



**Sri Krishna College of Engineering and Technology**  
**An Autonomous Institution, Affiliated to Anna University**  
**Coimbatore – 641 008**



**DEPARTMENT OF MECHATRONICS ENGINEERING**

**CURRICULUM AND SYLLABI**

**Regulation 2020**

**B.E. MECHATRONICS ENGINEERING**



# **SRI KRISHNA INSTITUTIONS**

## **SRI KRISHNA COLLEGE OF ENGINEERING & TECHNOLOGY**

### **DEPARTMENT OF MECHATRONICS ENGINEERING**

**CURRICULUM & SYLLABUS FOR**

**REGULATION 2020**

**Applicable for students admitted from  
2020-2021 onwards**

# SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution Affiliated to Anna University  
Kuniamuthur,  
Coimbatore - 641 008

## VISION AND MISSION OF THE DEPARTMENT

### Vision

World class education in the fields of automation and simulation to make Mechatronics Engineering the most preferred program among engineering aspirants

### Mission

To impart knowledge to the students participating in the program by providing

**M1:** Expert Faculty to teach, inspire, mentor and motivate.

**M2:** Excellent Infrastructure with facilities to learn Mechatronics, research and experiment.

**M3:** Motivation towards self-learning, social responsibility and entrepreneurship.

**M4:** Exposure to the latest technologies through industry-institute interaction.

**M5:** Environment to develop their innovative thoughts, moral values, communication and multi-disciplinary skills.

### Programme Outcomes (POs):-

At the time of their graduation students of Mechatronics Engineering Programme should be in possession of the following Programme Outcomes

- a. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- d. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex

- engineering activities with an understanding of the limitations.
- f. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
  - g. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
  - h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
  - i. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
  - j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
  - k. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
  - l. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **Programme Educational Objectives (PEOs):-**

The following Programme Educational Objectives are designed based on the department mission

- PEO1 To apply knowledge of Mathematics, Science and Mechatronics Engineering to solve contemporary engineering problems in the field of automation.
- PEO2 To design, analyze, fabricate and test smart products.
- PEO3 To exhibit the skills of simulation and experimentation using advanced engineering tools of industrial standards.
- PEO4 To communicate and develop strong interpersonal abilities to prepare them for placements and higher studies.
- PEO5 To self-motivate towards lifelong learning and entrepreneurship.

### Mapping of PO's to PEO's

Programme Educational Objectives	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
PEO 1	3	2	3	1	2	3	2	2	3	3	3	2
PEO 2	3	3	2	2	3	2	2	1	2	2	2	3
PEO 3	3	3	3	2	1	3	2	2	2	3	1	3
PEO 4	3	2	3	1	2	3	2	2	2	3	3	3
PEO 5	3	3	3	1	2	3	3	2	2	3	1	3

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed
---	-------------------	---	-------------------	---	-----------------

#### **Programme Specific Outcomes (PSO's):-**

At the end of the Programme, Graduate shall have

PSO1 Design, simulate and create automation systems for various applications.

PSO2 Apply the Knowledge of Robotics for addressing Societal, health and Safety Issues.

**SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY,  
COIMBATORE-641008  
B.E. MECHATRONICS ENGINEERING  
REGULATION 2020  
CHOICE BASED CREDIT SYSTEM  
I – VIII SEMESTER CURRICULUM AND SYLLABI**

<b>SEMESTER I</b>							
<b>S No.</b>	<b>Course Code</b>	<b>Course</b>	<b>L/T/P</b>	<b>Contact hrs/week</b>	<b>Credit</b>	<b>Ext/Int</b>	<b>Category</b>
<b>Theory cum Practical</b>							
1.	20MA101	Engineering Mathematics – I	2/1/2	5	4	40/60	BSC
2.	20CH101	Engineering Chemistry	3/0/3	6	4.5	40/60	BSC
3.	20EN101	Technical Communication Skills	2/0/2	4	3	40/60	HSMC
4.	20CS111	Problem Solving Using C Programming	3/0/2	5	4.0	40/60	ESC
5.	20MT101	Production Technology	3/0/3	6	4.5	40/60	ESC
<b>Practical</b>							
6.	20MT102	Engineering Drawing and Graphics	1/0/3	4	2.5	40/60	ESC
<b>Mandatory Course</b>							
7.	20MC101	Mandatory Course – I	Three Weeks		0	0/100	MC
<b>Total</b>			<b>14/1/15</b>	<b>30</b>	<b>22.5</b>	<b>700</b>	

<b>SEMESTER II</b>							
<b>S No.</b>	<b>Course Code</b>	<b>Course</b>	<b>L/T/P</b>	<b>Contact hrs/week</b>	<b>Credit</b>	<b>Ext/Int</b>	<b>Category</b>
<b>Theory</b>							
1.	20MT201	Applied Mechanics	3/0/0	3	3	50/50	ESC
2.	20GE201	Universal Human Values	3/0/0	3	3	50/50	HSMC
<b>Theory cum Practical</b>							
3.	20MA201	Engineering Mathematics – II	2/1/2	5	4	40/60	BSC
4.	20PH201	Applied Physics	3/0/3	6	4.5	40/60	BSC
<b>Practical</b>							
5.	20MT203	Computer Aided Machine Drawing Laboratory	1/0/2	3	2	40/60	ESC
6.	20ME103	Engineering Practices Laboratory	0/0/3	3	1.5	40/60	ESC
<b>Mandatory Course</b>							
7.	20MC102	Mandatory Course – II	2/0/0	2	0	0/100	MC
<b>Total</b>			<b>14/1/10</b>	<b>25</b>	<b>18</b>	<b>700</b>	

SEMESTER III							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Theory</b>							
1.	20MT301	Electrical and Electronic Devices	3/0/0	3	3	50/50	ESC
2.	20MT302	Strength of Solids	3/0/0	3	3	50/50	PCC
<b>Theory cum Practical</b>							
3.	20MA301	Engineering Mathematics - III	2/1/2	5	4	40/60	BSC
4.	20MT303	Electrical Machines and Power Systems	3/0/3	6	4.5	40/60	PCC
5.	20MT304	Thermal and Fluid Engineering	3/0/3	6	4.5	40/60	PCC
6.	20IT101	Python Programming	3/0/2	5	4.0	40/60	ESC
<b>Total</b>			<b>17/1/10</b>	<b>28</b>	<b>23</b>	<b>600</b>	

SEMESTER IV							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Theory</b>							
1.	20MT401	Theory of Control Systems	3/0/0	3	3	50/50	PCC
2.	20XX0XX	Open Elective – I	3/0/0	3	3	50/50	OEC
<b>Theory cum Practical</b>							
3.	20MA401	Probability and Numerical Methods	2/1/2	5	4	40/60	BSC
4.	20MT402	Theory of Machines	3/0/3	6	4.5	40/60	PCC
5.	20MT403	Microcontroller and Its Applications	3/0/3	6	4.5	40/60	PCC
<b>Mandatory Course</b>							
6.	20MC110	Mandatory Course – III	2/0/0	2	0	0/100	MC
<b>Project</b>							
7.	20MT404	Industrial Field Training	0/0/2	2	1	0/100	PROJ
<b>Total</b>			<b>16/1/10</b>	<b>27</b>	<b>20</b>	<b>700</b>	

SEMESTER V							
S No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Theory</b>							
1.	20MT501	Machine Design	3/0/0	3	3	50/50	PCC
2.	20MT502	Embedded System For Mechatronics	3/0/0	3	3	50/50	EEC
3.	20MT9XX	Professional Elective – I	3/0/0	3	3	50/50	PEC
4.	20XX0XX	Open Elective - II	3/0/0	3	3	50/50	OEC
<b>Theory cum Practical</b>							
5.	20MT503	Fluid Power Systems	3/0/3	6	4.5	40/60	PCC
6.	20MT504	Power Electronics and Electrical Drives	3/0/3	6	4.5	40/60	PCC
<b>Mandatory Course</b>							
7.	20MC108	Mandatory Course – IV	2/0/0	2	0	0/100	MC
<b>Total</b>			<b>20/0/6</b>	<b>26</b>	<b>21</b>	<b>700</b>	

SEMESTER VI							
S No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Theory</b>							
1.	20MT9XX	Professional Elective – II	3/0/0	3	3	50/50	PEC
2.	20MT9XX	Professional Elective – III	3/0/0	3	3	50/50	PEC
3.	20MTXXX	Emerging Elective- I	3/0/0	3	3	50/50	EEC
<b>Theory cum Practical</b>							
4.	20MT601	Virtual Instrumentation and Its Application	3/0/3	6	4.5	40/60	PCC
5.	20MT602	Industrial Automation	3/0/3	6	4.5	40/60	PCC
6.	20MT603	Sensors, Measurements and Instrumentation	3/0/3	6	4.5	40/60	PCC
<b>Project</b>							
7.	20MT604	Mini Project	0/0/2	2	1	40/60	PROJ
<b>Mandatory Course</b>							
8	20MC109	Mandatory Course – V	2/0/0	2	0	0/100	MC
<b>Total</b>			<b>20/0/11</b>	<b>31</b>	<b>23.5</b>	<b>800</b>	

SEMESTER VII							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Theory</b>							
1.	20MT701	Industrial Management and Work Ethics	3/0/0	3	3	50/50	HSMC
2.	20MT9XX	Professional Elective – IV	3/0/0	3	3	50/50	PEC
3.	20MT9XX	Professional Elective – V	3/0/0	3	3	50/50	PEC
4.	20MT9XX	Professional Elective – VI	3/0/0	3	3	50/50	PEC
5.	20MTXXX	Emerging Elective – II	3/0/0	3	3	50/50	EEC
<b>Theory cum Practical</b>							
6.	20MT702	Computer Integrated Manufacturing	3/0/2	5	4	40/60	PCC
7.	20MT703	Robotics and Machine Vision System	3/0/2	5	4	40/60	PCC
<b>Employability Enhancement Skills</b>							
8	20EES01	Employability Enhancement Skills	-	-	2	0/100	EES
<b>Total</b>			<b>21/0/4</b>	<b>25</b>	<b>25</b>	<b>800</b>	

SEMESTER VIII							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
<b>Project</b>							
1.	20MT801	Industrial Project	0/0/24	24	12	40/60	PROJ
<b>Total</b>			<b>0/0/24</b>	<b>24</b>	<b>12</b>	<b>100</b>	

**EMPLOYABILITY ENHANCEMENT SKILL:**

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	20EES01	International Conference/Journal Publication (National/ International)/ IPR	-	-	2	EES

**PROFESSIONAL ELECTIVES (PE):**

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
<b>Stream I :Manufacturing and Design</b>						
1.	20MT901	Advanced Manufacturing Processes	3/0/0	3	3	PEC
2.	20MT902	Micro and Nano Manufacturing	3/0/0	3	3	PEC
3.	20MT903	Additive Manufacturing Processes	3/0/0	3	3	PEC
4.	20MT904	Integrated Product and Process Development	3/0/0	3	3	PEC
5.	20MT905	Product Design and Manufacturing	3/0/0	3	3	PEC
6.	20MT906	CNC Machines and Programming	3/0/0	3	3	PEC
7.	20MT907	Mechanical Design For Robotics System	3/0/0	3	3	PEC
8.	20MT908	Industrial Metrology	3/0/0	3	3	PEC
9.	20MT909	Mechanical Cost Estimation	3/0/0	3	3	PEC

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
<b>Stream II : Automobile and Robotics</b>						
1.	20MT910	Theory of Automobile Engineering	3/0/0	3	3	PEC
2.	20MT911	Autotronics	3/0/0	3	3	PEC
3.	20MT912	Autonomous Vehicle Guidance System	3/0/0	3	3	PEC
4.	20MT913	Basics of Machine Learning	3/0/0	3	3	PEC
5.	20MT914	Robotic Control Systems	3/0/0	3	3	PEC
6.	20MT915	Medical Mechatronics	3/0/0	3	3	PEC

7.	20MT916	Mobile Robotics	3/0/0	3	3	PEC
8.	20MT917	Cognitive Robotics	3/0/0	3	3	PEC
9.	20MT918	Cloud Robotics	3/0/0	3	3	PEC

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
<b>Stream III :Intelligent Control System</b>						
1.	20MT919	Integrated Electronic Circuit	3/0/0	3	3	PEC
2.	20MT920	Consumer Electronics	3/0/0	3	3	PEC
3.	20MT921	Wireless Sensor Networks For Robotics	3/0/0	3	3	PEC
4.	20MT922	Principles of AI And Expert Systems	3/0/0	3	3	PEC
5.	20MT923	Embedded System In Automation	3/0/0	3	3	PEC
6.	20MT924	Internet of Things For Mechatronics	3/0/0	3	3	PEC
7.	20MT925	Image Analytics	3/0/0	3	3	PEC
8.	20MT926	Intelligent Control System	3/0/0	3	3	PEC
9.	20MT927	Neural Network and Deep Learning	3/0/0	3	3	PEC

**OPEN ELECTIVES (OE): Offer to other departments**

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	Credits	Category
1.	20MT001	Basics of Robotics	3/0/0	3	3	OEC
2.	20MT002	Mechatronics Engineering Applications	3/0/0	3	3	OEC
3.	20MT003	Concepts of Virtual Instrumentation	3/0/0	3	3	OEC
4.	20MT004	Field and Service Robotics	3/0/0	3	3	OEC
5.	20MT005	Automation System	3/0/0	3	3	OEC
6.	20MT006	Intelligent Automotive Systems	3/0/0	3	3	OEC

**EMERGING ELECTIVES (EE): Offer to MCT**

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	Credits	Category
1.	20MT007	Basics of Digital Signal Processing	3/0/0	3	3	EEC
2.	20MT008	Industry 4.0 For Mechatronics	3/0/0	3	3	EEC
3.	20MT009	Soft Robotics	3/0/0	3	3	EEC
4.	20MT010	Design and Modelling of Mechatronics Systems	3/0/0	3	3	EEC
5.	20MT011	Robot Operating System	3/0/0	3	3	EEC
6.	20MT012	Supply Chain Management	3/0/0	3	3	EEC

### MANDATORY COURSES (MC):

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	Credits	Category
1.	20MC101	Induction Program	3 weeks		0	MC
2.	20MC102	Environmental Sciences	2/0/0	2	0	MC
3.	20MC103	Soft Skills	2/0/0	2	0	MC
4.	20MC104	Management Organizational Behavior	2/0/0	2	0	MC
5.	20MC105	General Aptitude	2/0/0	2	0	MC
6.	20MC106	Life Skills and Ethics	2/0/0	2	0	MC
7.	20MC107	Stress Management	2/0/0	2	0	MC
8.	20MC108	Constitution of India	2/0/0	2	0	MC
9.	20MC109	Essence of Indian Traditional Knowledge	2/0/0	2	0	MC
10.	20MC110	Biology	2/0/0	2	0	MC

### Category wise Comparison of Courses and Credits

S.no	Category	AICTE- MECH R2018		SKCET-MCT R2020	
		No of Courses	No. of Credits	No of Courses	No. of Credits
1	Humanities (HSMC)	3	9	3	9
2	Basic Sciences (BSC)	7	30	6	25
3	Engineering Sciences (ESC)	6	24	8	24.5
4	Professional Core (PCC)	16	53.5	14	57.5
5	Professional Electives (PEC)	6	18	6	18
6	Open Electives (OEC)/ Emerging Elective (EEC)	3	9	5	15
7	Project Work (PROJ)	4	15	3	14
8	Employability Enhancement Skill (EES)			1	2
9	Mandatory Courses (MC)	3	0	5	Non credit
<b>Total</b>		<b>48</b>	<b>158.5</b>	<b>51</b>	<b>165</b>

### Scheme of Credit Distribution- Summary

S. No	Stream	Credits/Semester								Credits	%
		I	II	III	IV	V	VI	VII	VIII		
1.	Humanities (HSMC)	3	3					3		9	5.45
2.	Basic Sciences (BSC)	8.5	8.5	4	4					25	15.15
3.	Engineering Sciences (ESC)	11	6.5	7						24.5	14.84
4.	Professional Core (PCC)			12	12	12	13.5	8		57.5	34.84
5.	Professional Electives (PEC)					3	6	9		18	10.9
6.	Open Electives (OEC)/ Emerging Elective (EEC)				3	6	3	3		15	9.09
7.	Project Work (PROJ)				1		1		12	14	8.48
8.	Employability Enhancement Skill (EES)							2		2	1.21
9.	Mandatory Courses (MC)										
<b>Total</b>		<b>22.5</b>	<b>18</b>	<b>23</b>	<b>20</b>	<b>21</b>	<b>23.5</b>	<b>25</b>	<b>12</b>	<b>165</b>	<b>100</b>

# SEMESTER-I



20MA101	<b>ENGINEERING MATHEMATICS I</b> <b>(COMMON TO MECH,MCT,CIVIL,ECE,EEE,CSE,IT,AIDS)</b>	2/1/2/4
<b>Nature of Course</b>		
J (Problem analytical)		
<b>Pre requisites</b>		
Concept of Differentiation and Matrices		
<b>Course Objectives:</b>		
1	To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.	
2	To know about system of linear equations and its solution set and how to write down the coefficient matrix and augmented matrix of a linear system	
3	To familiarize with functions of several variables applicable in many branches of engineering.	
4	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C101.1	Recall the concepts of matrices, ordinary and partial derivatives.	[R]
C101.2	Express square matrix in the diagonal form.	[U]
C101.3	Solve systems of linear equations numerically and to find inverse matrices.	[AP]
C101.4	Apply numerical techniques effectively to analyse and visualize data to solve basic engineering-related problems.	[AP]
C101.5	Find the extreme values of the given functions to solve the engineering problems.	[AP]
C101.6	Find the solution of second and higher order differential equations connected with electric circuits and simple harmonic motion.	[AP]
<b>Course Contents:</b>		
<b>MATRICES</b>		
Definition – Types of matrices – Characteristic equation – Eigenvalues and eigenvectors of a real matrices and their properties (statement only) – Cayley-Hamilton theorem (statement only) – Verification and application to find inverse and powers of real matrices – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by Orthogonal transformation. (14)		
<b>SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS</b>		
Newton-Raphson method – Fixed point iteration method – Gauss-Elimination method – Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigenvalue of a matrix by Power method and Jacobi method. (16)		
<b>CALCULUS</b>		
Concepts of limits and continuity – Functions of several variables – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers – Ordinary differential equations – Higher order linear differential equations with constant coefficients –Euler Cauchy's equations – Applications of ODE: Solving electrical circuits and simple harmonic motion. (18)		

<b>Lab Component</b>	
<ol style="list-style-type: none"> <li>1. Entering row vector, column vector, accessing blocks of elements in MATLAB.</li> <li>2. Entering matrices, to locate matrix elements and Correcting any entry through indexing in MATLAB.</li> <li>3. Sum, product, transpose, inverse, determinant and rank of a matrices using MATLAB.</li> <li>4. Eigenvalues and eigenvectors of a matrix using MATLAB.</li> <li>5. System of linear equations in MATLAB using Gaussian elimination.</li> <li>6. System of linear equations in MATLAB using matrix inverse method.</li> <li>7. System of linear equations in MATLAB using linsolve.</li> <li>8. First and second derivative of single variable functions using MATLAB.</li> <li>9. Maxima and Minima of a function using MATLAB.</li> <li>10. Higher Order Equations of constant coefficients using MATLAB.</li> </ol>	
<b>Total Hours:(48+12)</b>	
<b>60</b>	
<b>Text Books:</b>	
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14 <sup>th</sup> Edition,Pearson, Reprint,2018
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43 <sup>rd</sup> edition, Khanna Publications, Delhi, 2018.
<b>Reference Books:</b>	
1	Veerarajan. T, "Engineering Mathematics I", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4 <sup>th</sup> edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics" 9 <sup>th</sup> edition, Laxmi publications ltd, 2014.
<b>Web References:</b>	
1	<a href="http://www.nptel.ac.in/courses/111105035">http://www.nptel.ac.in/courses/111105035</a>
2	<a href="http://www.nptel.ac.in/courses/122104017">http://www.nptel.ac.in/courses/122104017</a>
3	<a href="http://nptel.ac.in/courses/122102009">http://nptel.ac.in/courses/122102009</a>
4	<a href="http://nptel.ac.in/courses/111107063">http://nptel.ac.in/courses/111107063</a>
<b>Online Resources:</b>	
1	<a href="https://www.coursera.org/learn/linearalgebra2">https://www.coursera.org/learn/linearalgebra2</a>
2	<a href="https://www.coursera.org/learn/differentiation-calculus">https://www.coursera.org/learn/differentiation-calculus</a>
3	<a href="https://www.coursera.org/learn/single-variable-calculus">https://www.coursera.org/learn/single-variable-calculus</a>
4	<a href="https://alison.com/courses/Algebra-Functions-Expressions-and-Equations">https://alison.com/courses/Algebra-Functions-Expressions-and-Equations</a>

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical &amp; Project</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>CIA-III [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

20CH101	<b>ENGINEERING CHEMISTRY</b> (Common to all I Year B.E. / B.Tech)		3 /0 /3 /4.5
<b>Nature of Course</b> : E (Theory skill based)			
<b>Pre requisites</b> : NIL			
<b>Course Objectives:</b>			
1	To make the students conversant with water treatment, boiler feed water techniques.		
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.		
3	To understand the principles and applications of electrochemistry and to learn electroanalytical methods.		
4	To understand the basic concepts, synthesis, and applications of nanomaterials.		
5	To explore the synthesis and properties of important engineering plastics, energy sources and drug molecules.		
6	To understand the concepts of photophysical and photochemical processes in spectroscopy.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C101.1	Recall the requirements of water treatment procedures and boiler feed water for industries.		[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.		[AP]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.		[U]
C101.4	Understand the basic concepts and applications of Nanochemistry.		[U]
C101.5	Use the knowledge of polymers, various energy sources and storage devices in engineering field.		[AP]
C101.6	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.		[U]
<b>Course Contents:</b>			
<p><b>Water chemistry and Corrosion:</b> Water treatment-characteristics of water-hardness-types and estimation of hardness by EDTA method with numerical problems. Boiler feed water-requirements-disadvantages of hard water. Domestic water treatment-disinfection methods (chlorination, Ozonation, UV treatment)-demineralization process-desalination-reverse osmosis. Corrosion-types-mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion-protective coatings-electroplating of gold-electroless plating of nickel.</p> <p><b>Electrochemistry and Energy sources:</b> Electrochemical cells-electrolytic cell-reversible and irreversible cells - Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Nanochemistry-Basics-Comparison of molecules, nanomaterials and bulk materials; Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: Electrochemical deposition and</p>			

electro spinning. Applications of nanomaterials in medicine. Energy Sources-Fuel cells ( $H_2$ - $O_2$ ). Storage Devices-Batteries- Alkaline-Lead acid, Nickel cadmium and Lithium-ion batteries.

**Polymer chemistry, Spectroscopic techniques and Synthesis of drug molecules:**

Introduction-monomers and polymers-classification of polymers-Polymerization-types. Mechanism of addition polymerization (free radical mechanism). Plastics-classification-preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and PET. Moulding methods- moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays (Compression moulding) and PET bottles (Blow moulding). Spectroscopy-Beer Lambert's law, principle, instrumentation, and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES). Synthesis of a commonly used drug molecule-Asprin, p-nitroaniline from acetanilide.

**Field work:**

Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

**Lab Components:**

1	Estimation of hardness of water by EDTA method	[E]
2	Estimation of alkalinity of water sample	[E]
3	Determination of chloride content in bleaching powder	[E]
4	Estimation of dissolved oxygen in water	[E]
5	Potentiometry- determination of redox potentials and emf's	[E]
6	Conductometric titration-mixture of acids vs NaOH	[E]
7	Determination of strength of strong acid by pH metry	[E]
8	Corrosion rate of mild steel in acid medium	[E]
9	Electroplating of nickel over copper	[E]
10	Spectrophotometry-Estimation of iron in water	[E]
11	Separation of mixture of amino acids by thin layer chromatography	[E]
12	Synthesis of Nylon 66	[E]
<b>Total Hours:</b>		<b>75</b>

**Understanding the concepts by simple Demonstrations/Experiments:**

1	To observe the hardness of given water sample by soap solution test
2	To view the colour of the different medium of given water sample using litmus paper test
3	To detect the chlorine content in tap water using simple chemical method
4	To know the presence of dissolved oxygen in given water sample using glucose by redox principle
5	To illustrate the rate of corrosion in steel nails using acid medium

**Text Books:**

1	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
2	Jain P. C. & Monica Jain., "Engineering Chemistry", 16 <sup>th</sup> Edition, Dhanpat Rai

	Publishing Company (P) Ltd, New Delhi, 2015.
3	Fundamentals of Molecular Spectroscopy, 4 <sup>th</sup> Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 1994.
4	Physical Chemistry, 11 <sup>th</sup> Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.
5	Nanochemistry, 2 <sup>nd</sup> Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.
6	N.Krishna Murthy, Vallinayagam D., "Engineering Chemistry" 3 <sup>rd</sup> Edition by PHI Learning Pvt Ltd., 2014
7	Sunita Rattan, A Text Book of Engineering Chemistry, Student Edition by SK Kataria Publishers, 2013.
8	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3 <sup>rd</sup> Edition PHI Learning Pvt Ltd., 2014.
<b>Reference Books:</b>	
1	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2	Liliya., Bazylak. I., Gennady. E., Zaikov., Haghvi. A.K., "Polymers and Polymeric Composites" CRC Press, 2014.
3	Lefrou., Christine., Fabry., Pierre., Poignet., Jean-claude., "Electrochemistry - The Basics, with examples" 2012 ., Springer.
4	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5	Perez, Nestor, "Electrochemistry and Corrosion Science", Springer, 2016.
6	Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
7	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.
<b>Web References:</b>	
1	<a href="http://www.analyticalinstruments.in/home/index.html">http://www.analyticalinstruments.in/home/index.html</a>
2	<a href="http://www.springer.com">www.springer.com</a> > Home > Chemistry > Electrochemistry
3	<a href="https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry">https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry</a>
4	<a href="http://www.edx.org/">www.edx.org/</a>
5	<a href="https://www.ntnu.edu/studies/courses">https://www.ntnu.edu/studies/courses</a>
6	<a href="http://www.corrosionsource.com/">www.corrosionsource.com/</a>
<b>Online Resources:</b>	
1	<a href="http://nptel.ac.in/courses/105104102/hardness.htm">nptel.ac.in/courses/105104102/hardness.htm</a>
2	<a href="https://ocw.mit.edu/courses/chemistry">https://ocw.mit.edu/courses/chemistry</a>
3	<a href="http://nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf">nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf</a>
4	<a href="https://alison.com">https://alison.com</a> - Spectroscopic technique, Colorimetry
5	<a href="https://ocw.mit.edu/courses/chemistry">https://ocw.mit.edu/courses/chemistry</a>
6	<a href="http://nptel.ac.in/courses/113108051">nptel.ac.in/courses/113108051</a>

**Assessment Methods & Levels (based on Blooms' Taxonomy)****Summative assessment based on Continuous and End Semester Examination**

<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	30	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

<b>20EN101</b>	<b>TECHNICAL COMMUNICATION SKILLS (MECH / MCT / CIVIL / IT / CSE)</b>	<b>2/0/2/3</b>
<b>Nature of Course</b> :E(Theory Skill Based)		
<b>Pre requisites</b> Basics of English Language		
<b>Course Objectives:</b>		
1	To enhance learners' LSRW skills.	
2	To develop effective communication skills.	
3	To facilitate learners to acquire effective technical writing skills.	
4	To prepare learners for placement and competitive exams.	
5	To facilitate effective language skills for academic purposes and real-life situations.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C101.1	Recall language skills for technical communication.	[U]
C101.2	Apply communication skills in corporate environment.	[AP]
C101.3	Understand and communicate effectively in personal and professional situation.	[AP]
C101.4	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]
C101.5	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]
C101.6	Apply language skills with ease in academic and real-life situations.	[AP]
<b>Course Contents:</b>		
<b>Listening and Speaking</b>		<b>17 Hours</b>
Introduction to Effective Communication- Basics of English Language - Importance of LSRW Skills - Self Introduction - Introducing Others - <b>Listening</b> to Short Conversations or Monologues - Listening to Speeches / Talks - Listening and Responding -- Longer Listening Tasks -Recognise Functions <b>Speaking</b> - Speaking about Giving Directions / Instruction - Talk about Preferences-Agree and Disagree - Giving Opinions - Speaking Practices by Giving Examples, Reasons and Extra Information- Short Talk on Business Topics- Non Verbal Communication- Presentation using Digital Tools- Power of Narrative- Leadership, Conflict and Persuasion.		
<b>Reading</b>		<b>13 Hours</b>
Reading Short Texts - Skimming and Scanning - Comparing Facts and Figures - Reading and Understanding Specific Information in a Text - Cloze Reading - Identifying Reasons and Consequences Through Reading Practices - Comprehension – Collocations.		
<b>Writing and Grammar</b>		<b>15 Hours</b>
Writing Formal Letters (Accepting and Declining Invitations) - Writing Business Letters (Placing an Order and Complaint Letter) - Email Writing – Memo - Circular - Agenda and Minutes of the Meeting - Job Application Letter - Resume Writing - Paragraph Writing – Proof Reading and Editing--Technical Instructions and Recommendations- Jumbled Sentences - Technical Definitions - Report Phrases - Report Writing - Technical Proposal -		

Transcoding (Bar Chart, Flow Chart).

Parts of Speech- Tenses – Subject Verb Agreement - Sentence Structures - Connectives - Modal Verbs - Question Formation - If Conditionals- Active and Passive - Impersonal Passive Voice - Vocabulary Building - Business Vocabulary -- Synonyms, Antonyms – British and American Words - One Word Substitution- Identifying Common Errors.

#### Lab Components

1	<b>Listening Comprehension</b>	[E]
2	<b>Pronunciation, Intonation, Stress and Rhythm</b>	[E]
3	<b>Common Everyday Situations: Conversations and Dialogues.</b>	[E]
4	<b>Formal Presentation</b>	[E]
5	<b>Group Discussion</b>	[E]
6	<b>Interview Skills</b>	[E]
	<b>Total Hours:</b>	<b>60</b>

#### Text Books:

1	Practical English Usage. Michael Swan. OUP. 1995.
2	Remedial English Grammar. F.T. Wood. Macmillan.2007
3	On Writing Well. William Zinsser. Harper Resource Book. 2001
4	Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.

#### Reference Books:

1	Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

#### Web References:

1	<a href="http://www.academiccourses.com/Courses/English/Business-English">http://www.academiccourses.com/Courses/English/Business-English</a>
2	<a href="https://steptest.in">https://steptest.in</a>

#### Online Resources:

1	<a href="https://www.coursera.org/specializations/business-english">https://www.coursera.org/specializations/business-english</a>
2	<a href="http://www.academiccourses.com/Courses/English/Business-English">http://www.academiccourses.com/Courses/English/Business-English</a>
3	<a href="https://scoop.eduncle.com/one-word-substitution-list">https://scoop.eduncle.com/one-word-substitution-list</a>

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	20	20	20	20	20
Understand	40	40	40	40	40
Apply	40	40	40	40	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

<b>20CS111</b>	<b>PROBLEM SOLVING USING C PROGRAMMING</b>		<b>3/0/2/4</b>
<b>Nature of Course</b>	F (Theory Programming)		
<b>Pre requisites</b>	Nil		
<b>Course Objectives:</b>			
1.	To understand problem solving using structured programming language		
2.	To gain knowledge about the control structures in C.		
3.	To develop logics and write C programs using arrays		
4.	To gain familiarity in inbuilt functions, structures and unions in C.		
5.	Apply concept and techniques for implementation in respective domain		
<b>Course Outcomes</b>			
Upon completion of the course, students shall have ability to			
C111.1	Apply problem solving techniques to solve real world problems		[AP]
C111.2	Understand C fundamental constructs and control structures		[U]
C111.3	Use the concept of pointers and arrays in designing programs		[AP]
C111.4	Design C programs using the concepts of strings and functions		[C]
C111.5	Develop programs using structures and Unions in C		[AP]
C111.6	Apply the suitable programming concept for the given computational problem		[AP]
<b>Course Contents:</b>			
<b>Problem Solving Techniques and C Fundamentals</b>			<b>15 Hours</b>
<p>Problem Solving Techniques: Algorithm, Pseudo-code and Flowchart. Creative Thinking and Problem solving skills in everyday life. Understanding Compiler and interpreter. Program Development LifeCycle. C Fundamentals: Structure of C program, Character Set – Identifiers and Keywords – Data Types – Constants - Variables and Arrays – Declarations - Operators and Expressions –Precedence of operators and associativity. Data input and output - Preparing and running a Complete C Program</p>			
<b>Control Structures, Arrays, Strings</b>			<b>15 Hours</b>
<p>Control Structures: Branching: if-else- Looping – while - do while – for - Nested control structures –switch – break – continue – comma - goto. Arrays - Defining an array - Processing an array - Multi dimensional arrays - Strings: Defining a string - Null character - initialization of strings – reading and writing a string - processing the string</p>			
<b>Pointers, Functions, Structures and Unions:</b>			<b>15 Hours</b>
<p>Pointers: fundamentals – Pointer Declaration &amp; Usage – Dynamic Memory Allocation. Functions: Defining a Function – Accessing a function – Function Prototype Functions - Pointer to Function - Functions Returning Pointers. - Pointers and Strings - Passing arguments to a function – Recursion. Structures and Unions: The Type Definition (type def) – Enumerated types – Structure - Type Definition – Initialization – Accessing Structures - Unions.</p>			
			<b>Total Hours</b>
			<b>45 Hours</b>
<b>Laboratory Component:</b>			
<b>S. No</b>	<b>List of Experiments</b>		
1.	Formulate simple algorithm and flowchart using Raptor Tool for simple and		

	complex problem				
2.	Program to process data types, format input and output and to evaluate an expression				
3.	Program using decision making statements				
4.	Program using looping statements				
5.	Program using single and two dimensional arrays				
6.	Program with Strings				
7.	Program using Pointers.				
8.	Program using Recursion				
9.	Program using structures				
10.	Branch specific application program				
<b>Total Hours</b>					
<b>30 Hrs</b>					
<b>Text Books:</b>					
1.	Sprankle M, "Problem Solving and Programming Concepts", 9 <sup>th</sup> Edition, Pearson Education, New Delhi, 2013				
2.	Yashavant Kanetkar, "Let Us C", 16 <sup>th</sup> Edition, BPB Publication, 2017.				
3.	Byron, S. Gottfreid, "Programming with C", McGraw Hill, Schaum's outlines, 4 <sup>th</sup> Edition, 2018.				
4.	Reema Thareja Computer Fundamentals and Programming in C, 2nd edition, OXFORD publications, 2016				
5.	Brian W. Kernighan, Dennis Ritchie, "The C Programming Language", 2 <sup>nd</sup> Edition Pearson Publications, 2015				
<b>Reference Books:</b>					
1.	Yashavant Kanetkar, "101 Challenges in C Programming" Edition, BPB Publication, 2017				
2.	Herbert Schildt, "The Complete Reference C", 4 <sup>th</sup> Edition, McGraw Hill, 2015				
3.	Venugopal K R and Sudeep R.Prasad, "Mastering C", 2 <sup>nd</sup> Edition, McGraw Hill, 2017				
4.	Jeri.R Hanly, and Elliot B Koffman, "Problem solving and programming Design in C", 8 <sup>th</sup> Edition, Pearson 2016				
<b>Web References:</b>					
1.	<a href="http://raptor.martincarlisle.com/">http://raptor.martincarlisle.com/</a>				
<b>Online Resources:</b>					
1.	<a href="https://nptel.ac.in/courses/106/104/106104128/">https://nptel.ac.in/courses/106/104/106104128/</a>				
2.	<a href="https://nptel.ac.in/courses/106/105/106105171/">https://nptel.ac.in/courses/106/105/106105171/</a>				
3.	<a href="https://www.coursera.org/specializations/c-programming">https://www.coursera.org/specializations/c-programming</a>				
<b>Tentative Assessment Methods &amp; Levels (based on Revised Bloom's Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Revised Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-1 [10 marks]</b>	<b>CIA-2 [10 marks]</b>	<b>CIA-3 [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	30	30	20	20	20
Understand	70	50	30	20	40
Apply	-	20	50	60	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes(PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C111.1	3	3	3						2	1		2	2	2	2
C111.2	3	3	3						2	1		2	2	2	2
C111.3	3	3	3						2	1		2	2	2	2
C111.4	3	3	3						2	1		2	2	2	2
C111.5	3	3	3						2	1		2	2	2	2
C111.6	3	3	3						2	1		2	2	2	2

<b>20MT101</b>	<b>PRODUCTION TECHNOLOGY</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To understand the various methods of manufacturing processes.</li> <li>2. To develop the knowledge about the working principles of machines and their process capabilities.</li> <li>3. To familiarize the basic concepts of manufacturing processes</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C101.1	Select the most appropriate manufacturing process for a given material and product.	[R]
C101.2	Understand basic manufacturing operations, including their capabilities, limitations.	[U]
C101.3	Interpret how a machine works	[AP]
C101.4	Select the process parameters for different manufacturing processes.	[AP]
<b>Course Contents:</b>		
Introduction to manufacturing processes - Moulding sand. Patterns: Types and materials. Core making. Cupola and Induction furnace. Sand casting, Investment casting, pressure die casting, centrifugal casting, continuous casting, Casting defects <b>(15 Hours)</b>		
Forging, rolling, Extrusion and wire drawing, Sheet metal working, Spinning, Swaging. Powder metallurgy and its applications, Brazing, soldering; Resistance welding, arc welding; submerged arc welding, inert gas welding: Welding defects, inspection <b>(15 Hours)</b>		
Engine Lathe – Operations and its parameters, Horizontal and Vertical milling machines – Milling operations, Standard shaper – Shaper mechanism, slotting Machine – Slotting operation, Types of planer machines – Double housing planer - Planer mechanism - Operation, Radial and Multiple spindle drilling machine – drilling tools, boring machine – boring tools, broaching machine – Broaching operation, Surface and cylindrical grinding machine, thread rolling and gear cutting machines. Selection of cutting tools in machining different materials. Introduction to Digital Manufacturing. <b>(15 Hours)</b>		
<b>Total hours:</b>		<b>45</b>
<b>Text Books:</b>		
1	HajraChoudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2014	
2	SeropeKalpakijian , “Manufacturing Processes”, Pearson Education, 2012	
<b>Reference Books:</b>		
1	MJ Rao, “Manufacturing Technology: Foundry, Forming and Welding”, Tata McGraw Hill, 2016	
2	G Boothroyd, “Fundamentals of Metal Cutting Machine Tools”, Tata McGraw Hill, 2009	
<b>Web References:</b>		
1	<a href="http://nptel.ac.in/courses/webcourse-contents/iit-roorkee/manufacturing-processes/">http://nptel.ac.in/courses/webcourse-contents/iit-roorkee/manufacturing-processes/</a>	
2	<a href="http://nptel.ac.in/courses/112105126/">http://nptel.ac.in/courses/112105126/</a>	
<b>Online Resources:</b>		
1	<a href="https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x">https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x</a>	
2	<a href="https://www.canvas.net/manufacturing">https://www.canvas.net/manufacturing</a>	

<b>Lab Components:</b>					
<b>Course Objectives:</b>					
4. To perform the different manufacturing processes.					
5. To expose hands-on training to the students by various experiments using machines like lathe, Shaper, Milling, drilling and grinding machines.					
<b>Course outcomes:</b>					
<b>Upon completion of the course, students shall have ability to</b>					
C101.5	Perform various turning operations on a given component using Lathe				[AP]
C101.6	Produce flat surface on the given component using milling, shaper and slotting machines				[AP]
C101.7	Improve surface finish in the given components using grinding machines				[A]
C101.8	Analyse and fabricate related mini projects.				[C]
<b>List of lab experiments:</b>					
1. Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, measuring of machining parameters)					
2. Make a Taper turning using compound rest method for the given diagram (for different taper angles)					
3. Do an external threading in a lathe and mate it with the given nut (for different pitch)					
4. Make an internal and external dovetail using shaping machine and mate both.					
5. Perform a Grinding (Cylindrical /Surface) operation and study the parameters that affect the surface finish.					
6. Produce spur gears using Milling machine for different module.					
7. Perform a drilling operation to make the shaft fit into the hole.					
8. Make a sand mould for the given patten in foundering shop.					
9. Mini Project work- Application oriented products using above experiments (Calculation of Production cost – Sum of raw material cost, machining cost, labor cost, Power cost and Overhead charges)					
<b>Total hours:</b>					<b>45</b>
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	30	20	20	-	20
Understand	50	40	40	20	40
Apply	20	40	40	40	40
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	40	-

Course Outcomes	Program Outcomes/ Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C101.1	3	3	3	3	3	3	3			3	3	3	3	3
C101.2	3		2	2	3	3	3			3	3		3	3
C101.3		2	3	2	2	3				2	3	2	3	3
C101.4	3	3		2	2	3	3				2	2	3	3
C101.5		2	3	2			3			3	2		3	3
C101.6		2	3	2	2	3	3			3	2	2	3	3
C101.7	3	3	3		2		3			3	2	2	3	3
C101.8	3	3	3	2	2		3			2	2	3	3	3

<b>20MT102</b>	<b>ENGINEERING DRAWING AND GRAPHICS</b>	<b>1/0/3/2.5</b>
<b>Nature of Course</b> : Practical		
<b>Pre requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To develop the visual science in the form of technical graphics.</li> <li>2. To make them learning theory of orthographic projections of points, lines, planes and solids as per the BIS codes prevalent to drawing practice.</li> <li>3. To develop the technical drafting skills of the engineering drawing concepts, ideas and design of engineering products.</li> <li>4. To know the method to construct the conic curves used in Engineering Applications.</li> <li>5. To develop an understanding of Isometric to Orthographic Views and vice versa.</li> <li>6. To develop the imagination of solids inclined to one reference planes and to know the sectioning of solids and development of surfaces used in various fields.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C102.1	Read the projections of complex objects.	[R]
C102.2	Understand the different techniques of engineering drawing.	[U]
C102.3	Apply their visualization skills for developing new products.	[Ap]
C102.4	Imagine 3D objects from the given 2D diagram, Create isometric, orthographic projections and projection of lines and planes.	[C]
<b>Course Contents:</b>		
<b>Drafting mode: Manual</b>		
Elements and systems of dimensioning; Geometric Constructions and Engineering Curves: Conic sections -parabola, ellipse and hyperbola. Special curves- Involutives, helix and Spiral curves. <b>(10 hours)</b>		
Orthographic projections: First Angle Projections; Projection of points and straight lines; lines inclined to both HP and VP. Projection of Solids. Sections of simple Solids: Sectional views and true shape of the section. <b>(10 hours)</b>		
Development of Surfaces: Radial development method, development of various solid (Cone, Cylinder, Prism, Pyramid). Isometric projection of simple solids. <b>(10 hours)</b>		
C102.5	Develop section of solids including cylinders, cones, prisms and pyramids.	[C]
C102.6	Construct projections of lines, planes, solids, isometric projections and sections of solids using software.	[C]
<b>Drafting mode: Software</b>		
<b>Software used in Lab: Auto CAD</b>		
<ol style="list-style-type: none"> <li>1. Creation of simple component using Drawing and Modifying commands.</li> <li>2. Drawing front, top and side views of isometric drawings.</li> <li>3. Drawing front and top views of Plane surfaces (Hexagon, Pentagon and circle) inclined to HP</li> <li>4. Drawing front and top views of Plane surfaces (Hexagon, Pentagon and circle) – Inclined to VP.</li> <li>5. Drawing front and top views for a prism and a pyramid.</li> <li>6. Drawing front and top views for a cone and cylinder – Inclined to HP/VP.</li> <li>7. Drawing Sectional views of a prism and a pyramid.</li> <li>8. Drawing sectional views of a cone and a cylinder with Section plane Inclined to HP/VP</li> </ol>		
<b>Total Hours : 60</b>		
<b>Text Books:</b>		
1.	Venugopal.K, PrabuRaja.V, “Engineering Graphics” New Age International Publishers, 15 <sup>th</sup> Edition, 2018.	
2.	Shah.M.B and Rana.B.C, “Engineering Drawing”, Pearson Education, 5 <sup>th</sup> edition, 2016.	

<b>Reference Books:</b>		
1	Natarajan.K.V, "A textbook of Engineering Graphics", Dhanalakshmi Publishers, 5th Edition, 2017.	
2	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 <sup>rd</sup> Edition, 2015.	
3	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2013.	
<b>Web References:</b>		
1	<a href="http://nptel.ac.in/courses/112104172/">http://nptel.ac.in/courses/112104172/</a>	
2	<a href="http://iitmweb.iitm.ac.in/phase2/courses/112104172/19">http://iitmweb.iitm.ac.in/phase2/courses/112104172/19</a>	
<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>		
<b>Summative assessment based on Continuous and End Semester Examination</b>		
<b>Bloom's Level</b>	<b>Rubric based Continuous Assessment [60 marks] (in %)</b>	<b>End Semester Examination [40 marks] (in %)</b>
Remember	-	-
Understand	20	20
Apply	10	10
Analyse	20	20
Evaluate	-	-
Create	50	50

<b>Course Outcomes</b>	<b>Program Outcomes/ Program Specific Outcomes</b>													
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
C102.1	3	3	3	3	3	3	3			3	3	3	3	3
C102.2	3		2	2	3	3	3			3	3		3	3
C102.3		2	3	2	2	3				2	3	2	3	3
C102.4	3	3		2	2	3	3				2	2	3	3
C102.5		2	3	2			3			3	2		3	3
C102.6		2	3	2	2	3	3			3	2	2	3	3

# **SEMESTER-II**



20MT201	APPLIED MECHANICS		3/0/0/3
<b>Nature of Course</b> : Analytical			
<b>Pre Requisites</b> : Nil			
<b>Course Objective:</b>			
1	To make understand the vector and scalar representation of forces and moments and the static equilibrium of particles and rigid bodies, effect of friction on equilibrium, laws of motion, kinematics of motion and the inter relationship.		
2	To make understand the properties of surfaces and solids, prediction of behavior of particles and rigid bodies under motion.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C201.1	Define the law of mechanics and various theorems.		[R]
C201.2	Understand the centroid or centre of gravity and moment of inertia.		[U]
C201.3	Apply the equilibrium concept to force systems of particle or solids in 2D and 3D and also kinematic and kinetics of particles.		[AP]
C201.4	Analyze the practical problems using free body diagrams.		[AN]
<b>Course Contents:</b>			
System of forces- Laws of Mechanics– scalars and vectors- Resolution and Resultant of Coplanar concurrent Forces; Free body diagram - Equilibrium of a particle in two dimensions and in space; Moment of a force – Reduction of system of forces into single force and couple; Types of supports and reaction - Equilibrium of rigid bodies in two dimensions. <b>(15 hours)</b>			
Frames and Machines- Centroid of Common Shapes of Area-Centroid and Area Moment of Inertia of Composite Areas (Rectangle, triangle, circle, quarter and semicircle) by using Standard formula. Parallel axis and perpendicular axis theorems, Polar moment of inertia - Centre of gravity of 3D composite bodies by using standard formula - Mass Moment of Inertia of Composite Bodies -Prismatic, Cylindrical and conical solids (Qualitative Treatment only) <b>(15 hours)</b>			
Displacements, Velocity and acceleration of uniform and uniformly accelerated rectilinear motion of particles - Motion of particles under Gravity; Curvilinear motion - Tangential and normal components of acceleration - Motion of projectile - Types of Friction – Laws, Simple contact and ladder friction - Newton’s laws of motion - Work Energy Equation - Direct central impact of elastic bodies - Kinematics of rigid bodies – Translation and Rotation of Rigid Bodies – Fixed axis rotation - General Plane motion –absolute and relative velocity of slider crank mechanism. <b>(15 hours)</b>			
<b>Total :45 hours</b>			
<b>Text Books:</b>			
1	F.P. Beer, and Jr. E.R Johnston, “Vector Mechanics for Engineers–Statics and Dynamics”, Tata McGraw Hill Publishing Company, New Delhi, 11th edition, 2017.		
2	N.Kottiswaran, “Engineering Mechanics Statics and Dynamics”, Sri Balaji Publications, 2013.		
<b>Reference Books:</b>			
1	Dr. H. J. Shah and S. B. Junnarkar, “Applied Mechanics”, Charotar Publishing House Pvt. Ltd, Gujarat, India, 32 <sup>nd</sup> edition, 2016.		

2	Irving H. Shames, "Engineering Mechanics-Statics and Dynamics", Pearson Education Asia Pvt. Ltd. 2013.
---	--

**Web References:**

1	<a href="http://www.googleweblight.com">www.googleweblight.com</a>
2	<a href="http://www.myengineeringmechanics.com">http://www.myengineeringmechanics.com</a>

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C201.1	Remember	Test (Definition)	5
C201.2	Understand	Online Quiz	5
C201.3	Apply	Problem Solving	5
C201.4	Analyse	Group Assignment	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	30	20	20	20
Understand	30	30	30	30
Apply	30	25	30	30
Analyse	10	25	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcomes	Program Outcomes/ Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C201.1	3	3	3	3	3	3	3			3	3	3	3	3
C201.2	3	3	3	3	3	3	3			3	3	3	3	3
C201.3	3	3	3	2	2					3	2	2	3	3
C201.4	3	3	3	2	2					2	2	3	3	3

20GE201	<b>UNIVERSAL HUMAN VALUES (All Branches)</b>		3/0/0/3
<b>Nature of Course</b>		C ( Theory Concept)	
<b>Pre requisites</b>		Interpersonal Communication and Value Sciences	
<b>Course Objectives:</b>			
1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.		
2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.		
3	Strengthening of self-reflection.		
4	Development of commitment and courage to act.		
5	Helping the students to appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings		
6	Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C201.1	Understand about themselves and their surroundings (family, society, nature).		[U]
C201.2	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.		[U]
C201.3	Apply responsibilities towards their commitments (human values, human relationship and human society).		[AP]
C201.4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.		[AP]
C201.5	Analyse ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.		[AN]
C201.6	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in the nature.		[U]
<b>Course Contents:</b>			
<b>Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being - Harmony in Myself!</b>			
<b>(15 Hours)</b>			
<p>Purpose and motivation for the course. Self-Exploration–Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Understanding human being as a co-existence of the sentient 'I' and the 'Material Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical Facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of 'I' with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail-Programs to ensure Sanyam and Health.</p>			

**Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence - Whole existence as Coexistence (15 Hours)**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and Competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.

**Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics (15 Hours)**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems. Case studies of typical holistic technologies, management models and eco-friendly production systems. Strategy for transition from the present state to Universal Human Order: a. Individual level: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

**Total Hours: 45**

**Text Books:**

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2	Rajni Setia, Priyanka Sharma, " Human Values", Genius Publication", Jaipur, 2019.

**Reference Books:**

1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3	India Wins Freedom - Maulana Abdul Kalam Azad.

**Web References:**

1	<a href="https://examupdates.in/professional-ethics-and-human-values/">https://examupdates.in/professional-ethics-and-human-values/</a>
2	<a href="http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html">http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html</a>
3	<a href="https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf">https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf</a>

**Online Resources:**

1	<a href="https://nptel.ac.in/courses/109/104/109104068/">https://nptel.ac.in/courses/109/104/109104068/</a>
2	<a href="https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b">https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b</a>

3	<a href="https://www.thebalancecareers.com/life-skills-list-and-examples-4147222">https://www.thebalancecareers.com/life-skills-list-and-examples-4147222</a>			
<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>		<b>Marks</b>
C201.1	Understand	Group Discussion		5
C201.2	Understand	Book Review		5
C201.3&4	Apply	Role Play		5
C201.5&6	Apply	Formal Presentation		5
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>CIA-III [10 marks]</b>	<b>Term End Assessment [50 marks]</b>
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

<b>20MA201</b>	<b>ENGINEERING MATHEMATICS II (COMMON TO MECH,MCT,CIVIL,ECE,EEE,CSE,IT,AIDS)</b>	<b>2/1/2/4</b>
<b>Nature of Course</b>	J (Problem analytical)	
<b>Pre requisites</b>	Concepts of Differentiation and Integration.	
<b>Course Objectives:</b>		
1	To gain knowledge in integrals, which are needed in engineering applications.	
2	To develop logical thinking and analytical skills in evaluating multiple integrals.	
3	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.	
4	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C201.1	Determine the area and volume by applying the techniques of double and triple integrals.	[R]
C201.2	Finding the values of integrals through different numerical methods.	[U]
C201.3	Differentiate and integrate a vector-valued functions to solve real world applications.	[AP]
C201.4	Calculate grad, div, curl and use Gauss, Stokes and Greens theorem to simplify the calculations of integrals.	[AP]
C201.5	Apply Laplace transform techniques in system modelling, digital signal processing, process control, solving boundary value problems.	[AP]
C201.6	Apply Laplace transform methods for solving linear differential equations.	[AP]
<b>Course Contents:</b>		
<b>INTEGRAL CALCULUS</b>		
Definite integrals: Evaluation of definite integrals using Bernoulli's formula –Multiple Integrals: Double integration in Cartesian coordinates – Area as double integral –Change of order of Integration – Triple integration in Cartesian co-ordinates –Volume as triple integral – Beta and Gamma functions – Relation between Beta and Gamma Functions – Evaluation of Integrals using Beta and Gamma Functions – Numerical integration: Trapezoidal rule and Simpson's rule for single and double integrals. (18)		
<b>VECTOR CALCULUS</b>		
Vector differential operator – Gradient of a scalar point function - Directional derivatives – Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields – Simple problems – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (theorems statements only) – Simple applications involving cubes and rectangular parallelepipeds. (14)		
<b>LAPLACE TRANSFORM</b>		
Convergence of Laplace transform – Transform of some standard functions – Unit step function – Unit Impulse function – Properties – Initial and final value theorem – Inverse Laplace transform – Partial fraction method – Convolution theorem – Application of Laplace transform for solving second order ordinary differential equation. (16)		
<b>Lab Components:</b>		
1. Double integrals evaluation in cartesian coordinates using MATLAB.		
2. Triple integral calculations using MATLAB in cartesian and cylindrical coordinates.		
3. Double integral evaluation in MATLAB by Trapezoidal rule.		
4. Evaluation of gradient, curl and divergence in MATLAB.		

5. Line integral over a vector field using MATLAB 6. Applying Green's theorem to solve integrals in MATLAB. 7. Relation between Laplace transform of function and its derivative using MATLAB. 8. Laplace transform of Dirac delta and Heaviside functions in MATLAB. 9. Solving Differential Equations in MATLAB using Laplace Transform. 10. Inverse Laplace Transform of symbolic expressions using MATLAB.					
<b>Total Hours:(48+12)</b>					<b>60</b>
<b>Text Books:</b>					
1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14 <sup>th</sup> Edition, Pearson, Reprint,2018.				
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.				
3	Grewal. B.S, "Higher Engineering Mathematics", 43 <sup>rd</sup> edition, Khanna Publications, Delhi, 2014.				
<b>Reference Books:</b>					
1	Veerarajan. T, "Engineering Mathematics II",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.				
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4 <sup>th</sup> edition, 2012.				
3	N.P.Bali and Dr.Manish Goyal,"A Text book of Engineering Mathematics" 9 <sup>th</sup> edition, Laxmi publications ltd, 2014.				
<b>Web References:</b>					
1	<a href="http://nptel.ac.in/video.php?subjectId=122107037">http://nptel.ac.in/video.php?subjectId=122107037</a>				
2	<a href="http://nptel.ac.in/courses/122107036/">http://nptel.ac.in/courses/122107036/</a>				
3	<a href="http://nptel.ac.in/video.php?subjectId=117102060">http://nptel.ac.in/video.php?subjectId=117102060</a>				
<b>Online Resources:</b>					
1	<a href="https://www.coursera.org/learn/pre-calculus">https://www.coursera.org/learn/pre-calculus</a>				
2	<a href="https://www.coursera.org/learn/linearalgebra1">https://www.coursera.org/learn/linearalgebra1</a>				
3	<a href="https://alison.com/courses/Advanced-Mathematics-1">https://alison.com/courses/Advanced-Mathematics-1</a>				
4	<a href="https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x">https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x</a> .				
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical &amp; Project</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>CIA-III [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

20PH201		APPLIED PHYSICS (Common to Mech. MCT and Civil)		3/0/3/4.5
<b>Nature of Course</b>		: E (Theory skill based)		
<b>Prerequisites</b>		: Nil		
<b>Course Objectives:</b>				
1	To learn the basic concepts of physics needed for all branches of engineering.			
2	To enable the students to understand the basics of properties of matter, harmonic oscillator, quantum mechanics and crystallography.			
3	To familiarize the principles of various instruments and laser.			
<b>Course Outcomes:</b>				
<b>Upon completion of the course, students shall have the ability to</b>				
C201.1	Describe the bending behavior beams, analyze the expression for young's modulus and working of torsional pendulum.			[U]
C201.2	Identify the various parameters that are measurable in different instruments.			[U]
C201.3	Discuss the physical characteristics of oscillation and the basic principle of laser.			[U]
C201.4	Understand the central concepts and principles in quantum mechanics, such as the Schrödinger equation, the wave function and its statistical interpretation.			[U]
C201.5	Estimate the Atomic packing and acquire the basic knowledge about Crystal Lattice, Unit cell, Crystal defects and classify the solids based on band theory.			[Ap]
C201.6	Apply the gained knowledge to solve the problems related to their field of study.			[Ap]
<b>Course Contents:</b>				
<b>Properties of matter and Instrumentations:</b>				<b>15 Hours</b>
<b>Properties of matter:</b> elasticity – Plasticity – Types of stress and strain – Hooke's law, stress-strain diagram - Poisson's ratio – Types of moduli of elasticity, relation between three moduli of elasticity –Factors affecting elasticity – Bending moment of a body: neutral surface and neutral plane, derivation of expression for bending moment of a beam with circular and rectangular cross section, cantilever, I- beam – Derivation of expression for Young's modulus – Torsion of cylinder: expression for couple per unit twist of a solid cylinder (derivation), torsional pendulum, expression for period of oscillation. <b>Instrumentations:</b> dial gauge – Piezo electric strain gauge – Load cell: pneumatic load cell and hydraulic load cell – Pirani gauge – Optical microscope: Scanning electron microscope (SEM), transmission electron microscope (TEM) – Types of errors: gross error, systematic error and random error.				
<b>Harmonic oscillations and Laser</b>				<b>15 Hours</b>
<b>Harmonic oscillations:</b> periodic motion – Simple harmonic motion: characteristics of simple harmonic motion – Simple spring-mass system – Resonance – Damped harmonic oscillator, energy decay in a damped harmonic oscillator. <b>Laser:</b> characteristics of laser – Principle of spontaneous emission and stimulated emission – Einstein's theory of matter radiation interaction and A and B coefficients (derivation) – Population inversion – Pumping – Different types of lasers: Neodymium laser, CO <sub>2</sub> and semiconductor laser (heterojunction) – Thermal effect – Qualitative industrial applications of lasers: welding, drilling and cutting.				
<b>Quantum mechanics and Crystallography:</b>				<b>15 Hours</b>
<b>Quantum mechanics:</b> Planck's quantum theory (derivation) – Matter waves, de-Broglie wavelength – Heisenberg's uncertainty principle – Schrödinger's wave equation: time independent and time dependent – Physical significances of wave function – Particle in a one dimensional potential box. <b>Crystallography:</b> crystal system – lattice – Bravais lattice, calculation of atomic packing factor for simple cubic, body centered cubic, face centered cubic and hexagonal close packed lattice – Miller				

indices – Crystal imperfections: point, line burger vector – Basic concepts of band theory and classification of materials into conductor, semiconductor and insulator.		
<b>Lab Component</b>		<b>30 Hours</b>
1	Young's modulus of the material - Non-Uniform bending method.	[U]
2	Moment of Inertia of disc and rigidity modulus of a wire – Torsional pendulum.	[U]
3	Projectile motion – Simulation lab.	[U]
4	Frequency of transverse and longitudinal wave modes – Melde's experiment.	[U]
5	Simple harmonic motion- Simulation lab.	[U]
6	Determination of laser and optical fiber parameters.	[U]
7	Determination of Planck's Constant.	[U]
8	Determination of Stefan's Constant.	[U]
9	Determination of lattice constant of cubic crystal structure.	[U]
10	Determination of band gap of semiconductor.	[U]
<b>Life Skills Experiments</b>		
1	How does a fuel (gas/liquid) pump nozzle shut off?	
2	How does a circuit breaker work?	
3	How to Check Earthing at Home?	
<b>Total Hours:</b>		<b>75</b>
<b>Text Books:</b>		
1	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2018	
2	Rajendran, V "Engineering Physics" Mc Graw Hill Publications Ltd, New Delhi, 2016.	
<b>Reference Books:</b>		
1	Avadhanulu M.N., Kshirshagar P.G., Arun Murthy TVS "A Text Book of Engineering Physics"S. Chand& Co Ltd, 2018.	
2	Sawhney A.K., Puneet Sawhney "A Course In Mechanical Measurements And Instrumentation & Control" Dhanpat Rai & Co, 2013.	
3	<b>Richard P. Feynman. Robert B. Leighton, Matthew Sands</b> "The Feynman Lectures on Physics Vol. I": The New Millennium Edition.2015	
<b>Web References/ Online Resources:</b>		
1	<a href="https://faraday.physics.utoronto.ca/IYearLab/Elastic-properties-of-solids-manual.pdf">https://faraday.physics.utoronto.ca/IYearLab/Elastic-properties-of-solids-manual.pdf</a>	
2	<a href="https://www.physik.uzh.ch/~matthias/espace-assistant/manuals/en/anleitung_102-tb_e.pdf">https://www.physik.uzh.ch/~matthias/espace-assistant/manuals/en/anleitung_102-tb_e.pdf</a>	
3	<a href="https://ir.nctu.edu.tw/bitstream/11536/1680/1/A1995TF11100052.pdf">https://ir.nctu.edu.tw/bitstream/11536/1680/1/A1995TF11100052.pdf</a>	
4	<a href="http://www2.optics.rochester.edu/workgroups/cml/whole-enchilada-SPR05.pdf">http://www2.optics.rochester.edu/workgroups/cml/whole-enchilada-SPR05.pdf</a>	
5	<a href="https://nptel.ac.in/courses/122/103/122103010/">https://nptel.ac.in/courses/122/103/122103010/</a>	
6	<a href="https://nptel.ac.in/courses/115/106/115106119/">https://nptel.ac.in/courses/115/106/115106119/</a>	
7	<a href="https://www.eatm.in/upload/srit_unit_i_laser.pdf">https://www.eatm.in/upload/srit_unit_i_laser.pdf</a>	
8	<a href="https://nptel.ac.in/courses/115/101/115101107/">https://nptel.ac.in/courses/115/101/115101107/</a>	
9	<a href="https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/">https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/</a>	
10	<a href="http://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf">http://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf</a>	

**Assessment Methods & Levels (based on Blooms' Taxonomy)****Summative assessment based on Continuous and End Semester Examination**

<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>CIA-III [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	30	20	30	20	30
Understand	60	60	60	40	60
Apply	10	20	10	30	10
Analyse	-	-	-	10	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

<b>20ME103</b>	<b>ENGINEERING PRACTICES LABORATORY</b>		<b>0/0/3/1.5</b>
<b>Nature of Course</b> : Practical application			
<b>Co requisites</b> : NIL			
<b>Course Objectives:</b>			
1	To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.		
2	To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C103.1	Identify and solve the basic engineering problems at home and in workplace.		[Ap]
C103.2	Develop the surfaces and make simple components like tray and funnel.		[C]
C103.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.		[Ap]
C103.4	Prepare pipe connections and sand moulds.		[Ap]
C103.5	Understand the fundamentals of hot forging and injection moulding		[U]
C103.6	Examine and troubleshoot electrical and electronic circuits		[A]
<b>GROUP A (CIVIL &amp; MECHANICAL)</b>			
Manufacturing Methods –Sheet metal operations - Welding - arc welding, gas welding, Study of TIG & MIG welding, Study of foundry, Demonstration of Smithy and Injection moulding - Carpentry work using power tools - Plumbing components and pipelines.			
<b>List of Experiments:</b>			
<b>S.No</b>	<b>List of Experiments</b>	<b>CO Mapping</b>	<b>RBT</b>
1	Preparation of butt joints and lap joints using arc welding	C103.3	[Ap]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C103.3	[Ap]
3	Preparation of wooden joints by sawing, planning and cutting.	C103.2	[Ap]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C103.3	[Ap]
5	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C103.4	[U]
6	Demonstration of Smithy operations	C103.4	[Ap]
7	Demonstration of assembly of pump / Demonstration of Injection moulding	C103.5	[Ap]
<b>GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)</b>			
Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipment's: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder, study of FM radio and mobile phone.			
<b>List of Experiments:</b>			
<b>S.No</b>	<b>List of Experiments</b>	<b>CO Mapping</b>	<b>RBT</b>
1.	Study and identification of electronic components with specification.	C103.6	[A]

2.	Testing of CRO and Electronic components using Multimeter.	C103.6	[A]
3.	Generation and measurement of signals using CRO.	C103.6	[A]
4.	Familiarisation of digital basic gate IC's.	C103.6	[A]
5.	Soldering practice-components devices and circuits- using general purpose PCB.	C103.6	[A]
6.	Demonstration of meters and electrical components.	C103.6	[A]
7.	Safety precautions with electrical components.	C103.6	[A]
8.	Residential house wiring.	C103.6	[A]
9.	Measurement of power and energy.	C103.6	[A]
10.	Trouble shooting of electrical equipments.	C103.6	[A]

**Reference Books:**

1	Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2	Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promoters Pvt Ltd., 2014.
3	Suyambazhagan S, 'Engineering practices' PHI Learning private limited, New Delhi, 2012.
4	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

**Web References:**

1	<a href="http://www.nptel.ac.in">www.nptel.ac.in</a>
2	<a href="http://www.sme.org">www.sme.org</a>
3	<a href="http://www.allaboutcircuits.com/education/">http://www.allaboutcircuits.com/education/</a>

**Assessment Methods & Levels (based on Bloom's Taxonomy)**

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	10	10
Understand	10	10
Apply	40	40
Analyse	20	20
Evaluate	10	10
Create	10	10

**Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)**

COs	POs											PSOs	
	a	b	c	d	e	f	g	h	i	j	k	1	2
C103.1	3	3	3		3		3		3	2		1	3
C103.2	3	3	3		3		3		3	2		1	3
C103.3	2	1	3	2	3			3	2		1		
C103.4													
C103.5													
C103.6													

<b>20MC102</b>	<b>ENVIRONMENTAL SCIENCES</b>		<b>2 /0 /0 /0</b>
<b>Nature of Course</b>	:C (Theory Concept)		
<b>Pre requisites</b>	:Basics in Environmental Studies		
<b>Course Objectives:</b>			
	1	To learn the integrated themes on various natural resources.	
	2	To gain knowledge on the type of pollution and its control methods.	
	3	To have an awareness about the current environmental issues and the social problems.	
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C102.1	Recall and play an important role in transferring a healthy environment for future generation.		[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.		[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.		[U]
C102.4	Apply the gained knowledge to overcome pollution problems.		[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.		[AP]
<b>Course Contents:</b>			
<b>Natural Resources:</b>			
Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification – Role of an individual in conservation of natural resources.			
<b>Environmental Pollutions:</b>			
Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Green house effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedyb. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.			
<b>Social issues and the Environment:</b>			
Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.			
<b>Total Hours:</b>			<b>30</b>
<b>Text Books:</b>			
1	AnubhaKaushik and C P Kaushik “Perspectives in Environmental Studies”4 <sup>th</sup> Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi		
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.		
<b>Reference Books:</b>			
1	Tyler Miller, Jr., “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.		
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13 <sup>th</sup> Edition,		

	McGraw Hill, 2015.		
3	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Third Edition, Pearson Education, 2014.		
<b>Web References:</b>			
1	<a href="http://nptel.ac.in/courses/104103020/20">http://nptel.ac.in/courses/104103020/20</a>		
2	<a href="http://nptel.ac.in/courses/120108002">http://nptel.ac.in/courses/120108002</a>		
3	<a href="http://nptel.ac.in/courses/122106030">http://nptel.ac.in/courses/122106030</a>		
4	<a href="http://nptel.ac.in/courses/120108004/">http://nptel.ac.in/courses/120108004/</a>		
5	<a href="http://nptel.ac.in/courses/122102006/20">http://nptel.ac.in/courses/122102006/20</a>		
<b>Online Resources:</b>			
1	<a href="https://www.edx.org/course/subject/environmental-studies">https://www.edx.org/course/subject/environmental-studies</a>		
2	<a href="http://www.environmentalscience.org">www.environmentalscience.org</a>		
<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>			
<b>Formative assessment based on Capstone Model (Max. Marks:40)</b>			
Course Outcome	Bloom's Level	Assessment Component	Marks
C102.1	Remember	Quiz	5
C102.2	Understand	Mini project based on environmental aspect	15
C102.3	Understand	Class Presentation	10
C102.4	Apply	Group Assignment	10
<b>Summative assessment based on Continuous Assessment</b>			
Bloom's Level	Continuous Assessment		
	CIA-I [0 marks]	CIA-II [0 marks]	Term End Assessment [60 marks]
Remember	-	-	30
Understand	-	-	40
Apply	-	-	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

# SEMESTER-III



<b>20MT301</b>	<b>ELECTRICAL AND ELECTRONIC DEVICES</b>	<b>3/0/0/3</b>
<b>Nature of Course:</b> Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To familiarize the basic concepts of electrical circuits and associated theorems.</li> <li>2. To understand the fundamentals semiconductors devices and circuits.</li> <li>3. To understand various combinational and sequential logic circuits using logic gates.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have the ability to</b>		
C301.1	Explore the acquired knowledge of electric circuits	[R]
C301.2	Describe various semiconductor devices.	[U]
C301.3	Explain the basic concepts of number systems and Boolean algebra.	[U]
C301.4	Apply the digital logic concept and understand various combinational and sequential logic circuits.	[AP]
<b>Course Contents:</b>		
Active elements, Passive elements, Voltage division, Current division, KCL, KVL, Node and Mesh analysis, Thevenin's theorem, Norton's theorem, Superposition theorem. <b>(15 hours)</b>		
P-N junction, Zener diode, BJT, <b>FET</b> , MOSFET, LED, photoconductive cell, photo diode, phototransistor and solar cell; Op-amps- inverting and non-inverting amplifiers, <b>Tuned Oscillator Circuit, Multivibrators</b> , Application circuits: Audio Amplifier, LED lights to reduce operating costs in Industry <b>(15 hours)</b>		
Boolean algebra, minimization of functions using Boolean identities and K-map, logic gates, Combinational logic circuits: multiplexer, demultiplexer, encoders and decoders, JK Flip-flop, D Flipflop, Synchronous Up counter, Synchronous Down Counter, Serial in serial out shift register, Parallel in parallel out shift register. <b>(15 hours)</b>		
<b>Total Hours:</b>		<b>45</b>
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Edward Hughes, ""Electrical and Electronic Technology", 12<sup>th</sup> Edition, Pearson, Newyork, 2016</li> <li>2. M. Morris Mano, Michael D. Ciletti, "Digital Design", Pearson, Newyork, 2018</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Thomas L. Floyd, "Electronic Devices-Conventional current version", 10<sup>th</sup> Edition Pearson, Newyork, 2017</li> <li>2. John Bird, "Electrical and Electronic Principles and Technology", 5<sup>th</sup> Edition, Routledge, UK, 2017.</li> <li>3. Anil K. Mani, "Digital Electronics: Principles, Devices and Applications", Wiley, New Jersey, 2019</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="http://www.allaboutcircuits.com">www.allaboutcircuits.com</a></li> <li>2. <a href="http://www.circuitstoday.com">www.circuitstoday.com</a></li> </ol>		

**Online Resources:**

1. <http://www.electronics-tutorials.ws>
2. <http://www.electrical4u.com/digital-electronics.htm>
3. <http://www.technologystudent.com/elec1/dig1.htm>
4. <https://www.ijariit.com/manuscripts/v4i3/V4I3-1830.pdf>
5. <https://circuitdigest.com/case-studies/using-led-lights-to-reduce-operating-cost-in-industries-that-run-24x7>

**Assessment Methods & Levels (based on Bloom's Taxonomy)****Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C301.1	Remember	Test	5
C301.2	Understand	Assignment	5
C301.3	Understand	Online Quiz	5
C301.4	Apply	Problem solving	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	
Remember	20	20	20	20
Understand	20	40	50	50
Apply	-	40	-	-
Analyse	60	-	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
C301.1	3	2	2	2	2	2	3						2	2
C301.2	3	2	2	3	2	2	3						2	2
C301.3	3	3	3	3	2	3	2						2	
C301.4	3	3	3	2	3	3	3						2	2

20MT302	STRENGTH OF SOLIDS	3/0/0/3
<b>Nature of Course</b> :Analytical		
<b>Pre requisites</b> :20MT201 Applied Mechanics		
<b>Course Objectives:</b>		
1	To impart knowledge on engineering materials and their mechanical properties.	
2	To impart knowledge on stress and strains and deformation in components due to different loads	
3	To enable the students to understand the concepts of beam, column and shafts	
4	To enable the students to understand the importance of Principal stresses and strain energy	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C302.1	Define the mechanical properties of the materials and find the stresses and strain in simple and compound bars.	[R]
C302.2	Interpret the effect of principal stresses in various members and strain energy for different loads.	[U]
C302.3	Develop the shear force, bending moment diagram and calculate the stresses induced in various types of beams.	[AP]
C302.4	Analyze and compare the torque transmitting carrying capacities of the circular shafts and find the required thickness of the pressure vessel for a given internal pressure.	[A]
C302.5	Estimate the slope and deflection of beams under various loading conditions and analyze the failure of columns with different end conditions.	[E]
<b>Course Contents:</b>		
<p>Mechanical properties of materials; Stress: Tension, Compression and Shear stresses; Strain: Linear, Volumetric and Shear Strains; Hooke's Law, Elastic constants and their relations; Factor of safety; Poisson's ratio. Analysis of bars of uniform section and composite sections; Thermal stresses in composite section; Principal Planes and Stresses: Analytical method, Strain Energy in gradually applied, suddenly applied and impact loadings.</p> <p style="text-align: right;"><b>(15 hours)</b></p> <p>Torsion equation, Torsion in solid and hollow circular shafts. Shear Force and Bending Moment Diagrams for Cantilever and Simply Supported Beams with Point and Uniformly Distributed Loads. Pure bending equation, Bending stress in symmetrical and unsymmetrical sections. Case study: Stress calculation, Shear force and Bending moment diagrams on Robotic Arms</p> <p style="text-align: right;"><b>(15 hours)</b></p> <p>Thin cylindrical vessel and spherical shells: Stresses, Effect of internal pressure on the dimensions. Evaluation of Slope and Deflection by Double integration and Macaulay's Method: Cantilever and Simply Supported Beams with Point and Uniformly Distributed Loads. Column: Effective length, Crippling load, Euler equation and Slenderness ratio.</p> <p style="text-align: right;"><b>(15 hours)</b></p>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	R.K.Bansal, "Strength of Materials", Laxmi Publication, 6th Edition, 2017.	
2	Ferdinand P Beer, Russell Johnston, "Mechanics of Materials", McGraw Hill Education, 8 <sup>th</sup> Edition, 2020.	
<b>Reference Books:</b>		
1	R C Hibbeler, "Statics and Mechanics of Materials", Pearson Education, 5 <sup>th</sup> Edition, 2014.	
2	Barry J. Goodno, James M. Gere, "Mechanics of Materials", Cengage Learning, 9 <sup>th</sup> Edition, 2017.	
<b>Web References:</b>		

1	<a href="https://nptel.ac.in/courses/112/106/112106141/">https://nptel.ac.in/courses/112/106/112106141/</a>			
2	<a href="https://www.coursera.org/learn/mechanics-1">https://www.coursera.org/learn/mechanics-1</a>			
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C302.1, 2	Understand	Test (Definition)	5	
C302.1,2,3	Apply	Assignment	5	
C302.3,4	Analyze	Tutorial	5	
C302.4,5	Evaluate	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	10	10	10	10
Understand	10	10	10	10
Apply	20	20	20	20
Analyze	30	30	30	30
Evaluate	30	30	30	30
Create	-	-	-	-

Course Outcomes	Program Outcomes/ Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C302.1	3	3	3	3	3	3	3			3	3	3	3	3
C302.2	3	3	3	3	3	3	3			3	3	3	3	3
C302.3	3	3	3	2	2					3	2	2	3	3
C302.4	3	3	3	2	2					2	2	3	3	3

20MA301	<b>ENGINEERING MATHEMATICS III MECH/MCT/CIVIL/ECE/EEE</b>	2/1/2/4
<b>Nature of Course</b>	J (Problem analytical)	
<b>Pre requisites</b>	Concepts of basic differentiation and Integration	
<b>Course Objectives:</b>		
1	To understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.	
2	To acquaint the student with transform techniques which are used in variety of engineering fields.	
3	To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation.	
4	To find the numerical solution for partial differential equations.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C301.1	Recall the basic integration concepts and partial derivatives	[R]
C301.2	Interpret Fourier series solutions to the engineering problems	[U]
C301.3	Apply continuous transforms techniques to evaluate definite integrals	[AP]
C301.4	Apply the Z transform techniques in discrete sequences	[AP]
C301.5	Apply analytical methods to solve the partial differential equations	[AP]
C301.6	Apply numerical methods to solve wave and heat equation with boundary conditions	[AP]
<b>Course Contents:</b>		
<b>Module 1: Fourier Series</b>		<b>15 Hrs</b>
Dirichlet's conditions-General Fourier Series-Odd and Even Functions- Half range sine series and cosine series - Parseval's Identity-Harmonic analysis		
<b>Module 2: Fourier Transform and Z Transform</b>		<b>15 Hrs</b>
<b>Fourier Transform:</b> Complex form of Fourier Transforms – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem and Parseval's Identity (Statement only) – Evaluation of integrals using Parseval's Identity. <b>Z- Transform:</b> Convergence of Z transform -Z-transform of Standard functions-Properties -Inverse Z- transform-Convolution theorem(Statement only)-Partial fraction method - Formation of difference equations - Solution of difference equations using Z-transform Techniques.		
<b>Module 3: Partial Differential Equations</b>		<b>15 Hrs</b>
Introduction to PDE – Solving PDE by Lagrange's linear equations-Linear homogeneous partial differential equations of second and higher order with constant coefficients-Classifications-Numerical Solution to Partial differential Equation-Elliptic equations- Laplace equation - Liebmann's Iteration Process -Poisson equation -Parabolic Equation (one dimensional heat equation) - Bender-Schmidt's Difference Scheme – Crank-Nicholson's Difference Scheme- Hyperbolic Equation (one dimensional wave equation).		
<b>Total Hours:</b>		<b>45 Hrs</b>
<b>Course Outcomes: (Laboratory)</b>		
<b>Upon the completion of the course, students shall have ability to</b>		
C301.1	Understand the need for a function or its approximation as an infinite series.	
C301.2	Represent discontinuous function which occurs in electrical circuits and signal processing by using Fourier series	
C301.3	Demonstrate the use of Fourier transform to connect the time domain and frequency domain	

C301.4	Understanding Z- transform and analyzing discrete signals by using Z- transform.
C301.5	To describe homogeneous and higher order partial differential equations using PDE techniques.
C301.6	Understanding of basic concepts in application of partial differential equations in one dimensional heat and wave equations.

<b>Laboratory Component:</b>			
<b>S.No</b>	<b>List of Experiments</b>	<b>CO Mapping</b>	<b>RBT</b>
1.	To perform symbolic Fourier series calculation of the given full range signals using suitable mathematical software.	C301.1	[AP]
2.	To perform symbolic Fourier series calculation of the given half range signals using suitable mathematical software.	C301.2	[AP]
3.	To plot the Fourier transform of time function using suitable mathematical software.	C301.3	[AP]
4.	To find the Z transform of given expression $f(n)$ using suitable mathematical software.	C301.4	[AP]
5.	To find the inverse Z transform of given expression $f(n)$ using suitable mathematical software.	C301.4	[AP]
6.	To find the solution of homogeneous partial differential equation using suitable mathematical software.	C301.5	[AP]
7.	To find the solution for higher order partial differential equations using suitable mathematical software.	C301.5	[AP]
8.	To solve initial and boundary value problems for systems of partial differential equations in one spatial variable $x$ and time $t$ using suitable mathematical software.	C301.5	[AP]
9.	To perform the solution of Laplace equation using suitable mathematical software.	C301.6	[AP]
10.	To perform the solution of Poisson equation using suitable mathematical software.	C301.6	[AP]
11.	To solve the one-dimensional heat equation using suitable mathematical software.	C301.6	[AP]
12.	To solve the one-dimensional wave equation using suitable mathematical software.	C301.6	[AP]

<b>Text Books:</b>	
1	Erwin E., "Advanced Engineering Mathematics", John Wiley and Sons (Asia) Limited, Hoboken, 2020.
2	Grewal. B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2018.
3	Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers, 6th edition, 2016.

<b>Reference Books:</b>	
1	Veerarajan. T, "Transforms and Partial differential equations", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., reprint, 2016.
2	N.P.Bali, "A Text book of Engineering Mathematics Sem-III/IV" 13th edition, Laxmi Publications Ltd, 2017.

3	Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2016.
4	P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2015.
5	Holly Moore, "MATLAB for Engineers" Fifth Edition – Pearson Publications, 2018.

**Web References:**

1	<a href="https://www.youtube.com/watch?v=jNC0jxb0OxE">https://www.youtube.com/watch?v=jNC0jxb0OxE</a>
2	<a href="https://www.youtube.com/watch?v=iRXXmtcocAQ">https://www.youtube.com/watch?v=iRXXmtcocAQ</a>
3	<a href="https://www.youtube.com/watch?v=OGT59INHz3Y">https://www.youtube.com/watch?v=OGT59INHz3Y</a>

**Online Resources:**

1	<a href="https://nptel.ac.in/courses/111/106/111106111/">https://nptel.ac.in/courses/111/106/111106111/</a>
2	<a href="https://nptel.ac.in/courses/111/107/111107111/">https://nptel.ac.in/courses/111/107/111107111/</a>
3	<a href="https://nptel.ac.in/courses/111/107/111107107/">https://nptel.ac.in/courses/111/107/111107107/</a>

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical & Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

**Course Articulation Matrix (Theory)**

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
6	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
<b>Avg</b>	<b>2.5</b>	<b>2.5</b>	-	-	-	-	-	-	-	-	-	-	<b>0.6</b>	-	-
1	Reasonably agreed				2	Moderately agreed					3	Strongly agreed			

<b>Course Articulation Matrix (Laboratory)</b>															
<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PS O 1</b>	<b>PS O 2</b>	<b>PS O 3</b>
<b>1</b>	1	1	-	-	3	-	-	-	-	-	-	-	1	-	-
<b>2</b>	2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
<b>3</b>	3	3	-	-	3	-	-	-	-	-	-	-		-	-
<b>4</b>	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
<b>5</b>	3	3	-	-	3	-	-	-	-	-	-	-		-	-
<b>6</b>	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-
<b>Avg</b>	<b>2.5</b>	<b>2.5</b>	-	-	<b>3</b>	-	-	-	-	-	-	-	<b>0.6</b>	-	-
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed				

<b>20MT303</b>	<b>ELECTRICAL MACHINES AND POWER SYSTEMS</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : 20MT301 Electrical and Electronic Devices		
<b>Course Objectives:</b>		
To impart knowledge on		
1. Constructional details, principle of operation, and applications of DC machines		
2. Constructional details, principle of operation, and applications of AC machines & Transformer		
3. Concept of Power systems		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C303.1	Select the various electrical machines and components of Electric Power systems.	[R]
C303.2	Explain the working of practical electrical machines and generation, transmission and distribution systems.	[U]
C303.3	Analyze the faults occurring in Electrical machines , Transmission and distribution networks	[A]
C303.4	Choose appropriate electrical machines suitable for a specific application based on their characteristics.	[E]
<b>Course Contents:</b>		
<b>DC machines:</b> Construction and Operating Principle, Classification, EMF and Torque Equations. Characteristics, Losses and efficiency, Starters and Speed control. DC machines application in Traction system, Introduction to BLDC motor. <b>(15 Hours)</b>		
<b>Three phase induction motors</b> Three phase induction motors principle of operation, types, torque-speed characteristics, speed control, single phase induction motors, Construction and working of synchronous motors,types,starting of synchronous motor, Case studies: New Trends in Energy Efficient Electrical machines, Requirements of high speed machines in industries <b>(15 Hours)</b>		
<b>Transformers:</b> Construction& working operation, EMF equation. Types, Ideal and practical transformer, equivalent circuit, regulation and efficiency, Autotransformers, Instrument transformers. <b>Basics of Power systems:</b> Basic structure of power system, ac and dc transmission concepts, Introduction to smart grid. <b>(15 Hours)</b>		
		<b>Total Hours: 45</b>
<b>Text Books:</b>		
1	V.K.Mehta and R.Mehta, "Principles of Electrical Machines", Fourth Revised Reprint, S.Chand Company, 2018	
2	Nagrath I.J. and D. P. Kothari, "Electric Machines", Fifth Edition, Tata McGraw Hill, 2017.	
<b>Reference Books:</b>		
1	V.K.Mehta and R.Mehta, "Principles of Power System", Third Revised Reprint, S.Chand Company, 2018	
2	Ahmed Mousa, "The Electric Power System: Generation, Transmission & Distribution Made Simple", Second edition, Lulu Publications, 2018	
<b>Web References:</b>		
1	<a href="http://www.learnengineering.org/">http://www.learnengineering.org/</a>	
2	<a href="http://nptel.ac.in/courses/108105053/">http://nptel.ac.in/courses/108105053/</a>	
<b>Online Resources:</b>		
1	<a href="https://www.electrical4u.com/">https://www.electrical4u.com/</a>	
2	<a href="https://www.electrical4u.com/p/electrical-machines.html">https://www.electrical4u.com/p/electrical-machines.html</a>	
<b>Lab Components:</b>		

**Course Objectives:**

4. To empower students to determine the parameters of AC, DC machines and Transformers by performing experiments on these machines.
5. To enable, train and evaluate the ability of the students to perform the analysis of digital electronics system.

**Course outcomes:****Upon completion of the course, students shall have ability to**

C303.5	Analyse the performance of Electrical machines.	[A]
C303.6	Analyse the methods of starting and speed control of various electrical machines.	[A]
C303.7	Choose electrical machines for various applications based on their characteristics	[E]
C303.8	Design digital electronic circuits for various applications	[C]

**List of lab experiments:****Electrical:**

1. Comparing the performance of D.C. shunt and series motor.
2. Assessing the characteristics of methods of speed control of D.C. shunt motor.
3. Analysis of factors affecting losses and efficiency of single phase transformer
4. Validation of slip and torque-speed characteristics of three-phase induction motor.
5. Comparing the different types of D.C. motor and induction motor starters.(study experiment)

**Electronics:**

6. Comparing the working of different types of digital Logic gates.
  7. Getting the addition and subtraction operations done in digital Adder and Subtractor circuits using logic gates.
  8. Comparing two binary numbers using digital 2 bit magnitude comparator.
  9. Transmitting and receiving serial data using digital multiplexer and de-multiplexer using logic gates
  10. Identifying memory cells using digital encoder and decoder using logic gates
  11. Displaying numbers in 7 segment display using BCD to 7 segment decoder circuit
- Note: Project should be submitted at the end of the semester

**Total Hours: 45****Assessment Methods & Levels (based on Blooms' Taxonomy)****Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	-	20
Understand	60	40	50	-	50
Apply	20		10		10
Analyse		-	10	20	10
Evaluate	-	20	10	40	10
Create	-	20	-	40	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<b>C303.1</b>	3	2	2	2	2	2	3		3				2	2
<b>C303.2</b>	3	2	2	3	2	2	3		3				2	2
<b>C303.3</b>	3	3	3	3	2	3	2		3				2	2
<b>C303.4</b>	3	3	3	2	3	3	3		3				2	2
<b>C303.5</b>	3	2	2				3		3			3	2	2
<b>C303.6</b>	3	2	2	3			3		3			3	3	3
<b>C303.7</b>	3	3	3	3		3	2		3			3	3	3
<b>C303.8</b>	3	3	3	2	3	3	3		3			3	2	3

<b>20MT304</b>	<b>THERMAL AND FLUID ENGINEERING</b>	<b>3/0/3/4.5</b>
<b>Nature of Course:</b> Analytical		
<b>Pre requisites:</b> 20MA101- Engineering Mathematics-I		
<b>Course Objectives:</b>		
1. To understand the properties of the fluid and appreciate the complexities involved in solving the fluid flow problems.		
2. To understand the laws and principles of thermodynamics and heat transfer.		
3. To evaluate the performance of refrigeration system.		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C304.1	Recall the basic properties, principles and applications of fluids.	[R]
C304.2	Analyze the head loss in pipes and study the basic concepts of computational fluid dynamics.	[A]
C304.3	Apply the basic laws and principles of thermodynamics to solve thermal problems and to find performance of the refrigeration cycle.	[AP]
C304.4	Analyze and obtain solutions to problem involving various modes of heat transfer.	[A]
<b>Course Contents:</b>		
Definitions of fluid properties (qualitative treatment only); Fluid pressure – Piezometer, U-tube manometer and U-tube differential manometer. Types of fluid flow; Continuity equation. Practical application of Bernoulli's equation in horizontal venturimeter. Laminar flow and turbulent flow (qualitative treatment only), Major energy losses due to friction in pipes. Centrifugal Pumps - Working principle, work done by the impeller on water. Case study: Fan selection using power and pressure rise for air cooling of a computer. <b>(15 Hours)</b>		
Basic concepts in thermodynamics; Zeroth law; First law of thermodynamics for closed system; Steady Flow Energy Equation for open system. Second law of thermodynamics – Heat engines, Carnot cycle - Carnot theorem; Refrigerator and heat pump; Concept of entropy. Case study: Energy consumption in household refrigerators. <b>(15 Hours)</b>		
Refrigeration terminology - Vapour compression refrigeration system and its performance - NH <sub>3</sub> - Water vapour absorption system. Heat transfer - Modes of heat transfer, Fourier's law of conduction, Newton's law of cooling, Electrical analogy of conduction and convective heat transfer through a plane and composite wall, Stefan Boltzmann law. Introduction to computational fluid dynamics (CFD). <b>(15 Hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	R. K. Bansal, A Textbook of Fluid Mechanics and hydraulic machines, Laxmi Publications, Revised 10 <sup>th</sup> edition, 2019.	
2	Nag P.K, Engineering Thermodynamics, Tata McGraw Hill, 6 <sup>th</sup> edition, 2017.	
3	Mahesh M. Rathore, Thermal engineering, Tata McGraw Hill education pvt. Ltd, New Delhi, 2010.	
<b>Reference Books:</b>		
1	Yunus A. Cengel, John M. Cimbala, "Fluid Mechanics Fundamentals and Applications", McGraw Hill education (India) Private Limited, 4 <sup>th</sup> edition, 2018.	
2	Yunus A. Cengel, Michael A. Boles, Thermodynamics: An engineering approach, McGraw	

Hill education India pvt. Ltd. 9 <sup>th</sup> edition, 2019.	
<b>Web References:</b>	
1	nptel.ac.in/courses/112105128/ Refrigeration And Air Conditioning
2	nptel.ac.in/courses/105101082/ Fluid Mechanics
<b>Lab Components:</b>	
<b>Course Objectives:</b>	
4. To understand the properties of the fluid and appreciate the complexities involved in solving the fluid flow problems.	
5. To understand the laws and principles of thermodynamics and heat transfer.	
6. To evaluate the performance of refrigeration and air conditioning system.	
<b>Course outcomes:</b>	
<b>Upon completion of the course, students shall have ability to</b>	
C304.5	Illustrate the working of thermo fluid components. [U]
C304.6	Analyze various flow problems and fluid characteristics. [A]
C304.7	Estimate the performance of various thermal engineering systems. [E]
C304.8	Develop practical heat transfer system like heat exchangers and composite walls. [AP]
<b>List of lab experiments:</b>	
1. Orifice meter (Including co efficient of discharge, verify Bernoulli's theorem, simple problems).	
2. Venturimeter (Including co efficient of discharge, verify Bernoulli's theorem, simple problems).	
3. Calculate the flow of water using Rotameter.	
4. Make a set of pipes and calculate the friction factor.	
5. Performance test on 4 stroke twin cylinder diesel engine with electric dynamometer.	
6. Study about air compressor theoretically and do a performance test (compare the theoretical and practical results).	
7. Study about refrigerator theoretically and do a performance test (compare the theoretical and practical results).	
8. Study about air conditioner theoretically and do a performance test (compare the theoretical and practical results).	
9. Make a composite wall with two or more different materials and perform a heat conduction (Tabulate the result for different material composition).	
10. Parallel flow and counter flow heat exchangers – Comparison.	
<b>Total hours:</b>	
<b>45</b>	

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>		
Remember	20	20	10	-	10
Understand	30	20	20	20	20
Apply	-	60	30	40	30
Analyse	50	-	40	20	40
Evaluate	-	-	-	20	-
Create	-	-	-	-	-

	PO 1	PO 2	PO 3	PO 4	P O5	PO 6	P O7	PO 8	PO 9	PO 10	P O1 1	P O1 2	PSO 1	PSO 2
<b>C304.1</b>	3	3	3	3	2	3	2					2	3	3
<b>C304.2</b>	3	3	3	3	2	3	2						3	3
<b>C304.3</b>	3	3	3	3		3		3				2		3
<b>C304.4</b>	3	3	3		2			3						3
<b>C304.5</b>	3	3	3	3		3	2	3	2				3	3
<b>C304.6</b>	3	3	3	3		3		3	2				3	3
<b>C304.7</b>	3	3	3	3		3	2	3	2				3	3
<b>C304.8</b>	3	3	3	3		3		3	2				3	3

20IT101	<b>PYTHON PROGRAMMING (COMMON TO CSE / IT / ECE / EEE / MCT)</b>		3/0/2/4
<b>Nature of Course</b>	F (Theory Programming)		
<b>Pre requisites</b>	Nil		
<b>Course Objectives:</b>			
1.	To understand and execute Python script using types and expressions.		
2.	To understand the difference between expressions & statements and to understand the concept of assignment semantics.		
3.	To utilize high level data types such as lists and dictionaries.		
4.	To import and utilize a module and to perform read & write operations on files.		
<b>Course Outcomes</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C101.1	Recognize the general principles and good Algorithmic Problem Solving		[R]
C101.2	Read, write, execute by hand simple Python programs.		[U]
C101.3	Structure simple Python programs for solving problems.		[U]
C101.4	Decompose a Python program into functions.		[AP]
C101.5	Represent compound data using Python lists, tuples and dictionaries.		[AP]
C101.6	Read and write data from / to files in Python Programs.		[AN]
<b>Course Contents:</b>			
<b>ALGORITHMIC PROBLEM SOLVING, DATA, EXPRESSIONS, STATEMENTS: 15 Hours</b>			
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). Illustrative Problems: Find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range. Python Interpreter and Interactive Mode; Values and Types: Int, Float, Boolean, String and List; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules and Functions, Function Definition and Use, Flow of Execution, Parameters and Arguments; Illustrative Programs: Exchange the values of two Variables, Circulate the values of n variables, distance between two points.			
<b>CONTROL FLOW, FUNCTIONS: 15 Hours</b>			
Conditionals: Boolean Values and Operators, Conditional (If), Alternative (If-Else), Chained Conditional (If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Sets -Set Operations, Classes. Illustrative Programs: Sum an array of numbers.			
<b>LISTS, FILES, MODULES, PACKAGES: 15 Hours</b>			
Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return Value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Files and Exception: Text Files, Reading and Writing Files, Format Operator; Command Line Arguments, Errors and			

Exceptions, Handling Exceptions, Modules, Packages; Numpy and Numpy Operations, Pandas and pandas operations, Matplotlib: types of plots. Case study: Analyze the academic performance of students and plot a graph.	
<b>Total Hours:</b>	
<b>45</b>	
<b>Laboratory Component:</b>	
<b>S. No</b>	<b>List of Experiments</b>
1.	Compute the GCD of two numbers.
2.	Find the square root of a number (Newton's method).
3.	Exponentiation (power of a number).
4.	Find the maximum of a list of numbers.
5.	Linear search and Binary search.
6.	Selection sort, Insertion sort.
7.	Merge sort.
8.	First n prime numbers.
9.	Multiply matrices.
10.	Programs that take command line arguments (word count).
11.	Plotting datasets.
12.	File handling and plotting.
<b>Total Hours:</b>	
<b>30</b>	
<b>Text Books:</b>	
1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2 <sup>nd</sup> Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 ( <a href="http://greenteapress.com/wp/think-python/">http://greenteapress.com/wp/think-python/</a> ).
2.	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3.	Tony Gaddis, "Starting out with Python", 2nd edition, Addison Wesley, Pearson, 2012
<b>Reference Books:</b>	
1.	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
2.	Timothy A. Budd, "Exploring PythonII", Mc-Graw Hill Education (India) Private Ltd., 2015.
3.	John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press, 2013.
<b>Web References:</b>	
1.	<a href="http://nptel.ac.in/courses/106106145/">http://nptel.ac.in/courses/106106145/</a>
2.	<a href="https://www.codecademy.com/learn/learn-python">https://www.codecademy.com/learn/learn-python</a>

3.	<a href="https://www.coursera.org/learn/python-data-analysis#syllabus">https://www.coursera.org/learn/python-data-analysis#syllabus</a>				
<b>Online Resources:</b>					
1.	<a href="https://www.programiz.com/python-programming">https://www.programiz.com/python-programming</a>				
2.	<a href="https://www.fullstackpython.com/best-python-resources">https://www.fullstackpython.com/best-python-resources</a>				
<b>Tentative Assessment Methods &amp; Levels (based on Revised Bloom's Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
Revised Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical Rubric based CIA [30 Marks]	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]		
Remember	30	30	20	-	20
Understand	40	30	30	30	30
Apply	30	40	50	70	50
Analyse					
Evaluate					
Create					

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.2	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.3	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.4	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.5	3	3	3	3	3	3	1	1			1	1	3	3	3
C101.6	3	3	3	3	3	3	1	1			1	1	3	3	3



# **SEMESTER-IV**



<b>20MT401</b>	<b>THEORY OF CONTROL SYSTEMS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Analytical		
<b>Pre Requisites</b> : 20MA301 Engineering Mathematics - III		
<b>Course Objectives:</b>		
1.	To impart the basic concepts of control systems components and its feedback control.	
2.	To Interpret various time domain and frequency domain tools for analysis and design of linear control systems.	
3.	To analyse the stability of systems using transfer function models.	
4.	To describe the methods of designing compensators using suitable techniques.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C401.1	Illustrate the basic components of control systems, mathematical modelling of systems and their representation techniques	[U]
C401.2	Demonstrate the various time domain and frequency domain tools for analysis.	[U]
C401.3	Identify the various techniques to determine the transfer function of a system and to design compensators	[AP]
C401.4	Analyse the stability of systems from transfer function models and by implementing heuristic controllers	[A]
C401.5	Evaluate the steady state error of various type and order of a system	[E]
<b>Course Contents:</b>		
Introduction and need for Control Systems- Open loop and closed loop systems–Poles and Zeros-Transfer Function Model –State Space Model –Mathematical Modelling of Mechanical, Electrical, Electrical analogous to mechanical systems –Block Diagram reduction –Signal flow graph. <b>(10 Hours)</b>		
Time domain analysis of Invariant systems: Types of test input -First and second order system response for step input-Time domain specifications, Error coefficients, Generalized error series, Steady state error, Effect of P, PI, PID controllers. Frequency response: Frequency domain specifications, Bode plots, Polar Plot, Case Study: Modeling simulation and control of Robotic Arm <b>(20 Hours)</b>		
Stability of systems: Characteristics equation, Location of roots in S plane for stability, Routh-Hurwitz, Root loci. Compensator design: Performance criteria – Lag, lead and lag-lead networks and Compensator design using bode plot, Introduction to Fuzzy logic controller <b>(15 Hours)</b>		
		<b>Total Hours: 45</b>
<b>Text Books:</b>		
1	I.J.Nagrath and M.Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2017	
2	D.SmarajitGhosh, Control Systems: Theory and Applications, Pearson Education, India, 2012.	
<b>Reference Books:</b>		
1	K.Ogata, “Modern Controls Engineering“, Prentice Hall of India Pvt. Ltd., New Delhi, 2015.	
2	M. Nakamura .S.Gata&N.Kyura, Mechatronic Servo System Control, Springer,2014.	
3	B.C. Kuo, “Automatic Control Systems”, Prentice Hall of India Pvt. Ltd., New Delhi, 2014.	

<b>Web References:</b>				
1	<a href="https://ocw.mit.edu/courses/">https://ocw.mit.edu/courses/</a>			
2	<a href="https://nptel.ac.in/courses/108101037">https://nptel.ac.in/courses/108101037</a>			
3	<a href="https://engrxiv.org/t8fsr/download">https://engrxiv.org/t8fsr/download</a>			
4	<a href="https://www.omega.co.uk/technical-learning/pid-fuzzy-logic-adaptive-control.html">https://www.omega.co.uk/technical-learning/pid-fuzzy-logic-adaptive-control.html</a>			
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
Course Outcome	Bloom's Level	Assessment Component	Marks	
C401.1	Understand	Surprise Test	5	
C401.2	Understand	Online Quiz	5	
C401.3	Apply	Assignment	3	
C401.4	Analyze	Test	5	
C401.5	Evaluate	Group Assignment	2	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	40	20	30	20
Understand	40	30	30	50
Apply	10	20	20	15
Analyze	10	30	20	15
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<b>C401.1</b>	3			2									3	3
<b>C401.2</b>		3	3	3									3	3
<b>C401.3</b>			3		3	3	3						2	2
<b>C401.4</b>		3	3	3					3				3	3
<b>C401.5</b>	2	3	2										2	2

20MA401	<b>PROBABILITY AND NUMERICAL METHODS MECH/MCT/CIVIL</b>	2/1/2/4
<b>Nature of Course</b>	J (Problem Analytical)	
<b>Pre requisites</b>	Concepts of Differentiation and Integration.	
<b>Course Objectives:</b>		
1.	To define the concept of probability and its features	
2.	To have a well – founded knowledge of standard distributions which can be used to describe real life phenomena	
3.	To learn the concept of testing hypothesis using statistical analysis	
4.	To study the concept of fitting a curve of best fit to the given numerical data and to calculate the deviation of the expected value from the observed value	
<b>Course Outcomes: (Theory)</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C401.1	Recall the concept of probability	[R]
C401.2	Understand to handle situations involving random variables and Standard distributions.	[U]
C401.3	Apply measures of central tendency to Analyze statistical data	[AP]
C401.4	Develop the inferences for engineering problems using testing of hypothesis.	[AP]
C401.5	Apply curve fitting to Fit a polynomial or special function curve for the given data.	[AP]
C401.6	Apply numerical methods to fit the polynomial.	[AP]
<b>Course Contents</b>		
<b>Module 1: Probability</b>		<b>15 Hrs</b>
Sample space, Axioms of Probability-Events-independent events-Conditional probability, Total Probability-Bayes Theorem (Statement only) – Simple Problems. One dimensional Random Variable-Probability mass function-Probability density function-Discrete random variable-Continuous Random Variable-Simple problems. Mathematical Expectations-Moments-Moment generating function-Properties-Standard distributions - Discrete distributions: Binomial – Poisson – Continuous distribution: Normal – Simple Problems.		
<b>Module 2: Statistics</b>		<b>15 Hrs</b>
Definition of Statistics-Applications-Data-Collection of Data: Internal and external data, Primary and secondary Data. Descriptive Statistics: Classification and tabulation of univariate data, Measures of central tendency: Mean, Median and Mode. Scatter diagram - correlation (Karl Pearson's)- Rank correlation (Spearman's)- Linear regression. Testing of Hypothesis-Small Samples-Student's t-Test for single mean, difference of mean-F test-Chi square test for goodness of fit and independence of attributes.		
<b>Module 3: Numerical Methods</b>		<b>15 Hrs</b>
Curve Fitting-Empirical laws -Linear law - Laws reducible to Linear law- Method of group averages - straight line and parabola -Principle of Least squares -Fitting straight line, parabola and exponential curve - Interpolation - Interpolation with equal intervals –Newton's Forward and Backward difference formula - Interpolation with unequal intervals –Newton's Divided difference formula – Lagrange's interpolation formula.		
		<b>Total Hrs</b>
		<b>45 Hrs</b>
<b>Course Outcomes: (Laboratory)</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C401.1	Analyze and interpret the distribution function for the given data.	[AP]
C401.2	Perform central tendency measures for the given data	[AP]
C401.3	Create 2D line plot for the given data.	[AP]
C401.4	Test the significance level of hypothesis	[AP]

C401.5	Estimate the correlation and regression between the given data.	[AP]
C401.6	Fit a polynomial for the given data by various interpolation formulas	[AP]

**Laboratory Component:**

S.No	List of Experiments	CO Mapping	RBT
1.	To fit a binomial distribution for the given data by using R programming.	C401.1	[AP]
2.	To fit a Poisson distribution for the given data by using R programming.	C401.1	[AP]
3.	To fit a normal distribution for the given data by using R programming.	C401.1	[AP]
4.	To find measures of central tendency for the given data by using R programming.	C401.2	[AP]
5.	To create 2D line plot for the given data by using R programming.	C401.3	[AP]
6.	Applying F test to test the significance difference between the variance of two samples by using R programming.	C401.4	[AP]
7.	Applying Chi Square test to test the goodness of fit for the given samples by using R programming.	C401.4	[AP]
8.	To find the correlation and regression between the given data by using R programming.	C401.5	[AP]
9.	To find regression between the given data by using R programming.	C401.5	[AP]
10.	To fit a straight line and parabola for the given data by using MATLAB.	C401.6	[AP]
11.	To fit a polynomial for the given data and finding the unknown by Lagrange's interpolation formula by using MATLAB.	C401.6	[AP]
12.	To fit a polynomial for the given data by Newton's forward and backward formula by using MATLAB.	C401.6	[AP]

**Text Books:**

1.	Peebles Jr. P.Z., —Probability Random Variables and Random Signal Principles, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2016
2.	Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, 12th edition , 2020
3.	Grewal B.S., Numerical methods in Engineering and Science. 12th edition, Stylus Publishing, 2018.

**Reference Books:**

1.	Ross, S, "A First Course in Probability, Ninth edition", Pearson Education, Delhi, 2018.
2.	Richard A. Johnson, Irwin Miller, John Freund, Miller & Freund's, "Probability and Statistics for Engineers", Ninth edition, 2016.
3.	Steven Chapra, "Applied Numerical Methods with MATLAB for engineers and scientists", 4 <sup>th</sup> edition, 2017.
4.	Holly Moore, "MATLAB for Engineers" Fifth Edition – Pearson Publications, 2018.

<b>Web References:</b>																
1.	<a href="http://nptel.ac.in/courses/111104079/">http://nptel.ac.in/courses/111104079/</a>															
2.	<a href="http://www.nptelvideos.in/2012/12/probability-random-variables.html">http://www.nptelvideos.in/2012/12/probability-random-variables.html</a>															
3.	<a href="http://freevideolectures.com/Course/2311/Digital-Communication/4">http://freevideolectures.com/Course/2311/Digital-Communication/4</a>															
<b>Online Resources:</b>																
1.	<a href="https://www.coursera.org/learn/probability-intro">https://www.coursera.org/learn/probability-intro</a>															
2.	<a href="https://www.coursera.org/lecture/wharton-introduction-spreadsheets-models/3-1-random-variables-and-probability-distributions-Y3bCF">https://www.coursera.org/lecture/wharton-introduction-spreadsheets-models/3-1-random-variables-and-probability-distributions-Y3bCF</a>															
3.	<a href="https://www.codewithc.com/newtons-interpolation-in-matlab/">https://www.codewithc.com/newtons-interpolation-in-matlab/</a>															
<b>Tentative Assessment Methods &amp; Levels (based on Revised Bloom's Taxonomy)</b>																
<b>Summative assessment based on Continuous and End Semester Examination</b>																
Revised Bloom's Level	Continuous Assessment												End Semester Examination (Theory) [40 marks]			
	Theory															
	CIA – I [10 Marks]	CIA – II [10 Marks]	CIA – III [10 Marks]			Practical Rubric based CIA [30 Marks]										
Remember	20	20	20			20			20							
Understand	30	30	30			30			30							
Apply	50	50	50			50			50							
Analyse	-	-	-			-			-							
Evaluate	-	-	-			-			-							
Create	-	-	-			-			-							
<b>Course Articulation Matrix (Theory)</b>																
C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3	
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-	
2	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-	
3	3	3	-	-	-	-	-	-	-	-	-	-		-	-	
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	
5	3	3	-	-	-	-	-	-	-	-	-	-		-	-	
6	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	
<b>Av g</b>	<b>2.5</b>	<b>2.5</b>	-	-	-	-	-	-	-	-	-	-	<b>0.6</b>	-	-	
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed					
<b>Course Articulation Matrix (Laboratory)</b>																
C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3	
1	1	1	-	-	3	-	-	-	-	-	-	-	1	-	-	
2	2	2	-	-	3	-	-	-	-	-	-	-	1	-	-	
3	3	3	-	-	3	-	-	-	-	-	-	-		-	-	
4	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-	
5	3	3	-	-	3	-	-	-	-	-	-	-		-	-	
6	3	3	-	-	3	-	-	-	-	-	-	-	1	-	-	
<b>Av g</b>	<b>2.5</b>	<b>2.5</b>	-	-	<b>3</b>	-	-	-	-	-	-	-	<b>0.6</b>	-	-	
1	Reasonably agreed				2	Moderately agreed				3	Strongly agreed					

<b>20MT402</b>	<b>THEORY OF MACHINES</b>	<b>3/0/3/4.5</b>
<b>Nature of Course:</b> Analytical		
<b>Pre requisites:</b> 20MT201 Applied Mechanics		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>To develop competency in understanding of theory of all types of mechanisms</li> <li>To understand the analysis of kinematics, force analysis, balancing and vibration</li> <li>To make the student conversant with friction drives and mechanism for control</li> <li>To develop competency in drawing the cam profile for its follower motion.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C402.1	Classify all types of mechanism and their concepts	[U]
C402.2	Apply kinematics to draw the velocity and acceleration diagrams	[AP]
C402.3	Analyze the friction drives, vibration and working principle of mechanisms for control	[A]
C402.4	Construct the cam profile and evaluate the dynamic force in engine components	[C]
<b>Course Contents:</b>		
<p>Mechanism Terminology - Kinematic Diagrams – Mobility- Kutzbach criterion- Grashof's law - Kinematic Inversions of four bar and slider crank chains - pantograph, Watt straight line mechanism, toggle mechanism, Ackermann steering gear – Geneva mechanism. Velocity and acceleration analysis of four bar and slider crank mechanism using relative velocity method – Concepts of Coriolis Acceleration. <b>(15 hours)</b></p> <p>Cam- Displacement diagrams- Parabolic, Uniform and Simple harmonic motion- Layout of plate cam profiles (Inline and offset of knife edge follower only) Gears – types; terminology; and epicyclic spur gear trains. D' Alembert's principle - Force analysis in Reciprocating engines (Analytical method) - Turning moment diagrams and Fly wheels in engines. <b>(15 hours)</b></p> <p>Static and dynamic balancing - Balancing of several masses in different planes - Vibration- Free damped vibration- logarithmic decrement - Dunkerley's method and critical speed of shafts – Types of brakes - Band and block brake – Tension and power transmission in Flat belts - Gyroscopic effect on Naval ships. Basics of MEMS VSG gyros <b>(15 hours)</b></p>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	S.S.Rattan, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 5 <sup>th</sup> Edition, 2019.	
2	David H. Myszka, "Machines & Mechanisms: Applied Kinematic Analysis", Pearson Prentice Hall, 4 <sup>th</sup> Edition, 2012.	
<b>Reference Books:</b>		
1	L. Robert Norton, "Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines" McGraw-Hill, 6 <sup>th</sup> Edition, 2020.	
2	J.E.Shigley and J.J.Uicker, "Theory of Machines and Mechanisms", Oxford University Press India, 4 <sup>th</sup> Edition, 2014	
<b>Web Resources:</b>		
1	<a href="https://nptel.ac.in/courses/112/106/112106270/">https://nptel.ac.in/courses/112/106/112106270/</a>	
2	<a href="https://nptel.ac.in/courses/112/105/112105268/">https://nptel.ac.in/courses/112/105/112105268/</a>	
3	<a href="https://www.siliconsensing.com/technology/mems-gyroscopes/">https://www.siliconsensing.com/technology/mems-gyroscopes/</a>	

<b>Lab Components:</b>					
<b>Course Objectives:</b>					
5. To develop competency in understanding of theory of all types of mechanisms					
6. To understand and analyze the kinematics, force analysis and balancing.					
<b>Course outcomes:</b>					
<b>Upon completion of the course, students shall have ability to</b>					
C402.5	Examine the working of universal Governors and balancing of vibrating systems.				[AP]
C402.6	Determine the moment of inertia and natural frequency of various vibrating equipment.				[A]
C402.7	Create and analyze various mechanisms.				[C]
<b>List of lab experiments:</b>					
1. Measure and Comment on mechanical advantage, Transmission angle, joints and type of given mechanisms.					
2. Fabricate a four bar mechanism.					
3. Compare the characteristics for Watt and Proell governors.					
4. Determination of critical speeds of shaft and analyze it.					
5. Balancing of reciprocating masses and interprets the unknown mass.					
6. Balance the given rotating masses and apply it to balance the cycle wheel.					
7. Determination of mass moment of inertia of the disc using Motorised Gyroscope.					
8. Determine the mass moment of inertia of the object using compound pendulum setup experimentally. Verify the answer theoretically.					
9. Determination of mass moment of inertia of flywheel axle system.					
10. Determination of transverse frequency of beam and compare it theoretically.					
11. Determination of natural frequency of given spring mass system in free longitudinal vibrations.					
12. Tension, Impact and hardness test on Mild Steel, Copper and Brass.					
Note:- At the end of semester, students should submit the working model of various mechanisms					
<b>Total hours:</b>					<b>45</b>
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	10	10	-	10
Understand	20	20	20	20	20
Apply	20	20	20	20	20
Analyse	20	20	20	20	20
Evaluate	20	10	30	20	10
Create	-	20	-	20	20

	PO 1	PO 2	PO 3	PO 4	P O5	PO 6	P O7	PO 8	PO 9	PO 10	P O1 1	P O1 2	PSO 1	PSO 2
<b>C402.1</b>	3	3	3	3	2	3	2					2	3	3
<b>C402.2</b>	3	3	3	3	2	3	2						3	3
<b>C402.3</b>	3	3	3	3		3		3				2		3
<b>C402.4</b>	3	3	3		2			3						3
<b>C402.5</b>	3	3	3	3		3	2	3	2				3	3
<b>C402.6</b>	3	3	3	3		3		3	2				3	3
<b>C402.7</b>	3	3	3	3		3	2	3	2				3	3
<b>C402.8</b>	3	3	3	3		3		3	2				3	3

<b>20MT403</b>	<b>MICROCONTROLLER AND ITS APPLICATIONS</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : 20MT301 Electrical and Electronic Devices		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To introduce AVR Microcontroller and ATMEGA328.</li> <li>2. To impart the concepts and MSP430 and PIC Microcontroller.</li> <li>3. To familiarize ARM Processor.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C403.1	Interpret the architecture of microcontrollers.	[U]
C403.2	Identify the functional blocks of MSP430 and PIC Microcontroller.	[AP]
C403.3	Utilize the features of ARM processor.	[AP]
C403.4	Examine the suitability of microcontrollers for specific applications	[A]
<b>Course Contents:</b>		
<p>Introduction to Microcontroller - Essential Component of a Microcontroller - AVR: Architecture, General Purpose and Status Register, Data Memory - Structure of Assembly Language and Assembling an AVR Program, Arithmetic and logical Instructions, Branch and call Instructions, Low power AVR Microcontroller (ATMEGA328) architecture, Interfacing with stepper motor. <b>(15 hours)</b></p> <p>MSP430 Microcontroller: Functional block diagram - Central Processing Unit – Addressing modes – Instruction set - Timer: Watch dog timer, Basic Timer1, Timer A - Low-Power Modes of Operation – Architecture of PIC18 series PIC182420. <b>(15 hours)</b></p> <p>ARM Architecture: ARM programmers’ model, Data processing instructions, Data transfer instructions, Control flow instructions, 3 and 5 stage pipeline, Thumb Programmers’ Model, Thumb Instruction Set, IoT based smart security system. <b>(15 hours)</b></p>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1.	Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, “AVR Microcontroller and Embedded Systems Using Assembly and C”, Pearson Edition, 2013.	
2.	John H Devis, “MSP430 Microcontroller Basics” Elsevier Science & Technology, 2015.	
3.	Steve Furber, “ARM system-on-chip architecture”, Pearson Edition, 2016.	
<b>Reference Books:</b>		
1.	Microchip, megaAVR Data Sheet.	
2.	Tim Wilmshurst, “Designing Embedded Systems with PIC Microcontrollers Principles and Applications”, Elsevier Science, 2010.	
3.	Cortex-M4 Devices, Generic User Guide by ARM.	
<b>Web References:</b>		
1.	<a href="https://circuitdigest.com/microcontroller-projects/getting-started-with-msp430-using-code-composer-studio">https://circuitdigest.com/microcontroller-projects/getting-started-with-msp430-using-code-composer-studio</a>	
2.	<a href="https://nptel.ac.in/courses/117104072/#">https://nptel.ac.in/courses/117104072/#</a>	
3.	<a href="https://www.instructables.com/id/IOT-Based-Surveillance-Camera-Raspberry-Pi-Pan-Til/">https://www.instructables.com/id/IOT-Based-Surveillance-Camera-Raspberry-Pi-Pan-Til/</a>	
<b>Lab Components:</b>		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>4. To provide the practical understanding on the programming concept of microcontrollers.</li> <li>5. To experiment with the interfacing of hardware units with microcontrollers.</li> </ol>		
<b>Course outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		

C403.5	Experiment with microcontrollers.	[A]
C403.6	Apply the instruction set and programming concepts of microcontroller by executing simple examples.	[AP]
C403.7	Apply the programming concepts for interfacing hardware units.	[AP]
C403.8	Create applications using AVR, PIC Microcontrollers and ARM Processor.	[C]

**List of lab experiments:**

1. Programming for LED blinking using practical AVR microcontroller.
2. Interfacing stepper motor with practical AVR microcontroller.
3. Interfacing sensor with practical AVR microcontroller.
4. Establishing serial communication with practical AVR microcontroller
5. Basic programming in MSP430 Microcontroller.
6. Interfacing Programming with MSP430 Microcontroller.
7. Basic programming in PIC microcontroller.
8. Interfacing Programming with PIC Microcontroller.
9. Programming for LED blinking using ARM
10. Establishing serial communication with ARM.

**Total hours: 45**

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	10	10	10	-	10
Understand	40	40	40	-	40
Apply	30	30	20	50	30
Analyze	20	20	30	25	20
Evaluate	-	-	-	-	-
Create	-	-	-	25	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<b>C403.1</b>	3	2	2	2	3								3	3
<b>C403.2</b>	3	2	2	2	3								3	3
<b>C403.3</b>	3	3	3	2	3	2							3	3
<b>C403.4</b>	3	3	3	2	3	2							3	3
<b>C403.5</b>					3				3	2			3	3
<b>C403.6</b>					3				3	2			3	3
<b>C403.7</b>					3				3	2			3	3
<b>C403.8</b>					3				3				3	3

<b>20MT404</b>	<b>INDUSTRIAL FIELD TRAINING</b>	<b>0/0/2/1</b>
----------------	----------------------------------	----------------

### SOP for Industrial Field Training

1. A minimum of 15 days in-plant training has to be undergone by the student in the third semester vacation.
2. Students have to undergo practical training in Mechatronics engineering related industry/ project site or design / planning office so that they become aware of the practical application of theoretical concepts studied in the class rooms.
3. The student has to decide the company and period of training in the mid of third semester. The information of the company has to be intimated to their respective tutors.
4. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.
5. The report should contain the details of the Company layout, organizational structure, work flow, etc. At the end of the training student will submit a report as per the prescribed format to the department.
6. A certificate from company stating that the student has undergone the training successfully, has to be produced after the training.

<b>Assessment Components</b>		
<b>S.No.</b>	<b>Category</b>	<b>Marks</b>
1	Fixing Industry	<b>10</b>
2	Certificate from Industry	<b>10</b>
3	Power point Presentation	<b>40</b>
4	Report Submission	<b>40</b>
<b>Total</b>		<b>100</b>



# SEMESTER-V



<b>20MT501</b>	<b>MACHINE DESIGN</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Analytical		
<b>Pre requisites</b> : 20MT302 Strength of Solids		
<b>Course Objectives:</b>		
1	To formulate and analyze stresses and strains in machine elements and structures subjected to various loads.	
2	To design and analyze various joints, power transmission shafts carrying various elements with geometrical features.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C501.1	Interpret the failure modes of various mechanical parts.	[U]
C501.2	Find the stress developed in welded, threaded joints and power screws.	[U]
C501.3	Analyze the stress developed in various mechanical elements.	[A]
C501.4	Design and dimension the various mechanical power transmission elements.	[Ap]
Design Process and Procedure - Stresses - Static, residual - Factors of safety - Theories of failure – Stress concentration factors - Goodman, Soderberg equations - Limits, Fits and Tolerances- Design of axially loaded Transverse and Parallel fillet welded joints – Design of axial loaded threaded joints – Design of screw jack. <b>(15 hours)</b>		
Design of Solid and Hollow shafts based on strength – Design of flanged coupling and Bushed pin coupling - Design of Journal Bearings – selection of Deep groove ball bearings - Design of helical and leaf springs - Design and selection of V belts and pulleys. <b>(15 hours)</b>		
Design and selection of roller chains and sprockets - Component design of spur, helical, bevel and worm gears based on wear strength. Ball screw selection and calculation for CNC Lathe feed drives (Qualitative treatment only) <b>(15 hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill education, 4 <sup>th</sup> edition 2016.	
2	Joseph Edward Shigley and Charles R.Mischke, “Mechanical Engineering Design”, tenth edition, McGraw-Hill International Edition, 2016.	
<b>Reference Books:</b>		
1	Robert L Norton, "Machine Design - An Integrated Approach, Pearson Education", , New Delhi, 2013.	
2	Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, fifth Edition, Wiley, 2015.	
<b>Web References:</b>		
1	<a href="http://www.mech.utah.edu/~me7960/lectures/Topic4-BallscrewCalculations.pdf">www.mech.utah.edu/~me7960/lectures/Topic4-BallscrewCalculations.pdf</a>	
2	<a href="https://nptel.ac.in/courses/112/105/112105124/">https://nptel.ac.in/courses/112/105/112105124/</a>	
3	<a href="https://www.coursera.org/learn/machine-design1">https://www.coursera.org/learn/machine-design1</a>	

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C501.1	Understand	Online Quiz	5	
C501.2	Understand	Test	5	
C501.3	Analyze	Group Assignment	5	
C501.4	Apply	Time line component reengineering	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	20	10	20	20
Understand	30	40	30	30
Apply	30	30	20	20
Analyse	20	20	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcomes</b>	<b>Program Outcomes/ Program Specific Outcomes</b>													
	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
C501.1	3	3	3	3	0	3	0	0	0	3	3	3	3	3
C501.2	3	3	0	3	3	3	3	0	0	0	3	3	3	3
C501.3	3	3	3	3	3	0	0	0	0	3	3	3	3	3
C501.4	3	3	3	3	3	3	3	0	0	3	3	3	3	3

<b>20MT502</b>	<b>EMBEDDED SYSTEM FOR MECHATRONICS</b>		<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory			
<b>Pre Requisites</b> : 20MT402 Microcontroller and its applications			
<b>Course Objectives:</b>			
1	To understand the basic concept of Embedded system.		
2	To know about the working principles of buses and devices for Embedded networking.		
3	To study the concept of Real time operating systems.		
4	To explain the Real Time operating system tools and its applications.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C502.1	Define the Embedded system hardware and its software		[R]
C502.2	Explain Devices and Buses used in Embedded networking		[U]
C502.3	Apply task synchronization using Inter Process communication		[AP]
C502.4	Utilize Embedded System development process		[AP]
<b>Course Contents:</b>			
Introduction to embedded systems, Hardware and software in a system, Structural Units of advanced processor, Components of ARM processor, Selection of Processors, System on Chip- I/O Devices, Timer and counting devices, Watchdog timer, Serial Communication Buses: USB, I <sup>2</sup> C, CAN Bus. <b>(15 hours)</b>			
Review of software programming in Assembly Language, Introduction to Embedded Programming in C: Header, Source Files, Preprocessor Directives, Macros, Functions, Data types, Queue, Stacks, Loops, Pointers - Processes, Tasks and Task scheduler, Task synchronization using Inter Process communication, Priority inversion, Embedded software development Life cycle. <b>(15 Hours)</b>			
Real time operating systems: MicroC/OS-II, VxWorks, Embedded system Development process, Embedded system Project Management, Case study: Embedded system for an Adaptive Cruise Control Systems in a Car, Embedded system in ATM Machine, Automatic Washing Machine. <b>(15 Hours)</b>			
<b>Total hours:</b>			<b>45</b>
<b>Text Books:</b>			
1	Rajkamal, "Embedded Systems Architecture, Programming and Design", TATA McGraw-Hill, Third Edition, 2017.		
2	Marilyn Wolf, "Computers as Components: Principles of Embedded Computer Systems Design, Elsevier Publications, Fourth Edition, 2017		
<b>Reference Books:</b>			
1	David E Simon, —An Embedded Software Primerll, Pearson Education India, New Delhi, 2013.		
2	K.V.K.K.Prasad "Embedded/Real-Time Systems: Concepts, Design and Programming", Dream tech, Wiley, 2013		
<b>Web References:</b>			
1	<a href="https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/">https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/</a>		
2	<a href="https://nptel.ac.in/courses/108/102/108102045/">https://nptel.ac.in/courses/108/102/108102045/</a>		

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C502.1	Remember	Test (Definition)	5	
C502.2	Understand	Online Quiz	5	
C502.3	Apply	Case Study	5	
C502.4	Apply	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	30	25	20	20
Understand	40	35	40	30
Apply	30	40	40	50
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Program Outcomes (PO)</b>												<b>Program specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>
C502.1	3		3		3						2		3	3
C502.2	3	3	3	3	3			3	3				3	3
C502.3	3	3	3	3	3								3	3
C502.4	3	3	3	3	3			3	3		2		3	3

20MT503	FLUID POWER SYSTEMS		3/0/3/4.5
<b>Nature of Course</b> : Theory			
<b>Pre requisites</b> : Nil			
<b>Course Objectives:</b>			
<ol style="list-style-type: none"> <li>1. To understand the concepts of fluid power.</li> <li>2. To explain the operation of different Hydraulic and Pneumatic components.</li> <li>3. To develop the design of Hydraulic and Pneumatic circuits applied in industries</li> </ol>			
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C503.1	Select appropriate symbols used for hydraulic and pneumatic systems.	[U]	
C503.2	Explain the construction and working of hydraulic and pneumatic components.	[R]	
C503.3	Apply the different pneumatic and hydraulic actuating techniques	[AP]	
C503.4	Build simple pneumatic and hydraulic circuits.	[AP]	
<b>Course Contents:</b>			
<b>Course Contents:</b>			
<p>Introduction to fluid power –Applications, Advantages, Disadvantages – Pascal’s Law – Properties of hydraulic fluid - Hydraulic Pumps – Classification and Performance- Symbols of hydraulic components – Hydraulic motors – types – Hydrostatic transmissions – Hydraulic Cylinders– Cushioning mechanism –Cylinder design - Control valves – Servo valves – Introduction to digital hydraulics <b>(15 hours)</b></p> <p>Accumulators – Intensifiers – Hydraulic power pack - Industrial Circuits: Deceleration circuit, Regenerative circuits, Speed control circuits, Sequencing circuits, Synchronizing circuits, Fail-safe circuits – Pneumatics: Air Compressor – Filter – Pressure regulator – Lubricator – Muffler – Air control valves - Actuators – Symbols of Pneumatic components <b>(15 hours)</b></p> <p>Principle of Vacuum – Vacuum systems - Pneumatic circuits – Cascade – Step counter method - Introduction to Electro Hydraulic &amp; Pneumatics – PLC applications in fluid power control – Ladder Diagram - Electro pneumatic and hydraulic circuits – Applications of Fluid power – Tipper - Excavators – Pick and Place robot – Braking system in automobiles – Hydraulic sugarcane harvesting machine <b>(15 hours)</b></p>			
			<b>Total hours: 45</b>
<b>Text Books:</b>			
1	Anthony Esposito, “Fluid Power with Applications”, Pearson Education, South Asia, 2014		
2	Srinivasan.R, “Hydraulic and Pneumatic controls”, McGraw –Hill education Pvt. Ltd, vijay Nicole, 2014		
<b>Reference Books:</b>			
1	S.R.Majumdar, “Pneumatic System Principle and Maintenance” Tata McGraw-hill. New Delhi,2017		
2	J.Michael, Pinches and G.John Ashby, “Power Hydraulics”, Prentice Hall, New Delhi,2018		
3	Majumdar S.R., “Oil Hydraulic systems Principle &Maintanance”, Tata McGraw-Hill, 2017		
<b>Web References:</b>			
1	<a href="http://nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf">http://nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf</a>		
2	<a href="https://www.schmalz.com/en/vacuum-knowledge/basic-knowledge/operating-principles-of-vacuum-generation/">https://www.schmalz.com/en/vacuum-knowledge/basic-knowledge/operating-principles-of-vacuum-generation/</a>		
3	<a href="https://www.hydraulicspneumatics.com/applications/agricultural/article/21882741/tough">https://www.hydraulicspneumatics.com/applications/agricultural/article/21882741/tough</a>		

	-sugar-cane-surrenders-to-tougher-hydraulic-harvester				
<b>Online Resources:</b>					
1	<a href="https://www.coursera.org/learn/fluid-power?">https://www.coursera.org/learn/fluid-power?</a>				
2	<a href="https://www.udemy.com/course/hydraulic-systems--english/">https://www.udemy.com/course/hydraulic-systems--english/</a>				
3	<a href="https://www.udemy.com/course/industrial-pneumatics-basics/">https://www.udemy.com/course/industrial-pneumatics-basics/</a>				
<b>Lab Components:</b>					
<b>Course Objectives:</b>					
4. To design and test Hydraulic and Pneumatic circuits					
5. To simulate circuits using FluidSim (Pneumatics & Hydraulics) and Automation Studio					
6. To actuate circuits using hydraulic and pneumatic components					
<b>Course outcomes:</b>					
<b>Upon completion of the course, students shall have ability to</b>					
C503.5	Identify and explain hydraulic and Pneumatic components and their symbols				[U]
C503.6	Explain the basic Hydraulic and Pneumatic circuits				[U]
C503.7	Build Hydraulic and Pneumatic circuits				[AP]
<b>List of lab experiments:</b>					
1. Study of pneumatic and hydraulic components					
2. Simulation and actuation of hydraulic linear & rotary actuator					
3. Simulation and actuation of speed control in hydraulic actuator					
4. Simulation and actuation of an accumulator circuit					
5. Simulation and actuation of counter balancing circuit					
6. Simulation and actuation of regenerative circuit					
7. Simulation and actuation of single and double acting pneumatic cylinder, parallel and series circuit					
8. Simulation and actuation of pneumatic logical circuits using Shuttle valve & two pressure valve					
9. Simulation and actuation of metering in and metering out pneumatic circuit					
10. Simulation and actuation of sequential pneumatic circuit (2 & 3 cylinder circuit)					
11. Simulation and actuation of pneumatic circuit using cascading method (2 & 3 cylinder circuit )					
12. Simulation and actuation of electro pneumatic circuits					
<b>Total hours:</b>					<b>45</b>
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
<b>Bloom's Level</b>	<b>Continuous Assessment</b>				<b>End Semester Examination (Theory) [40 marks]</b>
	<b>Theory</b>			<b>Practical</b>	
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>	<b>Rubric based CIA [30 Marks]</b>	
Remember	50	30	30	30	30
Understand	50	50	40	30	50
Apply	-	20	30	40	20
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes	Program Outcomes/ Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C503.1	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C503.2	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C503.3	3	3	3	3	3	3	3	0	0	0	0	0	3	0
C503.4	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C503.5	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C503.6	3	3	3	3	3	3	0	0	0	0	0	0	3	3
C503.7	3	3	3	3	3	3	3	0	0	0	0	0	3	3

<b>20MT504</b>	<b>POWER ELECTRONICS AND ELECTRICAL DRIVES</b>	<b>3/0/3/4.5</b>
<b>Nature of Course :</b> Theory		
<b>Pre requisites</b> :20MT301 Electrical and Electronic Devices 20MT303 Electrical Machines and Power Systems		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To learn the principles of operation, characteristics and applications of power semiconductor devices.</li> <li>2. To know the purpose and methods of protection, and triggering circuits for thyristors.</li> <li>3. To understand the principles of operation of basic power electronic converters.</li> <li>4. To understand the basics of electrical drives.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C504.1	Compare the characteristics of power semi-conductor devices and the working principles of various power converters.	[U]
C504.2	Inspect power electronic converters to verify their proper functioning.	[A]
C504.3	Choose appropriate power converter circuits and electrical drives through their acquired knowledge.	[AP]
C504.4	Develop power converters and electrical drives for various applications	[AP]
<b>Course Contents:</b>		
<p>Characteristics of Power Diode, Thyristor, Triac, MOSFET -Thyristor Protection, Single-phase diode rectifier- Phase Controlled Rectifiers (single-phase), Dual Converters (single-phase),Case study: Single phase rectifier in traction application. <b>(15 Hours)</b></p> <p>Principle of DC-to-DC Converter operation (chopper operation), Control Strategies, Step-up Choppers, Step down choppers, Types of Chopper Circuits, Inverters- Three Phase Bridge Inverters, Pulse-width Modulated Inverters, Battery Management System, AC Voltage Controllers- Single-Phase Voltage Controller with RL Loads, AC Voltage Controllers in industrial heating. <b>(15 Hours)</b></p> <p>Electrical Drives- Advantages and parts, Choice of Electrical drives, status of AC and DC drives, types of drive, Classes of duty, Closed-Loop (current-limit, torque and speed) Control of Drives, Switched Reluctance Motor Drives - Position Sensing System for Switched Reluctance Motor Control, Stepper Motor Drives, Servo Motor Drives, Variable Frequency Drives. <b>(15 Hours)</b></p>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	P.S. Bimbhra, "Power Electronics", Khanna Publishers, 6 <sup>th</sup> Edition, 2018	
2	Dubey.G.K., "Fundamentals of Electrical Drives", Narosa publishing house, 2 <sup>nd</sup> edition, 2010.	
<b>Reference Books:</b>		
1	Muhammad H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson, 4 <sup>th</sup> Edition, 2014	
2	Austin Hughes, William Drury, "Electric Motors and Drives", Elsevier,4 <sup>th</sup> Edition, 2013	
<b>Web References:</b>		
1	<a href="https://nptel.ac.in/courses/108/101/108101126/">https://nptel.ac.in/courses/108/101/108101126/</a>	
2	<a href="https://www.coursera.org/learn/power-electronics">https://www.coursera.org/learn/power-electronics</a>	
<b>Lab Components:</b>		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>5. To experimentally learn and verify the characteristics of power semiconductor devices and circuits.</li> <li>6. To become familiar with MATLAB simulation and to simulate and various power converters.</li> </ol>		
<b>Course outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		

C504.5	Compare various power electronic converters.	[U]
C504.6	Examine the design aspects of power electronic converters for various applications	[AP]
C504.7	Analyze power electronic circuits using the Simulink tool of MATLAB software.	[A]
C504.8	Select power converters and electrical drives for various applications.	[A]

**List of lab experiments:**

1. Hardware implementation of Gate firing circuits for SCR.
2. Design a single-phase half-controlled converter and obtain the output voltage waveforms across R and RL loads.
3. Design a single-phase fully controlled converter and obtain the output voltage waveforms across R and RL loads.
4. Design a single-phase AC Voltage controller and obtain the output voltage waveforms across R and RL loads.
5. Analyse the operation of series inverter and parallel inverter.
6. Design step up and step down choppers, and compare their output voltages.
7. Analyse the performance of voltage and current commutated choppers.
8. Simulate speed control of converter fed DC motor in MATLAB software.
9. Simulate position control of converter fed Stepper Motor in MATLAB software.
10. Design and simulate the 180 degree/120 degree modes of three-phase inverter.

**Total hours: 45**

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	10	10	10	-	10
Understand	40	40	40	20	40
Apply	30	30	30	50	30
Analyze	20	20	20	30	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C504.1	3	3	3	0	0	3	0	3	0	0	0	3	3	3
C504.2	3	3	3	0	3	3	0	3	0	0	0	3	3	3
C503.3	3	3	3	2	3	0	0	3	0	0	0	3	3	3
C504.4	3	3	3	2	3	3	0	0	0	0	0	3	3	3
C504.5	3	3	3	2	3	3	1	3	2	0	0	3	3	3
C504.6	3	3	3	0	3	3	0	3	2	0	0	3	3	3
C504.7	3	3	3	0	3	3	0	3	2	0	0	3	3	3
C504.8	3	3	3	2	3	0	0	3	2	0	0	3	3	3



# **SEMESTER-VI**



<b>20MT601</b>	<b>VIRTUAL INSTRUMENTATION AND ITS APPLICATION</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To familiarize the basics of Virtual Instruments</li> <li>2. To implement basic programming concepts in LabVIEW</li> <li>3. To understand various interfacing buses</li> <li>4. To understand certain applications using LabVIEW</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C601.1	Explain basic concepts of Virtual Instruments.	[U]
C601.2	Develop and simulate systems using LabVIEW.	[AP]
C601.3	Examine suitable interfacing buses and acquire real time data	[A]
C601.4	Apply Virtual Instruments for various applications	[AP]
<b>Course Contents:</b>		
Introduction to Virtual Instrumentation - Block diagram of Virtual Instrumentation - Graphical and data flow programming, comparison with conventional programming - Introduction to LabVIEW – Programming concepts: Loops, arrays, Cluster, Plotting data, Structures, Strings and File IO. Introduction to myRIO. <b>(15 Hours)</b>		
DAQ Hardware and DAQ Assistant - Selecting and configuring a Data Acquisition device - RS232, RS422, RS485, GPIB, VISA. Firewire Interface Buses: PCI, PCI-Express, PXI, PCMCIA, VXI <b>(15 Hours)</b>		
Hardware in the Loop (HIL) – Image acquisition and processing- Motion control – LabVIEW based Robot Control System, Graphical system design application for Material handling system and Plastic Injection Molding System, Data logging and Supervisory control- Introduction to LabVIEW NXG Web Module-IoT Remote Monitoring and Control with LabVIEW <b>(15 Hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	Richard Jennings, “LabVIEW Graphical Programming” Fifth Edition, McGraw-Hill Education 2019.	
2	John Essick, “Hands-On Introduction to Labview for Scientists and Engineers” Oxford University Press 2018	
<b>Reference Books:</b>		
1	Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, “LabVIEW Advanced Programming Techniques”, Second Edition, CRC Press, 2017	
2	S. Sumathi and P. Surekha, “LabVIEW based Advanced Instrumentation Systems” Springer-Verlag Berlin Heidelberg, 2011.	
3	Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Private Limited, 2012.	
<b>Web References:</b>		
1	<a href="http://www.ni.com">http://www.ni.com</a>	
2	<a href="https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php">https://www.halvorsen.blog/documents/teaching/courses/labview_automation/labview_basic.php</a>	

<b>Lab Components:</b>					
<b>Course Objectives:</b>					
5. To provide practical knowledge and hands-on experience on basic concepts of LabVIEW programming					
6. To implement data acquisition and interfacing					
<b>Course outcomes:</b>					
<b>Upon completion of the course, students shall have the ability to</b>					
C601.5	Apply programming concepts in LabVIEW				[AP]
C601.6	Experiment with a program for real-time data acquisition				[AP]
C601.7	Inspect the function myDAQ for various applications				[A]
C601.8	Examine physical quantities using myDAQ				[A]
<b>List of lab experiments:</b>					
1. Programming exercises for performing arithmetic operations.					
2. Programming exercises for verification of half adder and full adder.					
3. Programming to find Addition of First n natural numbers using for and while loop					
4. Programming to implement user authentication					
5. Programming exercises on case and sequence structures, file Input / Output.					
6. Programming exercises on image processing tools and functions in IMAQ vision.					
7. Programming to develop voltmeter using DAQ					
8. Programming to control Traffic light using DAQ					
9. Programming for implementing half wave and full wave rectifier using DAQ					
10. Programming for implementing Seven Segment Display using DAQ.					
11. Programming for measurement of real-time physical parameters using DAC					
12. Arduino Based Data Acquisition System Using LabVIEW.					
<b>Total hours:</b>					<b>45</b>
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	10	20
Understand	40	30	20	30	30
Apply	40	30	40	40	30
Analyse	-	20	20	20	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
C601.1	3	2	2	2	2	2	3		2				2	2
C601.2	3	2	2	3	2	2	3		2				2	2
C601.3	3	3	3	3	2	3	2		3				2	
C601.4	3	3	3	2	3	3	3		3				2	2
C601.5	3	2	2	2	2	2	3		2				2	2
C601.6	3	2	2	3	2	2	3		2				2	2
C601.7	3	3	3	3	2	3	2		3				2	
C601.8	3	3	3	2	3	3	3		3				2	2

<b>20MT602</b>	<b>INDUSTRIAL AUTOMATION</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To understand the concept of Industrial Automation.</li> <li>2. To study about the hardware and programming software of PLC.</li> <li>3. To explain the control functions involved in DCS and SCADA.</li> <li>4. To give adequate information about the interfaces used in HMI.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C602.1	Relate the significance of control in automation.	[U]
C602.2	Choose the PLC peripherals and build ladder logic programming.	[AP]
C602.3	Summarize the working of various elements of DCS and SCADA.	[U]
C602.4	Identify and interpret the processes in HMI.	[AP]
<b>Course Contents:</b>		
<p>Overview of Industrial Automation – Types of Automation- Control Elements of Industrial Automation - PLC architecture- Parts of PLC- CPU - Memory-Input/output modules - Timers and Counters – Instruction set - selection of PLC based on input and output - PLC programming languages- Ladder logic –Wiring of PLC-Industrial Networking : Modbus – Profibus – Fieldbus – Ethernet <b>(15 hours)</b></p> <p>Distributed Control System (DCS) architecture, Database organization in DCS, System elements of DCS - Field station - Intermediate station - Central computer station, Reliability parameters of DCS - - Introduction, Architecture, Application areas of SCADA, Major elements of SCADA systems, Comparison of SCADA, DCS and PLC, Considerations and benefits of SCADA system - Real time systems in SCADA. Interfacing of SCADA with PLC and other field devices - Introduction to field-programmable gate array (FPGA) <b>(15 hours)</b></p> <p>Human Machine Interface (HMI) –Automation system structure, Instrumentation subsystem, control subsystem, Human interface subsystem-operator panel-construction of the panel-Interfacing with control sub system-Types of Mimic panels, Advance HMI system-Intelligent operator panel - Interfacing PLC to HMI - Cyber security in Industrial automation – Applied Automation : PLC in wind turbine control - DCS in cement plants - HMI in Material Transfer application <b>(15 hours)</b></p>		
<b>Total hours:</b>		<b>45</b>
<b>Text Books:</b>		
1	Jon Stenerson, “Industrial Automation and Process Control”, 4 <sup>th</sup> edition, Prentice Hall, 2018.	
2	Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 6 <sup>th</sup> edition, 2019.	
<b>Reference Books:</b>		
1	Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 4 <sup>th</sup> edition, 2016.	
2	Dobrivoje Popovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 5 <sup>th</sup> edition, 2017.	
3	Webb, John W, “Programmable Logic Controllers - Principles and applications”, PHI Publication, 5 <sup>th</sup> edition, 2016.	
<b>Web References:</b>		
1	<a href="https://nptel.ac.in/courses/108106022/8">https://nptel.ac.in/courses/108106022/8</a>	
2	<a href="https://instrumentationtools.blogspot.com/2019/03/plc-study-material.html">https://instrumentationtools.blogspot.com/2019/03/plc-study-material.html</a>	
3	<a href="https://examsdaily.in/dcs-study-materials">https://examsdaily.in/dcs-study-materials</a>	

<b>Lab Components:</b>					
<b>Course Objectives:</b>					
5. To analyze the input and output interfaces of the PLC system.					
6. To develop PLC programs using timer and counter instructions.					
7. To identify the HMI operations on an automation environment.					
<b>Course outcomes:</b>					
<b>Upon completion of the course, students shall have ability to</b>					
C602.5	Outline basic components of a PLC and describe their functions				[U]
C602.6	Develop the ladder logic programs for PLCs.				[AP]
C602.7	Analyze and debug programs.				[A]
C602.8	Interpret the processes in HMI.				[U]
<b>List of lab experiments:</b>					
1. To study the block diagram and input and output modules interfaces of Programmable Logic Controller.					
2. Introduction to ladder programming and to implement basic logic gates.					
3. Water level control with PLC programming.					
4. Water level control with HMI					
5. Temperature control with PLC programming.					
6. Temperature control with HMI					
7. Belt conveyor control with PLC programming.					
8. Belt conveyor control with HMI.					
9. Servomotor control for linear applications using PLC programming.					
10. Servomotor control for linear applications using HMI.					
11. Servomotor control for Rotary applications using PLC programming.					
12. Servomotor control for Rotary applications using HMI.					
13. Develop SCADA program for Temperature control application.					
14. Develop SCADA program for Water level control application					
<b>Total hours:</b>					<b>45</b>
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>					
<b>Summative assessment based on Continuous and End Semester Examination</b>					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	10	10	-	30
Understand	50	40	40	30	40
Apply	30	50	50	50	30
Analyse	-	-	-	20	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcomes	Program Outcomes/ Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C602.1	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.2	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.3	3	3	3	3	3	3	3	0	0	0	0	0	3	0
C602.4	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.5	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.6	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.7	3	3	3	3	3	3	3	0	0	0	0	0	3	3
C602.8	3	3	3	3	3	3	3	0	0	0	0	0	3	3

<b>20MT603</b>	<b>SENSORS, MEASUREMENTS AND INSTRUMENTATION</b>	<b>3/0/3/4.5</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>To understand the basic concepts of sensors and instrumentation.</li> <li>To select appropriate instruments for various applications</li> <li>To familiarize students in handling various types of sensors &amp; measuring instruments.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C603.1	Choose suitable sensors and instruments for specific applications.	[R]
C603.2	Outline the need of measurements and instruments for various processes	[U]
C603.3	Explain the working principle of different meters for measurements and instruments	[U]
C603.4	Apply different sensors and measuring instruments in various applications	[AP]
<b>Course Contents:</b>		
Sensors –Classification of sensors - Transducers - selection of transducers - Hall effect sensors – Tactile, Proximity, Capacitive, Inductive sensor - Fiber optic, Thermal sensors, Chemical, Semiconductor, Biological, Inertial Rotary Sensors, Magnetic, Radiation, Humidity and Moisture Sensors, MEMs, Nano Sensors, Strain gauges <b>(15 Hours)</b>		
Measurements and its Significance, Methods of Measurements, Classification of Instruments and application - Characteristics of instruments, Errors in instruments, Calibration and Standards - Vernier Caliper and Micrometer - Electronic Voltmeter and their advantages- Electronic multimeter and ohmmeter - Vibrometer and Accelerometer – Density Measurement - Surface Evaluation - Perthometer, atomic force microscopy. <b>(15 Hours)</b>		
Angular velocity Measurement: Tachometers, Tacho generators, Digital tachometers and Stroboscopic methods – Encoders, decoders and resolvers - Data acquisition systems - Units of pressure - Manometers - Different types - Elastic type pressure gauges - Bourdon tube bellows - Diaphragms - Electrical methods - Sensors involvement in Virtual Instrumentation- Measurement of vehicle speed with radar sensors - Application of sensors in IoT - Artificial sensor mimics human sense of touch. <b>(15 Hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	Jacob Fraden, “Handbook of Modern Sensors Physics, Designs, and Applications”, Fifth Edition, Springer International Publishing, 2015	
2	Doebelin E O, “Measurement Systems Application and Design”, Tata McGraw Hill, Sixth Edition, 2017	
<b>Reference Books:</b>		
1	Dr. R.S. Sedha, “Electronic Measurements and Instrumentation”, S. Chand & Company Pvt. Ltd, 2013.	
2	Bewoor, “Metrology & Measurement” (2009). India: Tata McGraw-Hill.	
3	A.K.Sawhney, “A Course in Mechanical Measurements and Instrumentation”, Dhanpati Rai& Sons, New Delhi, 2014.	
<b>Web References:</b>		
1	<a href="https://www.mdpi.com/1424-8220/17/4/751/htm">https://www.mdpi.com/1424-8220/17/4/751/htm</a>	
2	<a href="https://instrumentationtools.com/control-and-instrumentation-engineer-study-guide/">https://instrumentationtools.com/control-and-instrumentation-engineer-study-guide/</a>	
3.	<a href="https://phys.org/news/2018-11-artificial-sensor-mimics-human.html">https://phys.org/news/2018-11-artificial-sensor-mimics-human.html</a>	
<b>Lab Components:</b>		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>To understand the working principle of various sensors</li> <li>To Familiarize the applications of various types of measuring instruments.</li> </ol>		
<b>Course outcomes:</b>		

Upon completion of the course, students shall have ability to		
C603.5	Apply the basic knowledge of sensors	[AP]
C603.6	Identify an appropriate sensor for measuring industrial parameter	[AP]
C603.7	Inspect the operation of sensor for unknown quantity measurement	[A]
C603.8	Explain various measurement techniques.	[U]

**List of lab experiments:**

1. Measurement of length, thickness and diameter of the given object using vernier calliper micrometer and linear scale.
2. Measurement of linear displacement using inductive sensor.
3. Displacement measurement using capacitive sensor.
4. Piezo Electric accelerometer for vibration measurement.
5. Measurement of pressure using Bourdon Gauge.
6. Measurement of temperature using Thermistor and RTD sensor.
7. Measure the torque developed using torque sensor.
8. Measure and control the speed of motor using stroboscope.
9. Measurement of flow using Rotameter.
10. Measure the strain applied in the cantilever beam using strain sensor.
11. Measurement of weight using load cell.
12. Measurement of water level using ultrasonic sensor.

**Total hours: 45**

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Assessment [10 marks]	Rubric based CIA [30 Marks]	
Remember	30	20	20	-	20
Understand	40	40	40	30	40
Apply	30	40	40	30	40
Analyse	-	-	-	40	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C603.1	3	3	0	3	0	0	2	3	3	0	3	0	3	3
C603.2	3	0	3	3	0	0	2	3	3	3	3	3	3	0
C603.3	3	3	3	3	3	0	0	3	3	0	3	3	0	3
C603.4	3	3	0	3	3	0	2	0	3	3	3	3	3	3
C603.5	3	3	3	3	3	0	0	3	0	3	3	0	3	0
C603.6	3	3	0	3	3	0	0	3	3	3	3	0	3	3
C603.7	3	3	3	3	3	0	0	3	0	3	3	3	3	3
C603.8	3	3	3	3	0	0	0	3	0	3	3	0	3	3

<b>20MT604</b>	<b>MINI PROJECT</b>	<b>1.5 Credits</b>
----------------	---------------------	--------------------

### GUIDELINES FOR MINI PROJECT

Week	Guidelines
0	<p>Students can do the project either individually or in a group of maximum 4 members.</p> <p>Students shall form their batch in the middle of 5<sup>th</sup> semester.</p> <p>Head of the department / Students shall fix guide who is appropriate to their field of interest.</p> <p>On discussion with their guides students shall identify a project title based on Mechatronics Engineering solution to societal problems or Re-engineer any of the automated systems.</p> <p>The identified projects need to address any Research Problems or to develop a product or to provide technical solution to the real world problems.</p>
1	<p>(i) An extensive literature review pertaining to the problem identified shall be done by the students</p> <p>(ii) Students shall file all referred literatures in hard copy</p>
2	
3	<p>(i) Students shall make the software modelling of the proposed project and tentative budget of the project</p> <p>(ii) Students shall get approval of PPT and project diary from their project guide at least one day before the review</p>
4	<p>ZEROth REVIEW – Approval of the project based on literature review and feasibility</p> <p>(i) Marks will be awarded based on selection of project title, presentation by individual batch members, feasibility of the project, literature review and dress code</p> <p>(ii) A hardcopy of all referred literatures shall be submitted</p>
5	<p>(i) Students shall do design calculations and prepare the assembly and part drawings</p> <p>(ii) Design calculations should be verified by the respective project guide and a design expert in the department. Further, the final approval should be obtained from project co-ordinator</p> <p>(iii) Students shall get approval of their PPT, partial project report with front page, introduction, literature review, design calculation chapters, journal paper, project diary from their project guide at least one day before the review</p>
6	
7	
8	
8	<p>FIRST REVIEW – Verification of design and bill of materials of the project.</p>

	<ul style="list-style-type: none"> <li>(i) Marks will be awarded based on design calculation, CAD modelling, bill of materials, contribution, dress code and presentation by individual batch members</li> <li>(ii) Students shall submit hardcopy of their partial project report corrected and approved by their project guide</li> <li>(iii) They shall also submit hardcopy of journal paper prepared and verified by their guide.</li> </ul>
9	Students shall procure the hardware components required for the project.
10	<ul style="list-style-type: none"> <li>(i) Fabrication of the approved project shall be carried out by students at the college premises only.</li> <li>(ii) Students shall update their work progress and get their project diary duly filled and attested by the guide</li> </ul>
11	
12	
13	<ul style="list-style-type: none"> <li>(i) Students shall present a paper in International Conference/publish a journal paper on their project in scopus / web of science journals</li> <li>(ii) Students shall get approval of their PPT, project report, project diary from their project guide at least one day before the review</li> </ul>
14	
15	<p>SECOND REVIEW – Demonstration of completed mini projects</p> <ul style="list-style-type: none"> <li>(i) Marks will be awarded based on completion of project, working model, project report, presentation by individual batch members, submission of International conference/journal paper and dress code</li> <li>(ii) Students shall get approval of PPT, International conference/journal paper and work progress in project diary from project guide</li> </ul>
16	<p>End Semester Project VIVA-VOCE Examination</p> <ul style="list-style-type: none"> <li>(i) The viva – voce examination evaluates project presentation by individual batch members, demonstration of the project, project diary, project report, dress code and the components decided by external examiners.</li> <li>(ii) Final report copies (Number of batch members + 2) should be submitted to project guide one day prior to scheduled viva date duly signed by project guide and head of the department</li> </ul>

**General Guidelines:**

- (i) Project report should be in prescribed format.
- (ii) Students those who are absent for any review will not get any marks for that review
- (iii) Students should be punctual to the reviews as per the time schedule
- (iv) Students shall follow formal dress code. Boys should come with clean shaved face
- (v) Students must follow strictly the instructions given then and there by the department.

<b>Assessment Components</b>		
<b>S.No.</b>	<b>Category</b>	<b>Marks</b>
1	Zeroth Review	<b>10</b>
2	First Review	<b>15</b>
3	Second Review	<b>20</b>
4	Journal / International Conference/ Patent publication	<b>15</b>
5	Viva Voce	<b>40</b>
<b>Total</b>		<b>100</b>



# **PROFESSIONAL ELECTIVES**



<b>20MT901</b>	<b>ADVANCED MANUFACTURING PROCESSES</b>	<b>3/0/0/3</b>
Nature of Course : Theory		
Pre requisites : 20MT101 Production Technology		
Course Objectives:		
<ol style="list-style-type: none"> <li>1. To impart knowledge on the principles of material removal mechanism of various advanced machining processes.</li> <li>2. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.</li> <li>3. To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.</li> </ol>		
Course Outcomes: Upon completion of the course, students shall have ability to		
C901.1	Recall the various unconventional manufacturing process based on energy sources and mechanism employed.	[R]
C901.2	Interpret the various operating parameters in advanced manufacturing processes under different conditions.	[U]
C901.3	Develop novel hybrid techniques for processing of unconventional materials.	[AP]
C901.4	Illustrate the various advanced finishing operations.	[AP]
<b>Course Contents:</b>		
<p><b>Mechanical and Thermal Processes:</b> Introduction, Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes. Principle, mechanism of material removal, Process Parameters, Process Capabilities, Applications and Limitations of USM, AJM and WJM processes. Principle, mechanism of material removal ,Process parameters , characteristics ,Surface finish and accuracy, Applications and Limitations of EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, PAM. <b>(15 Hours)</b></p> <p><b>Chemical and Hybrid Processes:</b> Principle and details of Chemical Machining (CHM), Photo-Chemical Machining (PCM) and Bio-Chemical Machining (BCM). Process principle , Mechanism of material removal ,Process Parameters, Process Capabilities ,Applications and Limitations of Electro Chemical Machining (ECM) Electro Chemical Deburring (ECDE), Electro Stream Drilling (ESD), Shaped Tube Electro Machining (STEM) and Electro Chemical Honing (ECH). <b>(15 Hours)</b></p> <p><b>Advanced Metal Forming and Finishing Process:</b> Advanced Metal Forming-High Energy Rate Forming (HERF) – Electro-Magnetic forming, Explosive forming, Electro – Hydraulic forming. Advanced Fine Finishing :Process principle ,Process equipment; Process Parameters, Capabilities, Applications and Limitations of Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF) Magneto Rheological Abrasive Finishing (MRAF) and Robotic Abrasive blasting system. Introduction to Virtual manufacturing. <b>(15 Hours)</b></p>		
<b>Total Hours</b>		<b>45</b>
<b>Text Books:</b>		
1	V.K.JAIN ,”Advanced Machining Processes”, Allied Publishers Pvt.Ltd, 2016	
2	Kaushik Kumar and J.PauloDavim , “Modern Manufacturing Processes” , Woodhead Publishing , 2020	
<b>Reference Books:</b>		
1	Kapil Gupta , “Advanced Manufacturing Technologies”,Springer ,2018.	

2	Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2017.
3	Benedict. G.F."Non-traditional Manufacturing Processes", Taylor & Francis, New York, 2017.
<b>Web References:</b>	
1	<a href="http://www.propelplm.com/blog/advanced-manufacturing-for-improved-manufacturing-processes">www.propelplm.com/blog/advanced-manufacturing-for-improved-manufacturing-processes</a>
2	<a href="https://www.rajagiritech.ac.in/Home/mech/Course_Content/Semester%20VI/ME%20306%20Advanced%20Manufacturing%20Technology/Module%206.pdf">https://www.rajagiritech.ac.in/Home/mech/Course_Content/Semester%20VI/ME%20306%20Advanced%20Manufacturing%20Technology/Module%206.pdf</a>
3	<a href="https://www.finishingsystems.com/blog/robotic-abrasive-blasting-on-the-rise">https://www.finishingsystems.com/blog/robotic-abrasive-blasting-on-the-rise</a>
4	<a href="http://nptel.ac.in/courses/112/107/112107077/web">http : //nptel.ac.in/courses/112/107/112107077/web</a> and video resources on Manufacturing Processes & Advanced manufacturing processes

<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative Assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course outcome</b>	<b>Bloom's Level</b>	<b>Assessment Components</b>	<b>Marks</b>	
<b>C901.1</b>	Remember	Online Quiz	<b>5</b>	
<b>C901.2</b>	Understand	Presentation	<b>5</b>	
<b>C901.3</b>	Apply	Problem Solving	<b>5</b>	
<b>C901.4</b>	Apply	Group Assignment	<b>5</b>	
<b>Summative Assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>END SEMESTER EXAMINATION [50 Marks]</b>
	<b>CIA-I [10 Marks]</b>	<b>CIA-II [10 Marks]</b>	<b>CIA - III [10 Marks]</b>	
Remember	20	20	25	20
Understand	30	20	25	20
Apply	50	60	50	60
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>C901.1</b>	3	0	0	0	0	0	3	0	0	0	0	3	3	0
<b>C901.2</b>	3	2	3	3	3	0	3	0	0	0	0	0	3	0
<b>C901.3</b>	0	0	2	0	3	0	3	0	0	0	0	3	3	0
<b>C901.4</b>	3	0	0	3	3	0	3	0	0	2	0	3	3	2

<b>20MT902</b>	<b>MICRO AND NANO MANUFACTURING</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : 20MT101 Production Technology		
<b>Course Objectives:</b>		
1	To introduce various Micro Fabrications involved in microsystem production	
2	To acquire the knowledge about the working principles of micro manufacturing	
3	To apply the techniques involved in nano finishing of micro system with good surface	
4	To select the appropriate element involved in the design and packages of micro	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C902.1	Explain the various micro fabrication processes	[U]
C902.2	Find the suitable micro manufacturing process in the production unit.	[R]
C902.3	Apply the Nano finishing techniques in various system	[AP]
C902.4	Examine general consideration of micro system packages	[A]
<b>Course Contents:</b>		
MEMS and Microsystems, Evolution of Micro fabrication, Applications of Microsystems. Micro system fabrication processes- photolithography, Ion implantation, chemical vapour deposition, and etching. Bulk micromachining, Surface micromachining- Introduction to Micro-energy and chemical system (MECS). <b>(15 Hours)</b>		
Nanofinishing Techniques: Advanced Finishing Processes (AFP) - Abrasive Flow Machining(AFM), Magnetic Abrasive Finishing(MAF), Elastic Emission Machining (EEM)- Chemical Mechanical Polishing (CMP). Production of carbon nano tubes: Chemical Vapour Deposition (CVD) and Arc discharge, Carbon nano tube applications in computers and X-ray equipment. Laser Micro welding- Electron Beam Micro-welding. <b>(15 Hours)</b>		
Micro system Packaging: General considerations, Three Levels of Microsystem Packaging: Die level -Device level - System level of packages. Essential Packaging Technologies: Die preparation- Surface bonding - Wire bonding – Sealing. Three-dimensional packaging - Assembly of microsystems – Selection of packaging materials. Clean room standards and clean room sub system. <b>(15 Hours)</b>		
		<b>Total Hours : 45</b>
<b>Text Books:</b>		
1	Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture and Nanoscale Engineering ", John Wiley, 2020.	
2	V. K. Jain, "Micromanufacturing Processes", CRC Press, 2016.	
<b>Reference Books:</b>		
1	N. P. Mahalik, "Micro-manufacturing and nanotechnology", Springer, 2011	
2	Sami Franssila, "Introduction to Microfabrication", 2nd Edition, Wiley, 2010	
<b>Web References:</b>		
1	<a href="https://micronanomanufacturing.asmedigitalcollection.asme.org/">https://micronanomanufacturing.asmedigitalcollection.asme.org/</a>	
<b>Online Resources:</b>		
1	<a href="https://nptel.ac.in/courses/112/107/112107078/">https://nptel.ac.in/courses/112/107/112107078/</a>	
2	<a href="https://nptel.ac.in/courses/112/103/112103202/">https://nptel.ac.in/courses/112/103/112103202/</a>	

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C902.1	Understand	Online Quiz	5	
C902.2	Remember	Test (Definition)	5	
C902.3	Apply	Problem Solving	5	
C902.4	Analyze	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyze	-	30	15	15
Evaluate	-	-	-	-
Create	-	-	-	-

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>
<b>C902.1</b>	3	0	3	3	0	0	0	0	0	0	0	0	3	3
<b>C902.2</b>	3	2	3	3	0	0	0	0	0	0	0	0	3	3
<b>C902.3</b>	3	0	2	0	3	0	0	0	0	0	0	0	3	3
<b>C902.4</b>	0	2	3	3	3	0	0	0	0	0	0	0	3	3

<b>20MT903</b>	<b>ADDITIVE MANUFACTURING PROCESSES</b>	<b>3/0/0/3</b>
Nature of Course :Theory		
Pre requisites : 20MT204 - Computer Aided Machine Drawing Laboratory		
Course Objectives:		
<ol style="list-style-type: none"> <li>1. To make the students aware of rapidly evolving and widely used technology.</li> <li>2. To impart in-depth knowledge on conceptual modeling, prototyping, rapid manufacturing and also about the latest trends and opportunities in Additive Manufacturing (AM) processes.</li> <li>3. To cultivate knowledge on choosing AM processes, devices and materials to suit particular engineering requirements.</li> </ol>		
Course Outcomes: Upon completion of the course, students shall have ability to		
C903.1	Outline the techniques for processing of CAD models for Rapid Prototyping.	[R]
C903.2	Illustrate the working principle and process parameters of AM processes.	[U]
C903.3	Apply the suitable process for fabricating a given product.	[AP]
C903.4	Explore the applications of AM processes in various fields.	[AP]
Course Contents:		
<p>Additive Manufacturing (AM) Process: Introduction , evolution, Distinction between AM &amp; Conventional Machining, Steps, Classification, Advantages ,Types of materials and Pre-processing. Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages . <b>(15 hours)</b></p> <p>Models and specifications, Process, Working principle, Applications, Advantages, disadvantages and Case studies of Laminated object manufacturing (LOM) ,Selective laser Sintering (SLS)and Electron Beam melting (EBM).Three Dimensional Printing (3DP) – Control of process parameters. Processing-structure-properties, relationships, Benefits, drawbacks and Applications of Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), and Electron Beam Based Metal Deposition. <b>(15 hours)</b></p> <p>Post Processing of AM Parts -Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. Guidelines for Process Selection -Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control. Application in manufacturing, aerospace, automotive and medical field – Bio inspired structures. Introduction to precision additive manufacturing. Introduction to 4D and 5DPrinting. <b>(15 hours)</b></p>		
<b>Total Hours</b>		<b>45</b>
<b>Text Books:</b>		
1	Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, 3rd Edition, Springer, 2020.	
2	Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: 3D Printing and Additive Manufacturing Principles and Applications” ,5th Edition, World Scientific, 2019.	
<b>Reference Books:</b>		

1	Kaushik Kumar, DivyaZindani, J.PauloDavim , “Rapid Prototyping, Rapid Tooling and Reverse Engineering”, De Gruyter Publisher ,2020.
2	Sunpreetsingh, Chander Prakash and Seeram Ramakrishna, “Additive Manufacturing: Knowledge for the beginners”, World Scientific, 2020.
3	Richard Leach and Simone Carmignato , “Precision Metal Additive Manufacturing”, CRC press, 2020.

**Web References:**

1	<a href="http://www.stratasys.com/solutions/rapid-prototyping">http://www.stratasys.com/solutions/rapid-prototyping</a>
2	<a href="https://www.ge.com/additive/additive-manufacturing">https://www.ge.com/additive/additive-manufacturing</a>
3	<a href="https://www.sciencedirect.com/science/article/pii/S1742706119307172">https://www.sciencedirect.com/science/article/pii/S1742706119307172</a>
4	<a href="https://www.sculpteo.com/en/3d-learning-hub/best-articles-about-3d-printing/4d-printing-technology/">https://www.sculpteo.com/en/3d-learning-hub/best-articles-about-3d-printing/4d-printing-technology/</a>

**Assessment Methods & Levels (based on Bloom’s Taxonomy)**

**Formative Assessment based on Capstone Model (Max. Marks:20)**

Course outcome	Bloom’s Level	Assessment Components	Marks
C903.1	Remember	Online Quiz	5
C903.2	Understand	Presentation	5
C903.3	Apply	Case Study	5
C903.4	Apply	Group Assignment	5

**Summative Assessment based on Continuous and End Semester Examination**

Bloom’s Level	Continuous Assessment			END SEMESTER EXAMINATION [50 Marks]
	CIA-I [10 Marks]	CIA-II [10 Marks]	MODEL EXAM [10 Marks]	
Remember	20	30	20	20
Understand	40	25	30	20
Apply	40	45	50	60
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
C903.1	3	2	0	0	3	0	3	0	0	0	0	3	3	0
C903.2	3	2	3	3	3	0	3	0	0	0	0	0	3	0
C903.3	0	0	2	0	3	0	3	0	0	0	0	3	3	0
C903.4	3	0	0	3	3	0	3	1	0	0	0	3	3	1

<b>20MT904</b>	<b>INTEGRATED PRODUCT AND PROCESS DEVELOPMENT</b>	<b>3/0/0/3</b>
<b>Nature of Course : Theory</b>		
<b>Pre requisites : Nil</b>		
<b>Course Objectives:</b>		
1	To study the product development process and organization.	
2	To study the product planning and organization needs.	
3	To select the concept for different product planning.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C904.1	List the different stages involved in product design and development process.	U
C904.2	Identify the need of customers and concept generation for a product	U
C904.3	Summarize the methodologies involved in concept selection and testing	U
C904.4	Explain the steps involved in innovative product development in industrial design.	Ap
<b>Course Contents:</b>		
Introduction - Characteristics of Successful Product - Challenges of Product Development - Development Processes and Organizations- A Generic Development Process -Concept Development: The Front-End Process Adapting the Generic Product Development Process- Product Development Process Flows- Product Planning Process- Identify Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning. <b>(15 Hours)</b>		
Identifying Customer Needs- Interpreting Raw Data in Terms of Customer Needs-Organizing the Needs into Hierarchy- Product specifications - Establishing Target Specifications-Setting the Final Specifications-Concept Generation -Clarify the Problem- Search Externally-Search Internally-Explore Systematically. <b>(15 Hours)</b>		
Concept Selection- Overview of Methodology-Concept Screening-Concept Testing-Define the Purpose of the Concept Test- Product Architecture-Implications of the Architecture-Establishing the Architecture-Delayed Differentiation-Platform Planning- Assessing the need of Industrial design and its Impact – Industrial Design Process of a product. <b>(15 hours)</b>		
<b>Total Hours</b>		<b>45</b>
<b>Text Books:</b>		
1	Karl T Ulrich, Steven D. Eppinger and Maria C. Yang, Product Design and Development, McGraw –Hill International, 7th Edition 2020.	
2	Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.	
<b>Reference Books:</b>		
1	Kevien Otto and Kristin Wood, “Product Design” Indian reprint, Pearson Publications, New Delhi, 2014.	
2	George. E. Dieter, Linda. C. Schmidt, “Engineering Design”, McGraw –Hill Internationals, 5th Edition, 2013.	
<b>Web References:</b>		
1	<a href="https://nptel.ac.in/courses/112/107/112107217/">https://nptel.ac.in/courses/112/107/112107217/</a>	
2	<a href="https://www.coursera.org/lecture/design/4-3b-concept-testing-0wvHJ">https://www.coursera.org/lecture/design/4-3b-concept-testing-0wvHJ</a>	

<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative Assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course outcome</b>	<b>Bloom's Level</b>	<b>Assessment Components</b>		<b>Marks</b>
C904.1	Understand	Online Quiz		5
C904.2	Apply	Assignment		5
C904.3	Understand	Test		5
C904.4	Apply	Seminar Presentation		5
<b>Summative Assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>END SEMESTER EXAMINATION [50 Marks]</b>
	<b>CIA-I [10 Marks]</b>	<b>CIA-II [10 Marks]</b>	<b>Term end Assessment [10 Marks]</b>	
Remember	30	30	30	30
Understand	40	30	40	40
Apply	30	40	30	30
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
C904.1	3	3	3	3	3	0	0	0	0	3	3	3	3	3
C904.2	3	3	0	3	3	0	0	0	0	0	3	3	3	3
C904.3	3	3	3	3	3	0	0	0	0	3	0	3	3	3
C904.4	3	3	3	0	3	0	0	0	0	3	3	3	3	3

<b>20MT910</b>	<b>THEORY OF AUTOMOBILE ENGINEERING</b>	<b>3/0/0/3</b>
Nature of Course : Theory		
Pre requisites : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>1. To understand the construction and working principle of various parts of an automobile.</li> <li>2. To gain knowledge in various transmission and drive line units of automobiles.</li> <li>3. To illustrate the new generation vehicles and their operation and controls.</li> <li>4. To enhance knowledge on modern safety system in automobiles.</li> </ol>		
<b>Course Outcomes:</b>		
Upon completion of the course, students shall have ability to		
C910.1	Identify different components and system of Automobile.	[R]
C910.2	Explain the Construction and Working principle of Front Axle, Rear Axle, Final Drive, Steering System, Brakes and Suspension System.	[U]
C910.3	Apply the knowledge of alternate fuels , electric vehicle and hybrid electric vehicles.	[AP]
C910.4	Elaborate the various safety norms of vehicle.	[AP]
<b>Course Contents:</b>		
<p>Classification of automobiles –Terms used in vehicle dimensions. Main components of an automobile–Frame structure-engine-transmission system. Types of drive auxiliaries. Engine and its components- Electronic fuel injection system-Engine control unit-Common rail fuel injection system-Magneto ignition system-Electronic ignition system and its types- Emission Control. Turbo chargers. <b>(15 Hours)</b></p> <p>Introduction to Manual and Automatic Transmission-Centrifugal clutch and Diaphragm type clutch-Sliding Mesh and Synchro mesh gear box-Torque Converter, continuously variable transmission (CVT) - Differential arrangement types. Front axle – Elliot axle. Steering mechanism –Rack and Pinion steering gear – Power steering – Steering geometry. Construction and operation of front suspension – Rear axle suspension– Leaf Spring - Independent suspension system -Trailing arm and Mac Pherson Strut type suspension- Shock absorbers. <b>(15 Hours)</b></p> <p>Factors governing braking – drum brake system – Disc brakes – Pneumatic and Hydraulic Braking Systems.<b>Automotive safety- Air bag</b> - Antilock Braking System - Traction Control – Electronic stability control.Compressed Natural Gas – CNG components for petrol engine. Liquefied Petroleum Gas - Bio-diesel - Bio-ethanol - Gasohol, Concepts and types of Electric vehicle. <b>Introduction to Predictive Vehicle Technology. (15 Hours)</b></p>		
<b>Total Hours</b>		<b>45</b>
<b>Text Books:</b>		
1	Er.S.K.Gupta, “A Text Book of Automobile Engineering”, Chand Publications, NewDelhi,2020.	
2	Srinivasan S, “Automotive Mechanics”, McGraw Hill Education, New Delhi, 2017.	
<b>Reference Books:</b>		
1	Kirpal Singh, “Automobile Engineering - VOL 1 & 2”, Standard Publishers, Seventh edition 2020, New Delhi..	
2	S.K.Gupta, “A Text book of Automobile Engineering”, S.Chand Publishers, 2018.	
3	William H Crouse, Donald L Anglin, “Automotive Mechanics”, McGraw Hill, 2017.	
<b>Web References:</b>		

1	<a href="http://www.daleadams.com/blogs/news/20-greatest-innovations-inventions-of-automobile-engineering-from-interestingengineering-com">http://www.daleadams.com/blogs/news/20-greatest-innovations-inventions-of-automobile-engineering-from-interestingengineering-com</a>
2	<a href="https://artificialintelligence.oodles.io/dev-blogs/The-Future-of-Artificial-Intelligence-in-the-Automotive-Industry">https://artificialintelligence.oodles.io/dev-blogs/The-Future-of-Artificial-Intelligence-in-the-Automotive-Industry</a>
3	<a href="https://biofuels-news.com/news/future-trends-in-biofuel/">https://biofuels-news.com/news/future-trends-in-biofuel/</a>

**Assessment Methods & Levels (based on Bloom's Taxonomy)**

**Formative Assessment based on Capstone Model (Max. Marks:20)**

Course outcome	Bloom's Level	Assessment Components	Marks
C910.1	Remember	Online Quiz	5
C910.2	Understand	Presentation	5
C910.3	Apply	Problem Solving	5
C910.4	Apply	Group Assignment	5

**Summative Assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			END SEMESTER EXAMINATION [50 Marks]
	CIA-I [10 Marks]	CIA-II [10 Marks]	MODEL EXAM [10 Marks]	
Remember	20	30	20	20
Understand	40	25	30	20
Apply	40	45	50	60
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C910.1	3	1	3	3	1	1	1		2	2	3	2	3	1
C910.2	3	2	3	3	2	2	1		2	2	3	3	3	1
C910.3	3	2	3	3	3	2	2		3	2	3	2	3	2
C910.4	3	2	3	3	3	3	2	2	2	2	3	3	2	2

20MT911	<b>AUTOTRONICS</b>		3/0/0/3
<b>Nature of Course :</b> Theory			
<b>Pre requisites :</b> 20MT910 Theory of Automobile Engineering			
<b>Course Objectives:</b>			
1	To interpret the basic electronic engine control used in automobiles		
2	To select appropriate Sensors and actuators for engines		
3	To learn and illustrate Electronic fuel injection, ignition system and advanced control system in automobiles		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C911.1	Relate the role of electronic control in vehicles.		[R]
C911.2	Illustrate various sensors and actuators in automobiles.		[U]
C911.3	Identify Electronic injection and ignition systems		[AP]
C911.4	Analyze advanced vehicle control system.		[A]
<b>Course Contents:</b>			
Fundamentals of Automotive Electronics: Microprocessor and micro Computer applications in automobiles -Electronic Engine Control system –Starting System – Charging System – Batteries - Electronic Fuel Control System - Analysis of Intake Manifold Pressure - Electronic Ignition-Automotive Control System - Case Studies: MEMS accelerometer-driven fuel-control system. <b>(15 hours)</b>			
Engine Management System: Automotive Engine Control Actuators -Carburettors - Electronic fuel injection -Safety and Comfort System. Digital Engine Control-Hybrid vehicle Power train System - Automotive Lighting and wiring harness systems.-Car navigation system-Advanced Telematics and communication systems - <b>Fleet telematics</b> . Exhaust Gas Recirculation (EGR) Control – Case Studies: Car Black Box - vehicle's Event Data Recorder (EDR). <b>(15 hours)</b>			
Automatic Transmission System - Variable Valve timing control - Integrated engine control system - Vehicle motion control-Active suspension system - Traction control system – Electronic steering control - Advanced Driver Assistance Systems (ADAS) - <b>HIL simulation</b> . Diagnostics: Engine control diagnostics- Expert Systems in Automotive Diagnosis – Case Studies: CAN Based Accident Avoidance System for Automobiles, <b>Self Driving Cars (AI)</b> <b>(15 hours)</b>			
<b>Total Hours</b>			<b>45</b>
<b>Text Books:</b>			
1	B.William Ribbens, “Understanding Automotive Electronics”, 7th Edition, Butterworth, Heinemann, Woburn, 2015		
2	H.William Crouse, Donald L.Anglin, “Automotive Mechanics”, 10th Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2013		
<b>Reference Books:</b>			
1	Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics”, 5th Edition, Springer Views, Germany, 2011.		
2	Tom Denton, “Automobile Electrical and Electronic Systems”, 5th Edition, Taylor and Francis group, 2018		
3	Tom Denton, “Electric and Hybrid Vehicles”, 2ND Edition, Taylor and Francis group, 2020		
<b>Web References:</b>			
1	<a href="https://www.dieselnet.com/standards/in/">https://www.dieselnet.com/standards/in/</a>		
2	<a href="http://www.drive_spark.com/fourwheelers/2016/top-5-best-gps-navigation-india">http://www.drive_spark.com/fourwheelers/2016/top-5-best-gps-navigation-india</a>		

	<a href="#">019244.html</a>
3	<a href="https://en.wikipedia.org/wiki/Bharat_Stage_emission_standards">https://en.wikipedia.org/wiki/Bharat_Stage_emission_standards</a>
4	<a href="https://seabeemagazine.navylive.dodlive.mil/files/2014/05/14264A-Construction-Mechanic-Basic-Chapters-8.pdf">https://seabeemagazine.navylive.dodlive.mil/files/2014/05/14264A-Construction-Mechanic-Basic-Chapters-8.pdf</a>
5	<a href="https://www.knowyourparts.com/technical-resources/electrical/electronic-power-steering/">https://www.knowyourparts.com/technical-resources/electrical/electronic-power-steering/</a>

**Assessment Methods & Levels (based on Bloom's Taxonomy)**

**Formative Assessment based on Capstone Model (Max. Marks:20)**

Course outcome	Bloom's Level	Assessment Components	Marks
C911.1	Remember	Test (Definition)	5
C911.2	Understand	Online Quiz	5
C911.3	Apply	Problem Solving	5
C911.4	Analyze	Group Assignment	5

**Summative Assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term end Assessment [10 Marks]	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyze	-	30	15	15
Evaluate	-	-	-	-
Create	-	-	-	-

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C911.1	3	3	3	3	3	3	3	0	2	3	3	3	3	3
C911.2	3	3	3	3	3	3	3	0	2	3	3	3	3	3
C911.3	3	3	3	3	3	3	3	0	0	3	3	3	3	3
C911.4	3	3	3	3	3	3	3	0	0	3	3	3	3	3

<b>20MT912</b>	<b>AUTONOMOUS VEHICLE GUIDANCE SYSTEM</b>	<b>3/0/0/3</b>
<b>Nature of Course :</b> Theory		
<b>Pre requisites :</b> Nil		
<b>Course Objectives:</b>		
1	To introduce the common types, missions and roles of autonomous vehicle systems.	
2	To describe the methods used by autonomous vehicle systems to perform Guidance, Navigation, & Control functions	
3	To challenge students to generate system requirements and develop system designs for autonomous vehicles based upon realistic mission scenarios.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C912.1	Recall the basic working principles of Autonomous Vehicle Systems	[R]
C912.2	Apply obstacle avoidance methods within an autonomous regime.	[AP]
C912.3	Examine search algorithms for autonomous vehicle guidance, navigation and control.	[A]
C912.4	Contrast path planning systems for autonomous vehicle guidance.	[A]
<b>Course Contents:</b>		
Overview of Unmanned Aerial Vehicle (UAV) Systems – Classes and Missions – Basic Aerodynamics – Performance – Stability and Control – Propulsion – Loads and Structures – Mission Planning and Control Stations – Air Vehicle and Payload Control – Communication and Navigation Systems – Launch and Recovery Systems – Roles of UAV in Army and Navy - Inertial navigation. Case studies: Shape changing ‘Dragon’ Drone, Multiple sensor fusion. <b>(15 hours)</b>		
Autonomous Ground Vehicles (AGVs): Autonomous Driving Technologies Overview, Driving Algorithms, Driving Client System and Cloud Platform – Vehicle Localization: GNSS, LIDAR, Dead Reckoning and Wheel Odometry – Perception – Prediction and Routing: Overview, Traffic Prediction and Lane Level Routing – Decision, Planning and Control – Simulation and Model Training – Case studies: Artificial Intelligence for Autonomous Military Surveillance, Tesla's autonomous robotaxi. <b>(15 hours)</b>		
Autonomous Underwater Vehicles (AUVs): Overview, Vehicle Kinematics Fundamentals – Propulsion Systems – Motion Planning – Stabilization – Control using Approximate Linearization and Point-Point Stabilization – Robust Kinematic and Dynamic Feedback Control-Case studies: Self Assembling underwater devices. <b>(15 hours)</b>		
<b>Total Hours</b>		<b>45</b>
<b>Text Books:</b>		
1	Paul GerinFahlstrom, Thomas James Gleason, “Introduction to UAV Systems”, John Wiley & Sons Ltd, 2012	
2	Liu.S, Li.L, Tang.J, Wu.S, Gaudiot.J, “Creating Autonomous Vehicle Systems”, Morgan & Claypool Publishers, 2018.	
<b>Reference Books:</b>		
1	Reg Austin, “Unmanned Aircraft Systems: UAVs Design, Development and Deployment”, John Wiley & Sons Ltd, 2011	
2	UmitOzguner, Tankut Acarman, Keith Redmill, “Autonomous Ground Vehicles”, Artech House, 2011	
3	SabihaWadoo, Pushkin Kachroo, “Autonomous Underwater Vehicles: Modeling, Control Design and Simulation”, CRC Press, 2011.	

Web References	
1	<a href="https://www.edx.org/course/decision-making-for-autonomous-systems">https://www.edx.org/course/decision-making-for-autonomous-systems</a>
2	<a href="https://in.udacity.com/course/self-driving-car-engineer-nanodegree--nd013">https://in.udacity.com/course/self-driving-car-engineer-nanodegree--nd013</a>
3	<a href="https://www.mooc-list.com/course/mobile-robots-and-autonomous-vehicles-fun">https://www.mooc-list.com/course/mobile-robots-and-autonomous-vehicles-fun</a>
4	<a href="https://www.intechopen.com/books/new-approach-of-indoor-and-outdoor-localization-systems/inertial-navigation-systems-and-its-practical-applications">https://www.intechopen.com/books/new-approach-of-indoor-and-outdoor-localization-systems/inertial-navigation-systems-and-its-practical-applications</a>
5	<a href="https://www.irjet.net/archives/V7/i7/IRJET-V7I7189.pdf">https://www.irjet.net/archives/V7/i7/IRJET-V7I7189.pdf</a>
6	<a href="https://fas.org/sgp/crs/natsec/R45178.pdf">https://fas.org/sgp/crs/natsec/R45178.pdf</a>

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C912.1	Remember	Technical Quiz	5
C912.2	Understand	Guidance & Navigation Algorithms as individual assignment	5
C912.3	Apply	Group Assignment	5
C912.4	Create	Conceptual design of an autonomous system for a given mission	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	30	30	25	25
Understand	40	30	25	25
Apply	10	20	30	30
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C912.1	3	3	3	3	3	3	3	0	0	3	0	2	3	3
C912.2	3	3	3	3	3	3	3	0	0	3	0	0	3	3
C912.3	3	3	3	3	3	3	0	0	0	3	2	0	3	3
C912.4	3	3	3	0	3	3	0	0	0	3	2	2	3	3

<b>20MT913</b>	<b>BASICS OF MACHINE LEARNING</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : 20MA402 Probability, Statistics and Numerical Methods		
<b>Course Objective:</b>		
1	To enable students to understand the basic concepts and techniques of machine learning.	
2	To make students become acquainted with supervised learning methods in Machine Learning	
3	To understand the underlying mathematical relationships and the paradigms of un-supervised learning.	
4	To implement various Deep learning algorithms in real-world applications.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C913.1	Recall the basic concepts of various learning methods	[R]
C913.2	Understand the architectures and algorithms of machine learning models.	[U]
C913.3	Analyze the suitable machine learning methods/algorithms for various type of learning problems	[A]
C913.4	Apply the machine learning algorithms to solve real-world issues	[AP]
<b>Course Contents:</b>		
Introduction to Machine Learning, Types of Learning –Applications of Machine Learning – Tools and Issues in Machine Learning – Preparing to Model – Modelling and Evaluation – Basics of Feature Engineering – Basics of Neural Networks - Obstacle avoidance in a Mobile Robot- Application of Neural Networks in manufacturing and process control applications. <b>(15 Hours)</b>		
Supervised Learning: Classification – Regression: Linear regression, Logistic regression – Decision Tree – Support Vector Machines – Bayesian Classification - Hidden Markov Model - Navigation and path planning of a mobile robot <b>(15 Hours)</b>		
Unsupervised Learning: Clustering: Types of clustering, Partitioning methods of clustering, Hierarchical clustering – Finding Pattern using Association rule – Reinforcement Learning – Representation Learning – Active Learning – Ensemble Learning – Imitation learning in humanoid robots- Introduction to cyber-physical system. <b>(15 Hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	Srinivasaraghavan A, Joseph V, 'Machine Learning', Wiley India Pvt. Ltd., 2019	
2	Dutt S, Chandramouli S, Das AK, 'Machine Learning', Pearson India Education Services Pvt. Ltd., India, 2019.	
<b>Reference Books:</b>		
1	Ethem Alpaydin, 'Introduction to Machine Learning', MIT press, Cambridge, England, Fourth Edition, 2020	
2	Trappenberg TP, 'Fundamentals of Machine Learning', Oxford UP, 2020.	
3	Jason Bell, 'Machine Learning – Hands-On for Developers and Technical Professionals', Wiley, USA, 2015	

<b>Web References:</b>				
1	<a href="https://onlinecourses.nptel.ac.in/noc21_cs24/preview">onlinecourses.nptel.ac.in/noc21_cs24/preview</a>			
2	<a href="https://www.coursera.org/learn/machine-learning">https://www.coursera.org/learn/machine-learning</a>			
3	<a href="https://www.datacamp.com/tracks/machine-learning-with-python">https://www.datacamp.com/tracks/machine-learning-with-python</a>			
4	<a href="http://scikit-learn.org/stable/tutorial/basic/tutorial.html">http://scikit-learn.org/stable/tutorial/basic/tutorial.html</a>			
5	<a href="https://machinelearningmastery.com/machine-learning-in-python-step-by-step/">https://machinelearningmastery.com/machine-learning-in-python-step-by-step/</a>			
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C913.1	Remember	Test (Definition)	<b>5</b>	
C913.2	Understand	Online Quiz	<b>5</b>	
C913.3	Apply	Problem Solving	<b>5</b>	
C913.4	Analyze	Group Assignment	<b>5</b>	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	40	35	30	25
Understand	40	40	40	35
Apply	10	15	20	30
Analyze	10	10	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>C913.1</b>	3	3	0	0	0	3	0	0	0	0	0	0	3	3
<b>C913.2</b>	3	0	3	3	0	3	0	0	0	0	0	0	0	3
<b>C913.3</b>	3	3	3	3	2	3	0	0	0	0	0	0	3	0
<b>C913.4</b>	3	3	3	3	0	3	1	0	0	0	0	0	3	3

<b>20MT919</b>	<b>INTEGRATED ELECTRONIC CIRCUITS</b>		<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory			
<b>Pre Requisites</b> : 20MT301 Electrical and Electronic Devices			
<b>Course Objectives:</b>			
1	To provide insight on basic Operational Amplifier.		
2	To understand Fabrication and characteristics of Operational Amplifiers.		
3	To develop knowledge of Timers and Phase lock loop.		
4	To enable the students to be aware of the application areas of operational amplifiers.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C919.1	Explain the Fabrication and characteristics of Operational Amplifiers.		[U]
C919.2	Illustrate the operation of Integrated circuits and Operational amplifier.		[U]
C919.3	Develop Linear and Non Linear applications of Operational Amplifier.		[AP]
C919.4	Analyze the working of Timer and Phase lock loop.		[A]
<b>Course Contents:</b>			
Integrated Circuits Fabrication of ICs using silicon planar technology , Operational amplifier- Voltage Follower - Summing amplifier - Differential amplifier- Instrumentation amplifier - Voltage to Current converter - Phase changers - Sinusoidal Oscillators-IC application in High power car regulator . <b>(15 Hours)</b>			
555 Timer Functional block diagram and description - Monostable and Astable operation - Applications - 566 Voltage Controlled Oscillator - Principle of operation - Building block of PLL - Characteristics-,Voltage Regulator-. Case studies: Automatic changeover switch using 555 timer, Smart home automation based on 555 timer. <b>(15 Hours)</b>			
A-D and D-A Converters: Digital to Analog converters - Binary weighed and R-2R Ladder types - Analog to digital converters - Continuous - Counter ramp, successive approximation, single, dual slope and parallel types - DAC/ADC performance characteristics. New superconducting materials using material informatics. (Qualitative treatment only).] <b>(15 Hours)</b>			
			<b>Total hours: 45</b>
<b>Text Books:</b>			
1	D.RoyChoudhry, ShailBala Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018.		
2	Herbert Taub, Donald Schilling, "Digital integrated Electronics", TATA Mc Graw Hill ,2017		
<b>Reference Books:</b>			
1	J Michael Jacob, "Application and Design with Integrated Circuit" PHI learning Pvt Ltd,2015.		
2	Gayakwad A R, "OP- AMPS and Linear Integrated Circuits II, 4 <sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2018.		
<b>Web References:</b>			
1	<a href="https://nptel.ac.in/courses/108/108/108108111/">https://nptel.ac.in/courses/108/108/108108111/</a>		
2	<a href="https://nptel.ac.in/courses/108/106/108106068/">https://nptel.ac.in/courses/108/106/108106068/</a>		

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C919.1	Remember	Quiz	5	
C919.2	Understand	Test	5	
C919.3	Apply	Group Assignment	5	
C919.4	Analyze	Class Presentation	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>C919.1</b>	1	0	0	3	0	0	0	1	0	0	0	0	3	3
<b>C919.2</b>	0	3	3	3	0	0	0	0	0	0	0	0	3	3
<b>C919.3</b>	0	0	3	0	1	1	1	0	0	1	0	1	3	3
<b>C919.4</b>	0	3	3	3	0	0	0	0	1	0	0	0	3	3

<b>20MT920</b>	<b>CONSUMER ELECTRONICS</b>		<b>3/0/0/3</b>
<b>Nature of Course:</b> Theory			
<b>Pre Requisites</b> : 20MT301 Electrical and Electronics Devices			
<b>Course Objectives:</b>			
<ol style="list-style-type: none"> <li>1. To understand electronics engineering concepts used in consumer electronics systems.</li> <li>2. To identify the need of preventive maintenance in various electronic appliances.</li> <li>3. To use different product safety, compliance standards and techniques associated with electronic products.</li> </ol>			
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have the ability to</b>			
C920.1	Classify the different types of microphones.		[R]
C920.2	Identify the different Audio and Video systems		[Ap]
C920.3	Infer the working principles of various TV		[U]
C920.4	Understand the various electronic home appliances.		[R]
<b>Course Contents:</b>			
<p>Introduction: Electronics in everyday life, Audio System : Microphones, loudspeakers baffle and enclosure, Acoustics, mono, stereo, Quad, Amplifying System, Equalizers and Mixers Synthesizers, Commercial Sound, Theatre Sound System. Video Systems and Displays: Monochrome, Ear pods, Smart TV , Liquid Crystal Cool Display, Foldable Mobiles, Smart watch, wearable electronics, virtual anatomy, TFT, , HDTV, LCD,LED TV, Direct-To- Home (DTH- Set Top Box), Video Telephone and Video Conferencing. <b>(15 hours)</b></p> <p>Domestic &amp; Consumer Appliances: Gosun stove, sensor wake , Smart Washing machines, smart Microwave ovens, smart Air-conditioners and smart Refrigerators, Air purifiers, Computers office System, Power Supplies SMPS/UPS and Preventive maintenance and others systems such as Remote controls, Bar codes, RFID. <b>(15 hours)</b></p> <p>Product Compliance: Product safety and liability issues; standards related to electrical safety and fire hazards, EMI/EMC requirements, Design techniques for ESD, RF interference and immunity, Line current harmonics and mains voltage surge. <b>(15 hours)</b></p>			
<b>Total Hours:</b>			<b>45</b>
<b>Text Books:</b>			
1. Bali S.P. "Consumer Electronics", Pearson Education India, 2017 Edition.			
2. M.L.Anand, " Consumer Electronics( Fundamentals of Audio and Video Systems", Khanna Publishers", 3 <sup>rd</sup> Edition 2006.			
<b>Reference Books:</b>			
1. Bali R and Bali S.P. "Audio video systems : principle practices & troubleshooting " Khanna Book Publishing Co. (P) Ltd., 2010 Delhi , India, edition.			
<b>Web References:</b>			
<ol style="list-style-type: none"> <li>1. <a href="https://www.pcmag.com/encyclopedia/term/consumer-electronics">https://www.pcmag.com/encyclopedia/term/consumer-electronics</a></li> <li>2. <a href="https://en.wikipedia.org/wiki/Digital_electronics">https://en.wikipedia.org/wiki/Digital_electronics</a></li> <li>3. <a href="https://www.electronicsforu.com/?s=">https://www.electronicsforu.com/?s=</a></li> </ol>			
<b>Online Resources:</b>			
<ol style="list-style-type: none"> <li>1. <a href="https://www.businesscompanion.info/en/quick-guides/product-safety">https://www.businesscompanion.info/en/quick-guides/product-safety</a></li> <li>2. <a href="https://en.wikipedia.org/wiki/Consumer_electronics">https://en.wikipedia.org/wiki/Consumer_electronics</a></li> <li>3. <a href="https://www.tinkercad.com/learn/circuits">https://www.tinkercad.com/learn/circuits</a></li> </ol>			

<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C920.1	Remember	Test	5	
C920.2	Understand	Assignment	5	
C920.3	Understand	Online Quiz	5	
C920.4	Remember	Presentation	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 marks]</b>
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>	
Remember	50	50	50	50
Understand	30	25	20	25
Apply	20	25	30	25
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>
<b>C920.1</b>	3	3	3	3	3	3	3	0	0	0	0	0	3	3
<b>C920.2</b>	3	3	3	3	3	3	3	0	0	0	0	0	3	3
<b>C920.3</b>	3	3	3	3	3	3	3	0	0	0	0	0	3	3
<b>C920.4</b>	3	3	3	3	3	3	3	0	0	0	0	0	3	3

<b>20MT921</b>	<b>WIRELESS SENSOR NETWORKS FOR ROBOTICS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objective:</b>		
1	To Learn wireless sensor networks fundamental concept.	
2	To know about different applications of wireless sensor networks.	
3	To have deep knowledge on sensor network security issues and challenges.	
4	To understand the application of wireless sensor networks in swarm robotics.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C921.1	Define the basic principles of wireless sensor networks design and fundamental concepts.	[R]
C921.2	Understand the security and challenges in the deployment of wireless sensor networks.	[U]
C921.3	Explain the applications of wireless sensor networks in swarm robotics	[AP]
C921.4	Examine the design of wireless sensor networks for robotics	[AP]
<b>Course Contents:</b>		
Introduction and Overview of Wireless Sensor Networks, Applications, Basic Wireless Sensor Technology, Network Concept, Constraints and Challenges, localization and tracking, Networking sensors: Issues-Geographic-Energy aware routing, Attribute based routing, Infrastructure Establishment: Clustering, and Topology control of WSN. <b>(15 hours)</b>		
6LoWPAN-Architecture and Neighbor discovery and Challenges, Bluetooth SMART/Bluetooth Low Energy (BLE), Integration of WSN to IoT, unmanned aerial vehicles network, Security of Wireless Sensor Networks, Real life Deployment of Wireless sensor network. Case study: Wireless Sensor Networks in Mobile robots. <b>(15 hours)</b>		
Swarm Robotics: Nature swarm to swarm intelligence, General Modeling and methods, Characteristics, Features, Advantages, Application and scopes, Cooperation schemes between robots, Fundamental tasks. Robotic Wireless Sensor Networks: introduction, Routing, Communication Aware Robot Positioning and Movement Control, Localization, Network Stack Layer Analysis. case study: A robot swarm assisting a human fire-fighter. <b>(15 hours)</b>		
		<b>Total hours 45</b>

<b>Text Books:</b>	
1	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks – Technology, Protocols & Applications", Wiley Publication 2016
2	Feng Zhao, Leonidas Guibas "Wireless Sensor Networks- An Information Processing Approach", Elsevier 2015
<b>References</b>	
1	Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", Wiley, 2016
2	Holger Karl, Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2015.
3	Ibrahiem M. M. El Emary, S. Ramakrishnan, "Wireless Sensor Networks: From Theory to Applications", CRC Press Taylor & Francis Group, 2016
<b>Web Resources</b>	
1	<a href="https://nptel.ac.in/courses/106/105/106105160/">https://nptel.ac.in/courses/106/105/106105160/</a>

2	<a href="https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks/">https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks/</a>			
3	<a href="https://www.sciencedirect.com/science/article/abs/pii/S138912861830255X">https://www.sciencedirect.com/science/article/abs/pii/S138912861830255X</a>			
4	<a href="https://www.sciencedirect.com/science/article/pii/S221491471300024X">https://www.sciencedirect.com/science/article/pii/S221491471300024X</a>			
5	<a href="https://www.frontiersin.org/articles/10.3389/frobt.2020.00053/full">https://www.frontiersin.org/articles/10.3389/frobt.2020.00053/full</a>			
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C921.1	Remember	Test (Definition)	5	
C921.2	Understand	Online Quiz	5	
C921.3	Apply	Case study	5	
C921.4	Apply	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	30	25	25	25
Understand	35	40	40	35
Apply	35	35	35	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course outcome</b>	<b>Program outcomes</b>												<b>Program specific outcome</b>	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C921.1	3	0	0	0	0	3	3	3	3	3	3	3	3	3
C921.2	3	0	3	3	3	3	3	3	3	3	3	3	3	3
C921.3	3	3	3	3	0	0	3	3	3	3	3	3	3	3
C921.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3

<b>20MT922</b>	<b>PRINCIPLES OF AI AND EXPERT SYSTEMS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre requisites</b> : -		
<b>Course Objectives:</b>		
1.	To study the idea of intelligent agents and search methods.	
2.	To study the reasoning and decision making in uncertain world.	
3.	To study the concepts of expert systems and machine learning	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C922.1	Define the problems that are amenable to solution by AI methods.	[R]
C922.2	Illustrate a given problem in the language/framework of different methods.	[U]
C922.3	Examine the efficacy of expert systems to solve a given problem.	[A]
C922.4	Apply the basic AI algorithms to real time applications.	[AP]
<b>Course Contents:</b>		
<p>Introduction to AI- Intelligent Agents – Solving problems by Searching: Uninformed and Informed Search Strategies, Heuristic functions – Beyond Classical Search: Local Search Algorithms – Graph search and tree search algorithms – Defining Constraint Satisfaction Problems – Overview of Robotic Paradigms. <b>(15 Hours)</b></p> <p>Logical Agents – Knowledge based Agents, Propositional Logic – Using First order Logic– Classical Planning – Hierarchical Planning – Knowledge Representation –Natural Language Processing- Deep Learning for Natural Language Processing – Computer Vision - Robotic perception – Planning to Move – Planning uncertain movements – Reinforcement Learning in Robotics. <b>(15 Hours)</b></p> <p>Expert systems – Features of Knowledge-based Expert System - Rule based system architecture- Neural Net Expert System - Knowledge Acquisition and validation – Expert system shells - Expert system building tools – Knowledge based Expert system in Manufacturing and Planning – AI based anomaly detection - Robotic Expert System – Ethics of AI. <b>(15 Hours)</b></p>		
<b>Total hours:</b>		<b>45</b>
<b>Text Books:</b>		
1	Stuart Russel and Peter Norvig, 'Artificial Intelligence: A Modern Approach', Fourth Edition, Pearson Education, New Jersey, 2020.	
2	Krishnamoorthy CS, Rajeev S, 'Artificial Intelligence and Expert Systems for Engineers', CRC Press, 2018.	
<b>Reference Books:</b>		
1	Elaine Rich, Kevin Knight, Shivashankar B Nair, "Artificial Intelligence" Third edition, Tata McGraw Hill, 2017.	
2.	Murphy RR, 'Introduction to AI Robotics', Second Edition, MIT Press, Cambridge, London, 2019.	
3	Gupta I, Nagpal G, 'Artificial Intelligence and Expert Systems', Mercury Learning and Information, 2020.	
<b>Web References:</b>		
1	<a href="https://nptel.ac.in/courses/106106140/">https://nptel.ac.in/courses/106106140/</a>	
2	<a href="http://nptel.ac.in/courses/106105077">http://nptel.ac.in/courses/106105077</a>	

<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C922.1	Remember	Test (Definition)	5	
C922.2	Understand	Online Quiz	5	
C922.3	Analyze	Problem Solving	5	
C922.4	Apply	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 marks]</b>
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10 marks]</b>	<b>Term End Examination [10 marks]</b>	
Remember	25	15	25	20
Understand	35	25	25	25
Apply	40	30	25	30
Analyze	-	30	25	25
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>
<b>C922.1</b>	3	3	3	3	0	0	0	0	0	0	0	0	3	3
<b>C922.2</b>	3	3	3	3	3	0	0	0	0	0	0	0	0	3
<b>C922.3</b>	3	3	3	0	3	0	0	0	0	0	0	0	3	3
<b>C922.4</b>	3	3	3	3	0	1	0	0	0	0	0	0	3	3

# OPEN ELECTIVES



<b>20MT001</b>	<b>BASICS OF ROBOTICS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objective:</b>		
1	To Introduce the principles of robotics	
2	To Understand the design and implementation of robot applications and their relationship to other automated technologies.	
3	To Understand the basis of machine vision & its application in robotics	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C001.1	Recall the basic concepts of Robotics and Robot component	[R]
C001.2	Explain the concept of sensors used in robotics application and illustrate basic robot programming techniques	[U]
C001.3	Apply the concept of image processing & it's real time application in robotics	[AP]
C001.4	Analyze the concept of end effectors	[A]
<b>Course Contents:</b>		
Robotics : Introduction – Definition of a Robot – Laws of Robots – Robot Anatomy– Components of an Industrial Robot – Robot-work space – Classification of Robots – Machine Vision – Robotics & Machine Vision –Terminologies used for robotics specification and selection for industrial applications. <b>(15 Hours)</b>		
Robotic Sensors: Introduction – Types of Sensors in Robots – Tactile Sensors – Proximity Sensors (Position sensors) – Range sensors – Machine Vision Sensors, Robot End Effectors: Classification of End Effectors –Grippers – Types of Grippers – Mechanical Grippers– Vacuum/Suction Grippers – Magnetic Grippers. <b>(15 Hours)</b>		
Robot Programming: Introduction – Robot Programming Techniques – Online Programming – Lead Through Programming – Off Line Programming – Motion Programming –Manufacturing Applications – Material Handling Applications. Underwater robots, medical robots, landmine detection robots. <b>(15 Hours)</b>		
		<b>Total hours : 45</b>
<b>Text Books:</b>		
1	Er.A.K.Gupta, S.K.Arora, “Industrial Automation and Robotics”, University Science Press (An Imprint of Laxmi Publications pvt.Ltd), Third Edition 2013.	
2	M.P.Groover, “Industrial robotics- Technology, programming and Applications”, McGraw-Hill, 2016	
<b>Reference Books:</b>		
1	SathyaRanjan Deb, “Robotics Technology & flexible Automation”, Sixth edition, Tata Mcgraw-Hill Publication, 2011	
2	John.J.Craig, “Introduction to Robotics: Mechanics & control”, Second edition, 2012.	
3.	King Sun Fu, Rafael C. González, C. S. George Lee, “Robotics: control, sensing, vision, and intelligence”, Tata Mcgraw-Hill Publication, 2014.	
<b>Web References:</b>		
1	<a href="http://www.gorobotics.net/">http://www.gorobotics.net/</a>	
2	<a href="http://www.robotbooks.com/general-robotics-links.html">http://www.robotbooks.com/general-robotics-links.html</a>	
3	<a href="https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/">https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/</a>	

<b>Online Resources:</b>	
1	<a href="http://nptel.ac.in/courses/112101099/">http://nptel.ac.in/courses/112101099/</a>
2	<a href="https://www.youtube.com/watch?v=5tRT5j3jfsE">https://www.youtube.com/watch?v=5tRT5j3jfsE</a>

<b>Assessment Methods &amp; Levels (based on Bloom's Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C001.1	Remember	Test (Definition)	5	
C001.2	Apply	Quiz	5	
C001.3	Apply	Problem Solving	5	
C001.4	Analyze	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 marks]</b>
	<b>CIA-I [10 marks]</b>	<b>CIA-II [10marks]</b>	<b>Term End Examination [10 marks]</b>	
Remember	30	35	30	30
Understand	30	20	30	35
Apply	20	15	30	15
Analyse	20	30	10	20
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C001.1	3	2	3	3	1	2	1		2	3	3	2	3	1
C001.2	3	2	3	3	2	3	1		2	3	3	2	3	1
C001.3	3	3	3	3	3	3	1		3	3	3	2	3	2
C001.4	3	2	3	3	3	3	1		2	3	3	2	2	2

20MT002	<b>MECHATRONICS ENGINEERING APPLICATIONS</b>	3/0/0/3
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objective:</b>		
1	To educate the students about mechatronics and its concepts	
2	To learn about mechatronics engineering applications in various fields	
3	To understand and illustrate mechatronics application techniques over conventional and unconventional techniques	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C002.1	Define the role of mechatronics in various fields	[R]
C002.2	Demonstrate the role of sensors in various mechatronics applications.	[U]
C002.3	Apply various mechatronics concepts in engineering fields	[AP]
C002.4	Examine advanced applications of mechatronics	[A]
<b>Course Contents:</b>		
<p>Mechatronics Systems: Definition-applications-objectives-advantages. Mechatronics in Manufacturing. Mechanical Assembly techniques-Mechanisms in mechatronics. Conductors, insulators and semiconductors-Passive electrical components-Active elements-Digital electronic components. Digital control system</p> <p style="text-align: right;"><b>(15 hours)</b></p> <p>Motion Control devices: Hydraulic and pneumatic actuators-Electrical actuators-Micro actuators-Drive selection and Applications. Sensors and Transducers. Types and Selection. Design of mechatronics systems and stages-Robotics Systems-Pick and Place Robot- Sophia Robot. Artificial Neural Network in automobiles</p> <p style="text-align: right;"><b>(15 hours)</b></p> <p>Integrated systems: Fuzzy logic control in washing machine- Automatic camera system-Ink and laser jet printer-Bathroom scale system- Home Automation using IoT. Autotronics: Bosch Motronic Engine Management System-windscreen wiper mechanism-Digital Speedometer-Automatic Dim and Bright Control-Air Bag deployment control. Electrocardiograph (ECG) functions-Nervous System. Avionics: Cockpit instrumentation-Aircraft Guidance and Control-Aircraft Engine Control</p> <p style="text-align: right;"><b>(15 hours)</b></p> <p style="text-align: right;"><b>Total :45 hours</b></p>		
<b>Text Books:</b>		
1	Appukuttan.K.K, "Introduction to Mechatronics", 5th Edition, Oxford University Press, New Delhi, 2013	
2	Er.Rajput.R.K, "A Text Book of Mechatronics", 3rd Edition S. Chand & Company Ltd, New Delhi, 2013	
<b>Reference Books:</b>		
1	Devdas Shetty, Richard.A.Folk "Mechatronics System Design", 2nd Edition, Cengage Learning, USA, 2002	
2	Anandanatarajan.R, "Biomedical Measurements and Instrumentation", 2nd Edition, PHI Learning Private Limited, New Delhi, 2011	

<b>Web References:</b>	
1	<a href="https://nptel.ac.in/courses/112103174/">https://nptel.ac.in/courses/112103174/</a>
2	<a href="https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm">https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm</a>
3	<a href="https://www.bosch.com/stories/history-of-artificial-intelligence/">https://www.bosch.com/stories/history-of-artificial-intelligence/</a>
4	<a href="https://www.simform.com/home-automation-using-internet-of-things/">https://www.simform.com/home-automation-using-internet-of-things/</a>
5	<a href="https://en.wikipedia.org/wiki/Motronic">https://en.wikipedia.org/wiki/Motronic</a>

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C002.1	Remember	Test (Definition)	5
C002.2	Understand	Online Quiz	5
C002.3	Apply	Problem Solving	5
C002.4	Analyse	Group Assignment	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>C002.1</b>	3	3	3	2	2	3	2	2			2	3	1	1
<b>C002.2</b>	2	2	2	2	1	2	2	3			1	3	1	1
<b>C002.3</b>	3	3	3	3	3	3	3	3			2	3	2	3
<b>C002.4</b>	2	1	3	3	3	3	3	2			2	3	2	3

<b>20MT003</b>	<b>CONCEPTS OF VIRTUAL INSTRUMENTATION</b>		<b>3/0/0/3</b>
<b>Nature of Course</b> :Theory			
<b>Pre Requisites</b> : Nil			
<b>Course Objective:</b>			
1	To familiarize the basics of Virtual Instruments		
2	To implement basic programming concepts in LabVIEW		
3	To understand various interfacing buses		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C003.1	Explain basic concepts of Virtual Instruments.		[U]
C003.2	Outline programming concepts of LabVIEW.		[U]
C003.3	Build real time data acquisition system		[AP]
C003.4	Apply Virtual Instruments for various applications		[AP]
<b>Course Contents:</b>			
Introduction to Virtual Instrumentation – Graphical System Design model, Comparison with traditional Instrument - Graphical and data flow programming - Introduction to LabVIEW, Sub VI – Programming concepts: Loops, arrays, Cluster, Plotting data, Structures, Strings and File IO. <b>(15 Hours)</b>			
Common Instrument Interface: 4–20 MA Current Loop, RS 232, RS485, GPIB, VISA, Components of DAQ, DAQ Signal Accessory, DAQ Assistant, DAQ hardware and software <b>(15 Hours)</b>			
Hardware in the Loop (HIL), ADAS HIL With Sensor Fusion – Image processing and analysis - Machine Vision, Components and Programming process for Motion control, Data logging and supervisory control. Virtual Instrument Control System <b>(15 Hours)</b>			
<b>Total :45 hours</b>			
<b>Text Books:</b>			
1	Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Private Limited, 2012.		
2	Richard Jennings, “LabVIEW Graphical Programming” Fifth Edition, McGraw-Hill Education 2019.		
<b>Reference Books:</b>			
1	S. Sumathi and P. Surekha, “LabVIEW based Advanced Instrumentation Systems” Springer-Verlag Berlin Heidelberg, 2011.		
2	Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, “LabView Advanced Programming Techniques”, Second Edition, CRC Press, 2017		
<b>Web References:</b>			
1	<a href="http://www.ni.com">http://www.ni.com</a>		
2	<a href="https://www.lynda.com/LabVIEW-tutorials/Data-Acquisition-LabVIEW/2813149-2.html">https://www.lynda.com/LabVIEW-tutorials/Data-Acquisition-LabVIEW/2813149-2.html</a>		
<b>Assessment Methods &amp; Levels (based on Blooms’ Taxonomy)</b>			
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>			
<b>Course Outcome</b>	<b>Bloom’s Level</b>	<b>Assessment Component</b>	<b>Marks</b>
C003.1	Remember	Test (Definition)	<b>5</b>
C003.2	Understand	Online Quiz	<b>5</b>
C003.3	Apply	Case Study	<b>5</b>
C003.4	Apply	Group Assignment	<b>5</b>

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	20	10	25	25
Understand	40	40	35	35
Apply	40	50	40	40
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C003.1	3	2	2	2	3									
C003.2	3	2	2	2	3								2	2
C003.3	3	3	3	2	3	2							3	3
C003.4	3	3	3	2	3	2							3	3

20MT004	FIELD AND SERVICE ROBOTICS	3/0/0/3
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objective:</b>		
1	To understand the various parts of robots	
2	To develop the knowledge of various kinematics and inverse kinematics of robots.	
3	To study the control of robots for specific applications.	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C004.1	Define the basic concepts of robot	[R]
C004.2	Explain the function of sensors in the robot	[U]
C004.3	Choose a robot for advanced applications	[AP]
C004.4	Analyze robot kinematics and dynamics	[A]
<b>Course Contents:</b>		
Field and service robots-Classification-social and ethical implications of robotics- Robot for welding, Painting and REEM Robots. Robotic sensory devices and perception-Need for service robots - Applications- Patrolbot - Roomba and gita robots. Specifications of service and field Robots. <b>(15 Hours)</b>		
Non-conventional Industrial robots-Autonomous Mobile robots: Kinematics, locomotion, Perception-motion planning and control, localization and mapping; Intelligent unmanned vehicles – Robotic Navigation inspired by Principles of insect vision – 3D perception of mining Robotics. <b>(15 Hours)</b>		
Kinematics and dynamics-modeling and simulation-navigation, guidance and control. Planning And Navigation -Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance. Motor Selection in the design of a robotic joint. Digital control of a single axis. Delivery Robot used in Domino's Pizza, Amazon Echo vs Google Home. <b>(15 Hours)</b>		
		<b>Total hours : 45</b>
<b>Text Books:</b>		
1	Richard D Klafater, Thomas A Chmielewski, Michael Negin, "Robotic Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd.2011.	
2	R Siegwart, I. R. Nourobakhsh, Introduction to Mobile robotics, MIT Press, Cambridge, 2014	
<b>Reference Books:</b>		
1	G. Antonelli: Underwater Robots, 2nd Edition, Springer-Verlag, Berlin Heidelberg, 2011	
2	Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics", Springer, 2011	
3	Alex Zelinsky, "Field and Service Robotics". United Kingdom: Springer London. 2012	
<b>Web References:</b>		
1	<a href="http://nptel.ac.in/courses/112101099/">http://nptel.ac.in/courses/112101099/</a>	
2	<a href="http://nptel.ac.in/downloads/112101098/">http://nptel.ac.in/downloads/112101098/</a>	
3	<a href="https://http://pal-robotics.com/en/products/reem/">https://http://pal-robotics.com/en/products/reem/</a>	
4	Knight James & Sakhapov, Daniil & Domcsek, (2019). Insect-Inspired Visual Navigation On-Board an Autonomous Robot: Real-World Routes Encoded in a Single Layer Network. 60-67. 10.1162/isal_a_00141.	
5	<a href="https://eos.org/features/underground-robots-how-robotics-is-changing-the-mining-industry">https://eos.org/features/underground-robots-how-robotics-is-changing-the-mining-industry</a>	
6	<a href="https://link.springer.com/chapter/10.1007/978-1-4471-1273-0_9">https://link.springer.com/chapter/10.1007/978-1-4471-1273-0_9</a>	

**Assessment Methods & Levels (based on Blooms' Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C004.1	Remember	Test (Definition)	5
C004.2	Understand	Online Quiz	5
C004.3	Apply	Problem Solving	5
C004.4	Analyse	Group Assignment	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	-	30	15	15
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>C004.1</b>	3	3	3	3	3	3		3		3	3	3	3	3
<b>C004.2</b>	3	3	3	2	3	3	2	2			3	3	3	3
<b>C004.3</b>	3	3	2	3	3	1	1	2		2	3	2	3	3
<b>C004.4</b>	3	3	2	3	3	1	1	2		1	3	1	3	3

<b>20MT005</b>	<b>AUTOMATION SYSTEM</b>		<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory			
<b>Pre Requisites</b> : Nil			
<b>Course Objective:</b>			
<ol style="list-style-type: none"> <li>1. To understand the overview of Industrial Automation.</li> <li>2. To interpret the basics of PLC, DCS and SCADA.</li> <li>3. To learn the concept of HMI.</li> <li>4. To apply the concept of automation.</li> </ol>			
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C005.1	Relate the significance of control in automation.	[R]	
C005.2	Explain the concepts of PLC, DCS and SCADA in Automation.	[U]	
C005.3	Apply the concepts of PLC, DCS and SCADA in Automation.	[AP]	
C005.4	Analyse automation processes.	[A]	
<b>Course Contents:</b>			
Overview of Industrial Automation –Introduction, Industrial Revolutions, Current Challenges, technology trends, Automation system controllers, Functional requirements of an integrated information and automation systems - Types and advantages of automation system. <b>(15 Hours)</b>			
Programmable Logic Controller (PLC)-PLC architecture, Parts of PLC, Timers and Counters, Ladder logic, basic ladder logic programs. Distributed control system (DCS)- DCS Architecture, Functional components of DCS. Supervisory Control and Data Acquisition System (SCADA)- Overview of SCADA system. <b>(15 Hours)</b>			
Human Machine Interface (HMI) - Operator panel - Types of Mimic panels - Interfacing PLC to HMI - Artificial Intelligence in process control, Data flow with in automation system. Case studies:- Automatic room temperature control, Automatic water flow control, Automation of a conveyor system, Automatic traffic light control , Working of an automatic washing machine, Pneumatic circuit control using PLC. <b>(15 Hours)</b>			
			<b>Total hours:45</b>
<b>Text Books:</b>			
1	Mehta, B. R.; Reddy, Y. Jaganmohan, “Industrial process automation systems : design and implementation”, 6 <sup>th</sup> edition, Elsevier, 2015.		
2	.Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 6 <sup>th</sup> edition, 2019.		
<b>Reference Books:</b>			
1	Jon Stenerson, “Industrial Automation and Control”, 4 <sup>th</sup> edition, Prentice Hall, 2018		
2	Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 4 <sup>th</sup> edition, 2016.		
3	DobrivojePopovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 5 <sup>th</sup> edition, 2017.		
<b>Web References:</b>			
1	<a href="https://nptel.ac.in/courses/108106022/8">https://nptel.ac.in/courses/108106022/8</a>		
2	<a href="http://nptel.ac.in/courses/webcourse-contents/IITKharagpur/Industrial">http://nptel.ac.in/courses/webcourse-contents/IITKharagpur/Industrial</a>		
3	<a href="https://nptel.ac.in/courses/112102011/12">https://nptel.ac.in/courses/112102011/12</a>		

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C005.1	Remember	Test (Definition)	5	
C005.2	Understand	Online Quiz	5	
C005.3	Apply	Problem Solving	5	
C005.4	Analyze	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	20	10	10	30
Understand	50	40	40	40
Apply	20	20	40	20
Analyze	10	30	10	10
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>
<b>C005.1</b>	3	2	2	2	2	2	3						2	2
<b>C005.2</b>	3	2	2	3	2	2	3						2	2
<b>C005.3</b>	3	3	3	3	2	3	2						2	
<b>C005.4</b>	3	3	3	2	3	3	3						2	2

20MT006	INTELLIGENT AUTOMOTIVE SYSTEMS	3/0/0/3
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objectives:</b>		
<ol style="list-style-type: none"> <li>To understand the construction and working principle of various parts of an automobile.</li> <li>To interpret the basic electronic controls used in automobiles.</li> <li>To introduce the basic requirements of electric, hybrid and autonomous vehicles.</li> </ol>		
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have the ability to</b>		
C006.1	Identify the basic automobile components.	[R]
C006.2	Relate the role of electronic control in vehicles.	[U]
C006.3	Apply the basic working principles of Autonomous Vehicle Systems.	[AP]
C006.4	Contrast conventional and autonomous vehicle systems	[A]
<b>Course Contents:</b>		
Classification of automobiles -Main components of an automobile - Engine and its components – Introduction to Synchro Mesh and CVT Transmission –Rack and Pinion and Power steering– Construction and operation of MacPherson Strut suspension–Braking systems: Drum brakes and Disc Brakes. <b>(15 Hours)</b>		
Evolution of Automotive electronics–Starting System – Charging System –Electronic Fuel Control –Electronic Ignition Control – Electronic Engine Control – Active Suspension System – Anti lock Braking System – Traction Control System – Adaptive Cruise Control System – Tire Pressure Monitoring System - Airbags and Seatbelts –On Board Diagnostic Systems- Expert Systems. <b>(15 Hours)</b>		
Layout and basic system components of Electric Vehicles- Series and Parallel Hybrid Vehicles - Autonomous Driving Technologies Overview - Vehicle Localization: GNSS, LIDAR, Dead Reckoning and Wheel Odometry - Vehicle to Vehicle and Vehicle to Infrastructure Communication. <b>(15 Hours)</b>		
<b>Total Hours:45</b>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>Er.S.K.Gupta, “A Text Book of Automobile Engineering”, Chand Publications, NewDelhi,2014</li> <li>Tom Denton, “Automobile Electrical and Electronic Systems”, 5<sup>th</sup> Edition, Butterworth-Heinemann publications, Great Britain, 2017</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Liu.S, Li.L, Tang.J, Wu.S, Gaudiot.J, “Creating Autonomous Vehicle Systems”, Morgan &amp; Claypool Publishers, 2018.</li> <li>Kirpal Singh, “Automobile Engineering - VOL 1 &amp; 2”, Standard Publishers, Seventh edition 2011, New Delhi.</li> <li>B. William Ribbens, “Understanding Automotive Electronics”, 7th Edition, Butterworth, Heinemann, Woburn, 2015</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li><a href="https://www.edx.org/micromasters/chalmersx-emerging-automotive-technologies">https://www.edx.org/micromasters/chalmersx-emerging-automotive-technologies</a></li> <li><a href="https://www.edx.org/course/hybrid-vehicles-1">https://www.edx.org/course/hybrid-vehicles-1</a></li> </ol>		
<b>Online Resources:</b>		
<ol style="list-style-type: none"> <li><a href="https://in.udacity.com/course/self-driving-car-engineer-nanodegree--nd013">https://in.udacity.com/course/self-driving-car-engineer-nanodegree--nd013</a></li> <li><a href="https://www.edx.org/course/decision-making-for-autonomous-systems">https://www.edx.org/course/decision-making-for-autonomous-systems</a></li> </ol>		

**Assessment Methods & Levels (based on Bloom's Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

Course Outcome	Bloom's Level	Assessment Component	Marks
C006.1	Remember	Technical Quiz	5
C006.2	Understand	Case study on Electronic Engine Management Systems	5
C006.3	Apply	Group Assignment	5
C006.4	Analyze	Conventional to Autonomous Vehicles – Explore feasibility	5

**Summative assessment based on Continuous and End Semester Examination**

Bloom's Level	Continuous Assessment			End Semester Examination [50 marks]
	CIA-I [10 marks]	CIA-II [10 marks]	Term End Examination [10 marks]	
Remember	40	20	20	20
Understand	40	40	30	30
Apply	20	30	30	30
Analyse	-	10	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C006.1	1	1	1	1	2	1	2					3	1	
C006.2	2	2	2	2	1	2	2					3	1	
C006.3	3	3	3	3	3	3	3					3	2	3
C006.4	2	1	3	3	3	3	3					3	2	3

# **EMERGING ELECTIVES**



20MT007	BASICS OF DIGITAL SIGNAL PROCESSING		3/0/0/3
<b>Nature of Course</b> : Analytical			
<b>Pre Requisites</b> : 20MA301-Engineering Mathematics-III			
<b>Course Objective:</b>			
1.	To know about the various types of signals		
2.	To understand the fundamental concepts in digital signal processing.		
3.	To study the importance of Multirate signal processing and its application.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C007.1	Understand about various types of signals, classify them, analyze them, and perform various operations on them.		[U]
C007.2	Illustrate of transforms in the analysis of signals and systems in the frequency domain		[U]
C007.3	Explain the operation of digital signal processors		[U]
C007.4	Apply the concept of signal processing in various applications		[AP]
<b>Course Contents:</b>			
Classification of signals and systems: Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous and discrete time signals, signal sampling and quantization, discretization of continuous time signals. Basic system properties, Representation of digital signals. Case study of different signals from communication and biomedical field. <b>(15 hours)</b>			
Basic Concepts of Digital Signal Processing: Basic Digital Signal Processing in Block Diagrams :Digital Filtering - Signal Frequency (Spectrum) Analysis- Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm(FFT). Overview of Typical Digital Signal Processing in Real-World Applications - Digital Crossover Audio System- Speech Coding and Compression -Compact-Disc Recording System -Digital Photo Image Enhancement-Introduction to Melz spectrogram. <b>(15 hours)</b>			
Introduction to Multirate signal processing- speech and audio signal processing, Architecture of TMS 320C54XX Digital Signal processor-Digital Signal Processing Programming Examples - On-board DSP Technologies applied to Robotics Applications <b>(15 Hours)</b>			
<b>Total hours :</b>			<b>45</b>
<b>Text Books:</b>			
1	A.Anand kumar, "Digital Signal Processing" PHI learning Second edition 2015		
2	S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach', McGraw HillEdu, 2013.		
<b>Reference Books:</b>			
1	Rameshbabu, "Digital Signal Processing" Scitech Publications (India) Pvt.Ltd. 6 <sup>th</sup> Edition 2015.		
2	V.Udayashankara, "Modern Digital signal Processing", PHI Learning Private Limited, Third edition 2017.		
<b>Web References:</b>			
1	<a href="https://nptel.ac.in/courses/117/102/117102060/">https://nptel.ac.in/courses/117/102/117102060/</a>		
2	<a href="https://www.tutorialspoint.com/digital_signal_processing/">https://www.tutorialspoint.com/digital_signal_processing/</a>		
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>			
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>			
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>
C007.1	Remember	Assignment	<b>5</b>
C007.2	Understand	Online Quiz	<b>5</b>

C007.3	Apply	Problem Solving	5	
C007.4	Analyze	Test	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA1 [10 Marks]	CIA2 [10 Marks]	Term End Assessment [10 Marks]	
Remember	40	40	40	35
Understand	40	40	40	45
Apply	20	20	20	20
Analyze				
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
C007.1	3	2	2	2	2	2	3				2		2	2
C007.2	3	2	2	3	2	2	3				2		2	2
C007.3	3	3	3	3	2	3	2				2		2	
C007.4	3	3	3	3	2	3	2				2		2	

<b>20MT008</b>	<b>INDUSTRY 4.0 FOR MECHATRONICS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : Nil		
<b>Course Objectives:</b>		
1.	To make understand on fourth Industrial revolution, smart factories, cyber physical systems and virtual reality	
2.	To make understand the basics of industrial IOT and data management	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C008.1	Define the fourth industrial revolution	[R]
C008.2	Understand the basics of industrial IOT and key enablers of industrial IOT	[U]
C008.3	Apply the IIOT analytics and data management	[AP]
C008.4	Examine the IIOT Practical applications	[AN]
<b>Course Contents:</b>		
<b>INTRODUCTION TO INDUSTRY 4.0</b> : Drivers of Industry 4.0-The Fourth Industrial Revolution – Sustainability Assessment of Manufacturing- Lean Production System - Smart and Connected Business Perspective – End to End digital integration within a Smart Factories - Cyber - Physical Systems and Next - Generation -Collaboration Platform and Product Life cycle management - Augmented Reality and Virtual Reality - Artificial Intelligence - Big Data and Advanced Analysis <b>(15 Hours)</b>		
<b>BASICS OF INDUSTRIAL IOT</b> : Cybersecurity in Industry 4.0-Basics of industrial IoT- Industrial Internet Systems- Industrial Sensing and Actuation-Industrial Processes Business Models and Reference Architecture for IIoT. <b>KEY ENABLERS OF INDUSTRIAL IOT</b> : IoT Sensing - IoT Connectivity - IoT Networking - Process control. <b>(15 Hours)</b>		
<b>IIOT ANALYTICS AND DATA MANAGEMENT</b> : Introduction Machine Learning - Cloud Computing -Fog Computing in IIoT - Data Management with Hadoop - Advanced Technologies: Software Defined Networks (SDN) - Security in IIoT. <b>IIOT APPLICATIONS</b> : Factories and Assembly Line - Manufacturing Industry - Food Industry - Power Plants Healthcare - Inventory Management and Quality Control - Plant Security and Safety - Facility Management- Industry X.0 <b>(15 Hours)</b>		
		<b>Total hours: 45</b>
<b>Text Books:</b>		
1	Alasdair Gilchrist , "Industry4.0: The Industrial Internet of Things", Apress, 2016.	
2	Lane Thames, Dirk Schaefer , "Cyber Security for Industry4.0", Springer, 2017	
<b>Reference Books:</b>		
1	Bartodziej, Christoph Jan "The Concept Industry4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer Gabler, 2017.	
2	Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz , "Industry4.0: Industrial Revolution of the 21st Century", Springer, 2019	
<b>Web References:</b>		
1	<a href="https://www.epicor.com/en-in/resource-center/articles/what-is-industry-4-0/">https://www.epicor.com/en-in/resource-center/articles/what-is-industry-4-0/</a>	
2	<a href="https://www.i-scoop.eu/industry-4-0/">https://www.i-scoop.eu/industry-4-0/</a>	

3	<a href="https://nptel.ac.in/courses/106/105/106105195/">https://nptel.ac.in/courses/106/105/106105195/</a>			
<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C008.1	Remember	Test (Definition)	5	
C008.2	Understand	Online Quiz	5	
C008.3	Apply	Problem Solving	5	
C008.4	Analyse	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10 Marks]</b>	
Remember	30	20	20	20
Understand	30	30	30	30
Apply	30	25	30	30
Analyse	10	25	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
C008.1	2	3	3	3	3	3	3	0	0	0	0	0	3	3
C008.2	0	3	3	3	3	3	3	0	0	0	0	0	3	3
C008.3	0	0	3	3	3	3	3	0	0	0	0	0	3	3
C008.4	0	3	3	3	3	3	3	0	1	0	0	0	3	3

<b>20MT009</b>	<b>SOFT ROBOTICS</b>	<b>3/0/0/3</b>
<b>Nature of Course</b> : Theory		
<b>Pre Requisites</b> : 20MT702 Robotics and Machine Vision System		
<b>Course Objectives:</b>		
1	To interpret the basic Soft Robotic sensing and control	
2	To select appropriate Sensors and actuators for robots	
3	To learn and illustrate Artificial Muscle, actuation mechanisms and advanced hybrid robots	
<b>Course Outcomes:</b>		
<b>Upon completion of the course, students shall have ability to</b>		
C009.1	Relate the role of electronic control in soft robots.	[R]
C009.2	Illustrate various sensors and actuators in soft robotics.	[U]
C009.3	Identify hybrid actuators and bio-inspired mechanisms	[AP]
C009.4	Analyze advanced soft robot actuation mechanisms.	[A]
<b>Course Contents:</b>		
Introduction to soft robotics, compliance, and bio-inspiration, new concepts for distributed actuators and their control, Artificial muscles – <b>Introduction to smart materials and smart actuators</b> - dielectric elastomer actuators - Crystal deformation upon photo irradiation – Musculoskeletal robots – inherently compliant future robots – Actuation technologies for physical human robot interaction – wearable robots.		
<b>(15 hours)</b>		
Sensors and Actuators- Capacitive Tactile proximity sensing – Overview of soft robotic actuators – soft actuators based on electromagnetic coil and permanent magnet – Nanostructured materials for soft robotics (Sensors and Actuators) – photo responsive bending – bending and self-healing crystals – shape memory molecular crystals – organo super elasticity.		
<b>(15 hours)</b>		
Bio hybrid robots powered by artificial muscle tissue – plant inspired growing mechanism – soft hands for reliable grasping strategies – tubular continuum robots for surgical applications – Soft robotics with variable stiffness actuators – flexible robots for phono microsurgery – Bio-mimicry of Esophageal swallowing – Underwater soft robotics – Bio-inspired soft aerial robots.		
<b>(15 hours)</b>		
<b>Total hours:</b>		<b>45</b>
<b>Text Books:</b>		
1	Alexander Verl, Alin Albu-Schäffer, Annika Raatz, Oliver Brock, “Soft Robotics: Transferring Theory to Application”. Germany: Springer Berlin Heidelberg. 2015	
2	Amir Jafari, Nafiseh Ebrahimi, n.d. “Soft robotics in rehabilitation”, Elsevier Science. 2021	
<b>Reference Books:</b>		
1	Hideko Koshima, “Mechanically Responsive Materials for Soft Robotics”, Wiley, 2019.	
2	Soft Robotics: Trends, “Applications and Challenges” Proceedings of the Soft Robotics Week, Germany, Springer International Publishing, 2016.	
3	Kim, Jaeyoun (Jay). “Microscale Soft Robotics: Motivations, Progress, and Outlook”. Germany, Springer International Publishing, 2016.	
<b>Web References</b>		
1	<a href="https://news.mit.edu/2019/artificial-fiber-muscles-0711">https://news.mit.edu/2019/artificial-fiber-muscles-0711</a>	
2	<a href="https://www.wevolver.com/article/biomechanical.marvelcreating.an.artificial.muscle.a.ctuator">https://www.wevolver.com/article/biomechanical.marvelcreating.an.artificial.muscle.a.ctuator</a>	
3	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5495161/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5495161/</a>	

<b>Assessment Methods &amp; Levels (based on Blooms' Taxonomy)</b>				
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>				
<b>Course Outcome</b>	<b>Bloom's Level</b>	<b>Assessment Component</b>	<b>Marks</b>	
C009.1	Remember	Test (Definition)	5	
C009.2	Understand	Online Quiz	5	
C009.3	Apply	Problem Solving	5	
C009.4	Analyze	Group Assignment	5	
<b>Summative assessment based on Continuous and End Semester Examination</b>				
<b>Bloom's Level</b>	<b>Continuous Assessment</b>			<b>End Semester Examination [50 Marks]</b>
	<b>CIA1 [10 Marks]</b>	<b>CIA2 [10 Marks]</b>	<b>Term End Assessment [10Marks]</b>	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyze	-	30	15	15
Evaluate	-	-	-	-
Create	-	-	-	-

<b>Course Outcome (CO)</b>	<b>Programme Outcomes (PO)</b>												<b>Programme specific Outcomes (PSO)</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
C009.1	3	3	3	3	3	3	0	0	1	0	3	3	3	3
C009.2	3	3	3	3	3	3	3	0	0	0	3	3	3	3
C009.3	3	3	3	3	3	3	3	0	0	0	3	3	3	3
C009.4	3	3	3	3	3	3	3	0	0	1	3	3	3	3

# **MANDATORY COURSES**



20MC108	CONSTITUTION OF INDIA		2/0/0/0
<b>Nature of Course:</b> Theory			
<b>Pre Requisites</b> : Nil			
<b>Course Objectives:</b>			
1	To familiarize with basic information about Indian constitution		
2	To understand the fundamental rights and duties as citizens of India		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C108.1	Explain the objectives of the Constitution of India and its formation	[U]	
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]	
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]	
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]	
<b>Course Contents:</b>			
Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, <b>Citizenship</b> Article 5-11 .			
<b>(10 Hours)</b>			
Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat			
<b>(10 Hours)</b>			
Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. <b>Agricultural Law</b>			
<b>(10 Hours)</b>			
<b>Total Hours:</b>			<b>30</b>
<b>Text Books:</b>			
1	Dr.D.D.Basu, “Introduction to the Constitution of India”, LexisNexis, New Delhi, 22 <sup>nd</sup> edition, 2016.		
2	“Bare act-constitution of India”, The universal Publications, LexisNexis 2020, New Delhi, India.		
<b>Reference Books:</b>			
1	Subhash.C.Kashyap, “Our Constitution: An Introduction to India’s Constitution and Constitutional Law”, National Book Trust, India, 5 <sup>th</sup> edition, 2019.		
2	M. Laxmikanth, “Constitution of India”, Cengage Learning India. 1 <sup>st</sup> edition 2018.		
<b>Web References:</b>			
1	<a href="https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ">https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ</a>		
2	<a href="https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY">https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY</a>		
<b>Assessment Methods &amp; Levels (based on Blooms’ Taxonomy)</b>			
<b>Formative assessment based on Capstone Model (Max. Marks:20)</b>			
<b>Course Outcome</b>	<b>Bloom’sLevel</b>	<b>Assessment Component</b>	<b>Marks</b>
C108.1	Remember	Test	<b>20</b>
C108.4	Understand	Quiz	<b>40</b>
C108.3	Apply	Presentation	<b>20</b>
C108.2	Apply	Group Assignment	<b>20</b>
			<b>100</b>

Course outcome	Program outcomes (POs)												Program specific outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>C108.1</b>	0	0	0	0	0	3	3	3	0	1	0	0	0	3
<b>C108.2</b>	0	2	0	3	0	3	3	3	3	0	3	3	0	3
<b>C108.3</b>	0	0	0	3	0	3	3	3	3	0	3	3	0	3
<b>C108.4</b>	0	2	0	0	0	3	3	3	3	0	0	0	1	3

<b>20MC109</b>	<b>ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE</b>		<b>2/0/0/0</b>
<b>Nature of Course:</b> Theory			
<b>Pre Requisites</b> : Nil			
<b>Course Objectives:</b>			
1	To make understand the contribution of Indian mind in various fields.		
2	To cultivate critical appreciation of the thought content and provide insights relevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.		
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C109.1	Relate classical Indian traditions with contemporary traditions and culture.		[U]
C109.2	Describe the thoughts of Indians in different disciplines.		[R]
C109.3	Apply the knowledge to the present context.		[AP]
C109.4	Discover a better appreciation and understanding of Indian traditions.		[AP]
<b>Course Contents:</b>			
Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture. <b>(10 hours)</b>			
Astronomy in India – Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation - Ayurveda for Life, Health and Well-being. <b>(10 hours)</b>			
The Historical Evolution of Medical Tradition in Ancient India - Music in India - Classical & Folk dance - Theatre and Drama in India. <b>(10 hours)</b>			
			<b>Total Hours: 30</b>
<b>Text Books:</b>			
1	Kapil Kapoor and Michel Danino, Textbook of “Knowledge Traditions and Practices of India”, Central Board of Secondary Education, 2017.		
2	Yogesh Atal, “Indian Society: Continuity and Change”, Pearson Education India, 2016.		
<b>Reference Books:</b>			
1	Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.		
2	Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction to Social Thoughts”, S Chand Publisher, 2019.		
<b>Web References:</b>			
1	<a href="http://nopr.niscair.res.in/handle/123456789/43">http://nopr.niscair.res.in/handle/123456789/43</a>		
2	<a href="https://nptel.ac.in/courses/109/104/109104102/">https://nptel.ac.in/courses/109/104/109104102/</a>		
<b>Assessment Methods &amp; Levels (based on Blooms’ Taxonomy)</b>			
<b>Formative assessment based on Capstone Model (Max. Marks:100)</b>			
<b>Course Outcome</b>	<b>Bloom’s Level</b>	<b>Assessment Component</b>	<b>Marks</b>
C109.1	Remember	Quiz	<b>20</b>
C109.2	Understand	Group Assignment	<b>20</b>
C109.3	Apply	Presentation	<b>20</b>
C109.4	Apply	Survey	<b>40</b>
			<b>100</b>

Course outcome	Program outcomes (POs)												Program specific outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C109.1	0	0	0	0	0	3	3	0	0	0	0	3	0	3
C109.2	0	0	0	0	0	3	3	0	0	0	0	3	0	3
C109.3	0	0	0	0	0	3	3	0	0	0	0	3	0	3
C109.4	0	0	0	0	0	3	3	0	0	0	0	3	0	3

<b>20MC110</b>	<b>BIOLOGY</b>		<b>2/0/0/0</b>
<b>Nature of Course</b> : Theory			
<b>Pre requisites</b> : Nil			
<b>Course Objectives:</b>			
<ol style="list-style-type: none"> <li>1. To understand the basic biological concepts related to engineering systems.</li> <li>2. To have adequate knowledge about the various human anatomy and physiological systems.</li> <li>3. To impart the knowledge about biological systems in the environment.</li> </ol>			
<b>Course Outcomes:</b>			
<b>Upon completion of the course, students shall have ability to</b>			
C110.1	Relate the biological system with engineering concepts		[R]
C110.2	Understands the anatomy and physiology of human system.		[U]
C110.3	Understand the concept of plant, animal and microbial systems and growth in real life situations		[U]
C110.4	Apply the knowledge of applications of biological systems in relevant industries.		[AP]
<b>Course Contents:</b>			
Introduction, Science and Engineering – Phylogeny, Motivation, Methods, Synthesis, Biological Classification, Biology as whole, Applications of Biology, Principles of biology – Genetic Basics, substance for life – Basic organic chemical structure, chemical bonding, acid, base reactions, physicochemical interactions. <b>( 10 hours)</b>			
Cell – prokaryotes and eukaryotes, biological membrane, membrane transport, eukaryotic cell structure and function. Plant – plant division, Animal – reproductive strategies, Human – Skin, skeletal system, muscular system, nervous system, cardiovascular system, respiratory system, digestion, nutrition, excretory system. <b>( 10 hours)</b>			
Industrial Microbiology and its Applications, Relationship between Engineering and Biology - Living things as solution, models, recipients, inadvertently affected. Biological solutions to Industrial Problems. Cell organization, signalling and deciphering human genetic variation <b>(10 hours)</b>			
			<b>Total hours: 30</b>
<b>Text Books:</b>			
1.	A Text book of Biotechnology, R.C.Dubey, S. Chand Higher Academic Publications, 2015.		
2.	ThyagaRajan.S., Selvamurugan. N., Rajesh.M.P., Nazeer.R.A., Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K., “Biology for Engineers”, Tata McGraw-Hill, New Delhi, 2017.		
<b>Reference Books:</b>			
1.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2014.		
2.	David A. Vaccari , Peter F. Strom, James E.Alleman,” Environmental Biology for Engineers and Scientist”, A John Willey Inc. publications, 2018.		
<b>Web References:</b>			
1.	<a href="https://www.cellsalive.com/">https://www.cellsalive.com/</a>		
2.	<a href="https://www.visiblebody.com/teaching-anatomy/courseware">https://www.visiblebody.com/teaching-anatomy/courseware</a>		

Online Resources:	
1.	<a href="https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology/17.1%3A_Industrial_Microbiology">https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology/17.1%3A_Industrial_Microbiology</a>
2.	<a href="http://sites.khas.edu.tr/bioinformatics/whats/bioinformatics-genetics/">http://sites.khas.edu.tr/bioinformatics/whats/bioinformatics-genetics/</a>

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	Bloom's Level	Assessment Component	Marks
C110.1	Remember	Case Study Assessment	10
C110.2	Understand	Assignment	10
C110.3	Understand	Online Quiz	10
C110.4	Remember	Presentation	10
Summative assessment based on Continuous Assessment			
Bloom's Level	CIA-I	CIA-II	Term End Examination [60 marks]
Remember	-	-	50
Understand	-	-	20
Apply	-	-	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course outcome	Program outcomes (POs)												Program specific outcome (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C110.1	3	3	2	0	0	3	3	0	0	0	3	3	0	3
C110.2	3	3	2	2	2	3	3	0	0	0	3	3	0	3
C110.3	3	3	2	2	2	3	3	0	0	0	3	3	0	3
C110.4	3	3	2	2	2	3	3	0	0	0	3	3	0	3