenth Edition, Tata McGraw Hill Publisher,2012.

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U19MC906	DRONE 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 the basic knowledge about the development and potential of UAV in professional activities
CO2:	Illustrate the features and characteristics of an Unmanned Aerial System
CO3:	Demonstrate the basic concepts and features of flight
CO4:	Utilize the drone equipment maintenance and repair
CO5:	Develop the Regulatory measures and regulations

Pre-requisite

1. Electrical Drives and Controls
2. Digital Electronics

CO/PO, PSO Mapping

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

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

Course Assessment methods

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

Unit 01: INTRODUCTION TO UNMANNED AERIAL VEHICLES (UAV) — **9 Hours**

Overview and background: History of UAVs, Classifications of UAVs, Lift generation method. Contemporary applications like military, government and civil areas – Operational considerations like liability / legal issues, Ethical implications LOS / BLOS.

Unit 02: UNMANNED AERIAL SYSTEM (UAS) COMPONENTS — **9 Hours**

Platforms – Configurations – Characteristics – Applications – Propulsion: Internal combustion engines,

Turbine engines, Electric systems – On-board flight control – Payloads: Sensing/Surveillance, Weaponized UAS and delivery – Communications: Command/Control, Telemetry, Launch/recovery systems – Ground control stations	
Unit 02: BASIC CONCEPTS OF FLIGHT	**9 Hours**
Aerodynamics: Lift, weight, Thrust and drag – Flight performance: Climbing vs. Gliding flight, Range / Endurance – Stability and control: Flight axes, Flight controls, Autopilots – Emergency identification and handling – Fixed wing operations: Types of fixed-wing drones, Make, Parts, Terminology and Operation	
Unit 04: DRONE EQUIPMENT MAINTENANCE	**9 Hours**
Maintenance of drone: Flight control box – Maintenance of ground equipment – Batteries – Scheduled servicing – Repair of equipment – Fault finding and rectification –Weather and meteorology.	
Unit 05: REGULATORIES AND REGULATIONS	**9 Hours**
Homeland Regulatories: FCC, FAA and Foreign Regulatory – Regulations: FCC compliance, UAS registration, Federal Aircraft Regulations (FARs) - Safety considerations	

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

TEXT BOOKS

1. Reg Austin, "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Paul Fahlstrom, Thomas Gleason, "Introduction to UAV Systems", 4th Edition, John Wiley & Sons, NA, 2016.

REFERENCES

1. P K Garg, "Introduction to Unmanned Aerial Vehicles", New Age International Private Limited, 2020.
2. Garvit Pandya, "Basics of Unmanned Aerial Vehicles", Notion press, 2021.
3. AR.Jha, "Theory, Design, and Applications of Unmanned Aerial Vehicles", 1st Edition, CRC Press, Florida, 2017.
4. Randal W. Beard & Timothy W. McLain, "Small Unmanned Aircraft: Theory and Practice", Princeton University Press, Newjersy, 2010.

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U19MC2037	MACHINE VISION SYSTEM	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 fundamental concepts of digital image processing.
CO2:	Apply Image enhancement techniques in spatial domain.
CO3:	Identify the features and region of interest for a given image using segmentation approaches.
CO4:	Implement different compression techniques.
CO5:	Choose vision techniques for different applications.

Pre-requisite

Nil

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 Outcomes (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	2	3	2
CO4	2	2	3		2					3		2	3	2
CO5	3	3	2		2			2				2	3	2

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

Unit 01: IMAGE PROCESSING FUNDAMENTALS — **9 Hours**

Fundamental Steps in Digital Image Processing – Elements of Visual Perception – Image Sensing and Acquisition - Some Basic Relationship Between Pixels – Connectivity – Distance Measure – Brightness – Contrast – Hue – Saturation – Mach Band Effect – Types of Image – False Contouring – Colour Image Fundamentals RGB – HSI Models – Conversion from RGB to HSI.

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

Spatial domain filtering: Image negative, Contrast stretching, Gray level slicing – Histogram equalization – Smoothing filters – Sharpening filters – Maximum filter – Minimum filter – Median

filter – Bit Plane Slicing – Frequency domain filtering: Low-pass filter, High-pass filter, Butterworth High-pass filter, Low-pass and High-pass Gaussian filter.			
Unit 03: IMAGE SEGMENTATION			**9 Hours**
Image segmentation: Point, line and edge detection – Basics of intensity thresholding – Region based segmentation : Region growing, Region splitting and merging – Thresholding – Standard Binary Morphological Operations – Dilation and Erosion based Operations.			
Unit 04: IMAGE COMPRESSION			**9 Hours**
Image Compression – Lossless Compression – Huffman Coding –Arithmetic Coding – LZW Coding – Lossy Compression – Transform Coding - Compression Standards: JPEG Image Compression Standards and MPEG Video Compression Standards.			
Unit 05: VISION SYSTEMS			**9 Hours**
Industrial automation and quality inspection - Object detection - Gesture Recognition - Finger print Recognition - Vision for robot control - Selection of camera based on applications.			
Theory: 45 Hrs	**Tutorial: --**	**Practical: --**	**Total Hours: 45 Hrs**

TEXT BOOKS	
1.	Jayaraman S., Esakkirajan and Verrakumar, "Digital Image Processing", TMH New Delhi, 2nd edition, 2020.
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.	Rafael C.Gonzalex, Richard E.Woods, "Digital Image Processing", Pearson Education, Forth Edition, 2018.

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U19MC2038	SENSORS AND ACTUATORS	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 various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors.
CO2:	Analyze and select suitable sensor for motion, proximity and range measurement.
CO3:	Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4:	Analyze and select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5:	Select the advanced actuators for implementing macro and micro applications.

Pre-requisite

Nil

CO/PO, PSO Mapping

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

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

Course Assessment methods

Direct		Indirect
Internal test I (8) Internal test II (8) Internal test III (8) Assignment/Seminar/Quiz (5)	Objective test (6) Attendance (5) End Semester Examination (60)	Course end survey

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

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types. Temperature – IC, Thermistor, RTD, Thermocouple.

Unit 02: MOTION, OPTICAL AND RANGING SENSORS — **09 Hours**

Motion Sensors – Brush Encoders, Potentiometers, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Range Sensors – RF beacons,

Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)- Photo voltaic, LDR – Fiber optic sensors.	
Unit 03: FORCE, MAGNETIC, AND HEADING SENSORS	**09 Hours**
Strain Gage, Load Cell Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.	
Unit 04: FLUID POWER ACTUATORS	**09 Hours**
Hydraulic and Pneumatic System– ISO Symbols for their Elements - Hydraulic Pumps and Motor - Linear Actuators and Types - Control and Regulating Elements — Direction, Flow and Pressure Control Valves - Methods of Actuation, Types, Sizing of Ports - Spool Valves - Electro Hydraulic Servo Valves - Types - Sequencing Circuits Design - Combinational Logic Circuit Design – Interfacing to PLC.	
Unit 05: ADVANCED ACTUATORS	**09 Hours**
Servomotors - Stepper Motors - BLDC Motor and its Operating Modes – Linear Electrical Actuators - Piezo Electric Actuators - Piezoresistive actuators, micropumps and micro actuators with practical applications.	

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

Text Books

1. Bolton W., "Mechatronics", Pearson; 5th edition, 2015
2. Bradley D.A., and Dawson, Burd and Loader, "Mechatronics", Thomson Press India Ltd., 2004

REFERENCES

1. Ernest O. Doeblin, "Measurement system, Application and Design", Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004
2. Patranabis D., "Sensor and Actuators", Prentice Hall of India (Pvt) Ltd., 2005.
3. Renganathan S., "Transducer Engineering", Allied Publishers (P) Ltd., 2003
4. Antony Esposito, "Fluid Power Systems and Control", Prentice-Hall, 2006.
5. Austin Hughes, "Electric Motors and Drives Fundamentals, Types and Applications", Fourth Edition, Elsevier, 2013

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