Curriculum for UG Degree Course in

Mechatronics Engineering

Regulation 2024

CHENNAI INSTITUTE OF TECHNOLOGY

Section 1: General Course Structure

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

B. Structure of Program

S. No.	Category	Credits
1	Humanities & Social Science Courses (HSMC)	13
2	Basic Science Courses (BSC)	28
3	Engineering Science Courses (ESC)	34
4	Program Core Courses (PCC)	58
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Employability Enhancement Skills (EES)	13
8	Mandatory Course (MC)	-
	TOTAL	**170**

C. Course code and definition

Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits
<MT>	Professional core courses
<MT> PE	Professional Elective courses
<MT> OE	Open Elective Courses
<MT> MC	Mandatory Courses

- **Course level coding scheme:** Four-digit number used as suffix with the Course Code for identifying the level of the course. Thousand's place denotes regulation number (we use "4" for 2024-25 Regulation). Digit at hundred's place signifies the semester in which course is offered. Last two digits represent the serial order of course within the semester. For example, 4101, 4102, … are courses offered during first semester.

D. Category-wise Courses

Humanities & Social Science Courses (HSMC)

S. No.	Course Title	Semester	L-T-P-C
1	தமிழர் மரபு / Heritage of Tamils	I	1-0-0-1
2	Communicative English - I	I	3-0-2-4
3	Professional Ethics	I	3-0-0-3
4	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	II	1-0-0-1
5	Communicative English - II	II	3-0-2-4
	Total Credits		**13**

Basic Science Courses (BSC)

S. No.	Course Title	Semester	L-T-P-C
1	Calculus and Linear Algebra	I	3-1-0-4
2	Engineering Physics	I	3-0-2-4
3	Probability and Statistics	II	3-1-0-4
4	Material Science	II	3-0-2-4
5	Mathematical methods for Engineering	III	3-0-2-4
6	Numerical Methods	IV	3-1-0-4
		Total Credits	**24**

Engineering Science Courses (ESC)

S. No.	Course Title	Semester	L-T-P-C
1	Engineering Graphics	I	2-0-4-4
2	Problem Solving using C Programming	I	3-0-2-4
3	Engineering Mechanics	II	3-1-0-4
4	Problem Solving using Python Programming	II	3-0-2-4
5	Electronic Devices and Circuits.	II	3-0-2-4
6	Data Structures	II	3-0-0-3
7	Fluid Mechanics and Thermal System	III	3-0-2-4
8	Artificial Intelligence and Machine Learning	III	3-0-0-3
9	Object Oriented Programming	III	3-0-2-4
10	Mechanics of Materials	IV	3-0-0-3
		Total Credits	**37**

Program Core Courses (PCC)

S. No.	Course Title	Semester	L-T-P-C
1	Digital Electronics and Microcontroller	III	3-0-2-4
2	Electrical Drives and Actuators	III	3-0-2-4
3	Core Course Project - I	III	0-0-2-1
4	Control System Engineering	IV	3-0-0-3
5	Sensors, Measurements and Instrumentation	IV	3-0-2-4
6	Kinematics and Dynamics of Machinery	IV	3-0-2-4
7	Manufacturing Technology	IV	3-0-2-4
8	Computer Aided Design and Modelling Laboratory	IV	0-0-4-2
9	Core Course Project - II	IV	0-0-2-1
10	Design of machine Elements	V	3-0-0-3
11	Computer Aided Design and Manufacturing	V	3-0-2-4
12	Fluid Power System for Automation	V	3-0-2-4
13	Core Course Project - III	V	0-0-2-1
14	Design of Mechatronics System	VI	3-0-0-3
15	Robotics and Machine Vision Systems	VI	3-0-2-4
16	Industrial Automation	VI	3-0-2-4
17	Core Course Project - IV	VI	0-0-2-1
18	Embedded and Real Time Operating Systems	VII	3-0-0-3
19	Internet of Things - Concepts and Applications	VII	3-0-2-4
		Total Credits	**58**

Professional Elective courses

S. No.	Course Title	Semester	L-T-P-C
1	Professional Elective – I	V	3-0-2-3
2	Professional Elective – II	V	3-0-2-3
3	Professional Elective – III	V	3-0-2-3
4	Professional Elective – IV	VI	3-0-2-3
5	Professional Elective – V	VI	3-0-2-3
6	Professional Elective – VI	VII	3-0-2-3
		Total Credits	**18**

Open Elective Courses (OEC)

S. No.	Course Title	Semester	L-T-P-C
1	Open Elective – I	VI	3-0-0-3
2	Open Elective – II	VII	3-0-0-3
		Total Credits	**6**

Mandatory Course (MC)

S. No.	Course Title	Semester	L-T-P-C
1	MC43XX-Mandatory Course-I	III	2-0-0-0
2	MC44XX-Mandatory Course-II	IV	2-0-0-0
		Total Credits	**0**

Employability Enhancement Skills (EES)

S. No.	Course Title	Semester	L-T-P-C
1	Employability Enhancement Skills – I	I	0-0-2-1
2	Employability Enhancement Skills – II	II	0-0-2-1
3	Employability Enhancement Skills – III	III	0-0-2-1
4	Employability Enhancement Skills – IV	IV	0-0-2-1
5	Employability Enhancement Skills – V	V	0-0-2-1
6	Project Work Phase -I	VII	0-0-8-4
7	Project Work Phase -II	VIII	0-0-8-4
		Total Credits	**13**

E. Induction Program

- ***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.
- This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

Evaluation Scheme

a. **For Theory Courses:**
   The weightage of Internal assessment is 40% and for End Semester Exam is 60%
   The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass
b. **For Practical Courses:**
   The weightage of Internal assessment is 60% and for End Semester Exam is 40%
   For Theory cum Lab
   The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass.
c. **For Theory Cum Practical Courses:**
   The weightage of Internal assessment is 50% and for End Semester Exam is 50%
   The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

Note: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

d. For Project work:

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

F. Learning Beyond Class Room

a. Students should be encouraged to visit Centers of Excellence (COEs) in the campus and learn additional technical skills
b. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis

Section 2: Semester wise Structure and Curriculum for UG Course in Mechatronics Engineering

Semester I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	HS4101	தமிழர் மரபு / Heritage of Tamils	1	0	0	1
2	T	MA4101	Calculus and Linear Algebra	3	1	0	4
3	T&P	HS4102	Communicative English - I	3	0	2	4
4	T&P	PH4101	Engineering Physics	3	0	2	4
5	T&P	CS4111	Problem Solving using C Programming	3	0	2	4
6	T&P	ME4101	Engineering Graphics	2	0	4	4
7	T	ME4102	Engineering Mechanics	3	1	0	4
8	P	ES4101	Employability Enhancement Skills-I	0	0	2	1
						Total	**26**

Semester II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	HS4201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1
2	T	MA4201	Probability and Statistics	3	1	0	4
3	T	MT4201	Data Structures	3	0	0	3
4	T&P	HS4202	Communicative English - II	3	0	2	4
5	T&P	PH4201	Material Science	3	0	2	4
6	T&P	CS4212	Problem Solving using Python Programming	3	0	2	4

7	T&P	EC4212	Electronic Devices and Circuits.	3	0	2	4
8	P	ES4201	Employability Enhancement Skills-II	0	0	2	1
9			NCC Credit Course Level 1 ARMY WING*	2	0	0	2*
						Total	**25**

* NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester III							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA4301	Mathematical Methods for Engineering	3	1	0	4
2	T&P	MT4301	Digital Electronics and Microcontroller	3	0	2	4
3	T&P	MT4302	Fluid Mechanics and Thermal System	3	0	2	4
4	T	MT4303	Artificial Intelligence and Machine Learning Fundamentals	3	0	0	3
5	T&P	MT4304	Object Oriented Programming	3	0	2	4
6	T&P	MT4305	Electrical Drives and Actuators	3	0	2	4
7	P	MT4306	Core Course Project - I	0	0	2	1
8	P	ES4301	Employability Enhancement Skills-III	0	0	2	1
9	T	MC430X	Mandatory Course-I	3	0	0	0
						Total	**25**

Semester IV							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA4401	Numerical Methods	3	1	0	4
2	T	MT4401	Mechanics of Materials	3	0	0	3
3	T	MT4402	Control System Engineering	3	0	0	3
4	T&P	MT4403	Sensors, Measurements and Instrumentation	3	0	2	4
5	T&P	MT4404	Kinematics and Dynamics of Machinery	3	0	2	4
6	T&P	MT4405	Manufacturing Technology	3	0	2	4
7	P	MT4406	Computer Aided Design and Modelling Laboratory	0	0	4	2
8	P	MT4407	Core Course Project - II	0	0	2	1
8	P	ES4401	Employability Enhancement Skills-IV	0	0	2	1
9	T	MC440X	Mandatory Course-II	3	0	0	0
10	T		NCC Credit Course Level 2 NAVAL WING*	2	0	0	2*
						Total	**22**

* NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester V							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MT4501	Design of Machine Elements	3	0	0	3
2	T	MT4VXX	Professional Elective-I	3	0	0	3
3	T	MT4VXX	Professional Elective-II	3	0	0	3
4	T	MT4VXX	Professional Elective-III	3	0	0	3
5	T&P	MT4502	Computer Aided Design and Manufacturing	3	0	2	4
6	T&P	MT4503	Fluid Power System for Automation	3	0	2	4
7	P	MT4504	Core Course Project - III	0	0	2	1
8	P	ES4501	Employability Enhancement Skills-V	0	0	2	1
						Total	**22**

Semester VI							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MT4601	Design of Mechatronics System	3	0	0	3
2	T	MT46OX	Open Elective-I	3	0	0	3
3	T	MT4VXX	Professional Elective IV	3	0	0	3
4	T	MT4VXX	Professional Elective V	3	0	0	3
5	T&P	MT4602	Robotics and Machine Vision Systems	3	0	2	4
6	T&P	MT4603	Industrial Automation	3	0	2	4
7	P	MT4604	Core Course Project - IV	0	0	2	1
8	T		NCC Credit Course Level 3 AIR FORCE WING*	2	0	0	2*
						Total	**21**

* NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

Semester VII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
	T	GE4701	Professional Ethics in Engineering	3	0	0	3
1	T	MT4701	Embedded and Real Time Operating Systems	3	0	0	3
2	T	MT47OX	Open Elective-II	3	0	0	3
3	T	MT4VXX	Professional Elective- VI	3	0	0	3
4	T&P	MT4702	Internet of Things - Concepts and Applications	3	0	2	4
5	P	MT4703	Project Work Phase -I	0	0	8	4
						Total	**20**

Semester VIII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P	MT4801	Project Work Phase -II	0	0	8	4
						Total	**4**

APPENDIX A: PROFESSIONAL ELECTIVES

Applied Robotics	Electronics, Networking and Automation	Design and Manufacturing
Robot Control System	Linear Integrated Circuits	Product Life Cycle Management
Robot Operating Systems	ARM Architecture and Programming	Lean Manufacturing
Collaborative Robotics	Micro Electro Mechanical Systems	Advanced Manufacturing Systems
Robots and Systems in Smart Manufacturing	Power Electronics	Welding Technology and Automation
Microrobotics	Virtual Instrumentation	Additive Manufacturing
Mobile Robotics	Total Integrated Automation	Computer Integrated Manufacturing
Humanoid Robotics	Digital Twin and Industry 5.0	Process Planning and Cost Estimation
Drone Technologies	Industrial Network Protocols	Production Planning and Control

Autonomous Vehicle Technology	Cognitive Automation Systems	Management Courses
Automobile Engineering	Cognitive Computing	Principles of Management
Electric and Hybrid Vehicles	Deep Learning	Total Quality Management
Automotive Mechatronics	Natural Language Processing	Engineering Economics and Financial Accounting
Automotive System Modelling and Simulation	Computer Vision and Image Processing	Human Resource Management
Vehicle Dynamics and Controls	Reinforcement Learning	Knowledge Management
Advanced Driver Assistance Systems	Big Data Analytics	Industrial Management
Battery Management System	Robotic Process Automation	
Unmanned Aerial Vehicles	Optimization Techniques	

APPENDIX B: OPEN ELECTIVES

OPEN ELECTIVES- I

S.No	Course code	Course Title
1	MT46O1	Product Design and Development
2	MT4602	Fundamentals of Aeronautical Engineering
3	MT4603	Introduction to Aerial Robotics
4	MT2604	Wearable Devices
5	MT2605	Medical Mechatronics
6	MT2606	Industrial Internet of Things

OPEN ELECTIVES - II

S.No	Course code	Course Title
1	MT2701	Avionics
2	MT2702	Design of UAV Systems
3	MT2703	Machine Learning for Intelligent Systems
4	MT2704	Aircraft Mechatronics
5	MT2705	Agricultural Robotics and Automation
6	MT2706	Underwater Robotics

APPENDIX C: MANDATORY COURSES

Course Code	Course Title	Semester	L-T-P-C
MC4301	Introduction to Women and Gender Studies	III	2-0-0-0
MC4302	Elements of Literature	III	2-0-0-0
MC4303	Film Appreciation	III	2-0-0-0
MC4304	Disaster Management	III	2-0-0-0
MC4305	Design Thinking	III	2-0-0-0
MC4401	Environmental Science and Sustainability	IV	2-0-0-0
MC4402	Well, Being with traditional practices (Yoga, Ayurveda and Siddha)	IV	2-0-0-0
MC4403	History of Science and Technology in India	IV	2-0-0-0
MC4404	Political and Economic Thought for a Humane Society	IV	2-0-0-0
MC4405	State, Nation Building and Politics in India	IV	2-0-0-0
MC4406	Industrial Safety	IV	2-0-0-0

Semester I

Course Code	தமிழர் மரபு / Heritage of Tamils	L	T	P	C
HS4101		1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் –தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் தெய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.

2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

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1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).

3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, featuring documentaries, lectures, interviews, and discussions related to Tamil heritage and civilization.

2. **Madras Heritage and Carnatic Music:** This channel explores the heritage of Chennai (formerly Madras), including historical sites, architecture, cultural events, Carnatic music, and traditional arts of Tamil Nadu.

3. **Tamil Heritage Trust:** The Tamil Heritage Trust channel features videos on Tamil heritage, archaeological discoveries, heritage conservation, temple architecture, and cultural heritage initiatives.

4. **Vanam Tamil Arts & Culture:** This channel focuses on Tamil arts, culture, literature, folk traditions, dance forms, music, storytelling, and cultural events celebrating Tamil heritage.

5. **Chennai Heritage:** Chennai Heritage offers videos on the heritage of Chennai city, historical landmarks, monuments, heritage walks, cultural festivals, and stories of the city's past.

Course Code	தமிழர் மரபு / Heritage of Tamils	L	T	P	C
HS4101		1	0	0	1

UNIT I Language and Literature **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry – Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II Heritage - Rock Art Paintings to Modern Art – Sculpture **3**

Hero stone to modern sculpture - bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III Folk and Martial Arts **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV Thinai Concept Of Tamils **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V Contribution Of Tamils To Indian National Movement And Indian Culture **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
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8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

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12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, featuring documentaries, lectures, interviews, and discussions related to Tamil heritage and civilization.

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Course Code	MATHEMATICS – I	L	T	P	C
MA4101	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with differential calculus.
- To acquire the knowledge of evaluating integrals and their applications.
- To introduce the concept of ordinary differential equations in engineering problems.
- To develop the use of matrix algebra techniques for practical applications.
- To acquire the knowledge of vector spaces and linear transformation in all engineering disciplines.

UNIT I DIFFERENTIAL CALCULUS **12**

Representation of a function - Limits - Continuity – Derivatives- Mean Value theorem - Rolle's theorem - Maclaurin series - Partial derivatives - Total derivatives - Taylors series - Maxima and minima.

UNIT II INTEGRAL CALCULUS **12**

Multiple Integration: Double and Triple integrals - Change of order of integration in double integrals - Change of variables (Cartesian to polar) -Volume of solids - Gradient - Curl - Divergence - Theorems of Green in a plane - Gauss and Stokes theorems (Excluding Proof).

UNIT III DIFFERENTIAL EQUATIONS **12**

First order linear and nonlinear differential equations - Higher order linear differential equations with constant coefficients - Method of Variation of Parameters - Cauchy's and Legendre's equations - Solution of partial differential equations.

UNIT IV LINEAR ALGEBRA **12**

Matrices: Determinants - rank of a matrix - System of linear equations (Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan) - Eigen Values - Eigen Vectors - Reduce the quadratic form into Canonical form - LU decomposition - Singular Value Decomposition.

UNIT V VECTOR SPACES AND LINEAR TRANSFORMATIONS **12**

Vector Space – Subspace - linear dependence and independence - bases and dimensions - Linear transformations - Null space - range - Dimension theorem - Matrix representation of a linear transformations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Apply differential calculus tools in solving various applications in real situations.
CO2: Able to use the integral ideas in solving areas, volumes and other practical problems.
CO3: Apply various techniques in solving ordinary differential equations.
CO4: Recalling the matrix algebra methods for solving the practical problems.
CO5: Understand the concepts of vector spaces and applications of linear transformations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Friedberg. A.H., Insel. A.J, and Spence. L ., “Linear Algebra”, Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", Pearson India, 12thEdition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O’Neil, P.V. “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi,2007.
4. Sastry, S.S, “Engineering Mathematics", Vol. I& II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
7. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson India, Eighth Edition, 2017.
8. Kumaresan. S., “Linear Algebra – A Geometric Approach”, Prentice – Hall of India, New Delhi, Reprint, 2010.

TOTAL 60 PERIODS

Course Code	COMMUNICATIVE ENGLISH –I	L	T	P	C
HS4102		3	0	2	4

COURSE OBJECTIVES

To improve the communication competency.
To learn basic grammatical structures in suitable contexts.
To build students English language skills through LSRW.
To enable the students to write in English precisely and effectively
To develop language proficiency in expressing their opinions.

COURSE DESCRIPTION

This course aims to develop students' proficiency in English language skills, focusing on speaking, listening, reading, and writing. Emphasis is placed on real-life communication situations to enhance students' ability to interact effectively in various contexts.

PREREQUISITES

Basic knowledge of English grammar
Vocabulary is recommended for successful participation in this course.

Introduction To Effective Communication **1**

What is effective communication? Why is communication critical for excellence during study, research, and work? What are the seven Cs of effective communication?

UNIT I – Integrals Of Communication (Greetings &Introduction) **8**

Listening – Listening comprehensions, listening to News Speaking – Just A Minute, introducing a friend Reading – Reading Newspaper / Articles/ Magazines, reading comprehension Vocabulary – Synonyms& Antonyms, Acquaintance with Prefixes & suffixes from foreign languages in English to form derivatives and Word formation Grammar – Parts of Speech, Mixed Tenses, Active & Passive Voice Writing –Letter of Introduction, Developing the Hints

UNIT II – Giving And Receiving Instructions **9**

Listening – Listening to short stories, Narrations and Persuasive speech Speaking – Giving Instructions to use the Product/ Presenting or summarizing about a product Reading – Reading Advertisements / Biographies Vocabulary – Abbreviation, Acronyms, one – word Substitutes Grammar – WH Questions/Yes or No Questions, Imperatives Writing – Instructions, Paragraph Writing

UNIT III – Describing People And Places **9**

Listening – Listening to the description of a product Speaking –Picture Description, narrating personal experiences and events Reading – Gadget Reviews, User Manuals Vocabulary – Homonyms, Homophones, Compound Words Grammar – Adjectives, Adverbs, Articles. Writing – Recommendations, Product/ Process Description.

UNIT IV –Visualization and Classification **9**

Listening – TED talks Speaking – Interviewing a celebrity/Famous Personality Reading – Company profiles, Business Letters Vocabulary– Discourse Markers, Linking words and Phrases Collocation. Grammar – Pronouns, Conjunction, Preposition Writing – Interpretation of Charts and Graphs

UNIT V – Exposition **9**

Listening – Watching Movies / Listening to Dialogues and Conversations Speaking – Role play, Panel Discussion, Debate Reading – Blogs, Novels, Short Stories Vocabulary – Phrasal Verbs
Grammar– Simple/Compound/Complex Sentences, Error Spotting, Punctuation. Writing – Descriptive Essay, Dialogue Writing

TOTAL HOURS (THEORY):45

LIST OF EXERCISES:

1. Extempore (Oral)
2. Conversation on asking directions
3. Picture Description, about purchasing a product.
4. Summarizing a TED talk.
5. Role play.

PRACTICAL– 30 PERIODS

COURSE OUTCOMES

After the completion of the course, students will be able to

CO1. Use appropriate words in a professional context

CO2. Gain an understanding of basic grammatical structures and use them in the right context.

CO3. Write definitions, descriptions, narrations and essays on various topics

CO4. Speak fluently and accurately in formal and informal communicative contexts

CO5. Express their opinions effectively in both oral and written medium of communication.

TOTAL – 75 PERIODS

TEXT BOOKS

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)

2. English for Science & Technology Cambridge University Press, 2021.Authored by Dr. Veena Selvam,Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani,Department of English, Anna University.

3. Professional English-II, V.K.Publications, Dr.S.N. Mahalakshmi.

REFERENCES

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.

2. A Course Book on Technical English by Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.

3. Learning to Communicate–Dr.V. Chellammal. Allied Publishers, New Delhi,2003.

YOUTUBE RESOURCES:

1. **BBC Learning English EngVid -** EngVid features lessons by experienced English teachers on various topics such as grammar, speaking skills, idioms, and pronunciation. The videos are engaging and suitable for learners at different levels.

2. **EngVid Learn English with Misterduncan -** This channel offers lessons in a fun and entertaining format, covering grammar, vocabulary, and common English phrases. Misterduncan's engaging style makes learning English enjoyable.

3. **Learn English with Misterduncan Rachel's English -** Rachel's English focuses on pronunciation and accent reduction. The channel provides clear explanations, practice exercises, and tips to improve spoken English clarity and fluency.

4. **Rachel's English TED-Ed: Lessons Worth Sharing -** TED-Ed features animated lessons on a wide range of topics, including language and communication. Students can explore TED-Ed's library for insightful talks and discussions related to effective communication skills.

Course Code	ENGINEERING PHYSICS	L	T	P	C
PH4101		3	0	2	4

COURSE OBJECTIVES:

1. To enable students to understand the mechanics and properties of matter.
2. To provide an overview of sound and ultrasonic production, detection and applications.
3. To introduce the basics of lasers.
4. To enrich the basic knowledge of optical fiber
5. To understand quantum mechanical phenomena and apply them in computing fields.

UNIT I MECHANICS AND PROPERTIES OF MATTER **9**

Center of mass (CM) – motion of the CM – moment of inertia – theorems of M. I – moment of inertia of continuous bodies (Ring, Disc) – gyroscope.

Elasticity –Type of modulus: Young's Modulus, Bulk Modulus, Rigidity Modulus –Poisson ratio - Hooke's law – stress-strain diagram – Factors affecting elasticity – bending of Beams – Young's modulus by uniform bending and non–uniform bending – Torsional Pendulum – I – shaped girders.

UNIT II ACOUSTICS AND ULTRASONICS **9**

Acoustics: Classification and characteristics of sound – decibel – Weber – Fechner law – Factors affecting acoustics of buildings and their remedies – Absorption Coefficient. -Doppler effect. Ultrasonic – Production of Ultrasonic by Magnetostriction and piezoelectric methods – acoustic grating – Non-destructive testing – Pulse-echo system through transmission and reflection modes – A, B and C – scan displays.

UNIT III LASER **9**

Laser: Characteristics – Spontaneous and stimulated emission – Pumping methods – Optical Resonator – Active medium and Active center – Einstein's coefficient – Principles of Laser – population inversion-Components Laser systems - Types of laser – Nd – YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction - Industrial and medical application

UNIT IV FIBRE OPTICS **9**

Fiber optics – Principle, Numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Attenuation, Dispersion – Fiber Optical Communication system (Block diagram) – Displacement sensors- Temperature/Pressure sensors –Optical fibers in computers - Medical Applications: Endoscope.

UNIT V QUANTUM MECHANICS **9**

Blackbody Radiation - Planck's quantum theory – Compton effect – Particle properties of wave: Matter waves, wave function – The Schrodinger equation (Time-dependent and time-independent forms) – Particle in an infinite potential well: One Dimensional Box –Qubit- Quantum computing – the role of Quantum computing in advancing Artificial intelligence.

THEORY: 45 PERIODS

PRACTICAL EXERCISES (FIVE ONLY)

1. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
2. Non-Uniform bending – Determination of Young's modulus.
3. Uniform bending – Determination of Young's modulus.
4. Laser – Determination of the wavelength of the laser using grating.
5. Optical fiber – Determination of Numerical Aperture and acceptance angle.
6. Acoustic grating – Determination of velocity of ultrasonic waves in liquids.
7. Michelson Interferometer.

PRACTICAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

After the completion of the course, students will be able to

CO1. Understand the importance of mechanics and express their knowledge in properties of matter

CO2. Analyze the applications of acoustics and ultrasonic in engineering field.

CO3. Acquire knowledge in laser and its applications

CO4. Demonstrate a strong foundational knowledge in fiber optics.

CO5. Comprehend and apply quantum mechanical principles.

TEXT BOOKS

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw – Hill (Indian Edition), 2017.
3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009.
4. Kasap, Safa, Capper, " Handbook of Electronic and Photonic Materials"2nd edition, Springer,2017.
5. Eleanor Rleffel and Wolfgang Polak, "Quantum computing a gentle introduction", 1st edition,The MIT press,2012.

REFERENCES

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
3. D. Halliday, R. Resnick, and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.
4. Hugh D. Young, Roger A. Freedman, A. Lewis Ford, Searls and Zemansky University Physics, 2009.
5. David J. Griffiths, "Introduction to Quantum Mechanics", 2nd edition, Cambridge University Press, 2017.

WEB REFERENCES

1. Advanced Quantum Mechanics With Applications – https://nptel.ac.in/courses/115103104
2. Quantum Mechanics And Molecular Spectroscopy – https://nptel.ac.in/courses/104101126

3. Fiber Optic Communication Technology – https://nptel.ac.in/courses/108106167
4. Introduction To Photonics – https://nptel.ac.in/courses/108106135
5. Introduction To Laser – https://nptel.ac.in/courses/115102124
6. Biomedical Ultrasound - https://nptel.ac.in/courses/121108458

Course Code	PROBLEM SOLVING USING C PROGRAMMING	L	T	P	C
CS4111		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic programing constructs of C Language
- To develop C programming using arrays, strings and pointers
- To develop modular applications in C using functions
- To develop applications in C using struts and unions
- To do input/output and file handling in C

COURSE DESCRIPTION

Designing an algorithm involves breaking down the problem into smaller sub-problems and defining a step-by-step sequence of instructions to solve each sub-problem. Algorithms can be expressed using pseudo code or flowcharts before implementing them in C code. Choosing appropriate data structures such as arrays, linked lists, stacks, queues, trees, graphs, or hash tables based on the problem requirements is crucial for efficient problem-solving in C programming.

PREREQUISITES

- Proficiency in C programming language is essential, including knowledge of syntax, semantics, expressions, statements, arrays, strings, pointers, structures, and memory management concepts (dynamic memory allocation, pointers arithmetic).
- Familiarity with algorithm design principles, problem-solving techniques (brute force, divide and conquer, dynamic programming, greedy algorithms), algorithm analysis (time complexity, space complexity), and data structures (arrays, linked lists, stacks, queues) is necessary.

UNIT I Basics Of C Programming (Blooms Learning Levels: L3 – Apply) 15

Introduction to programming paradigms – Structure of C program – Setting up the development environment (IDEs, compilers) and First C programs – Variables, Keywords, Data types, Constants, Operators, input / output statements – Decision making statements – Looping with while, do-while, and for loops – Nested loops and loop control statements

Coding Exercises:

1. Write a C program to find the sum of two integers entered by the user
2. Write a C program to check if a given number is even or odd
3. Write a C program to find the largest among three numbers using if-else statements

Problems-solving Assignments:

1. Write a C program to calculate the factorial of a given positive integer using a loop
2. Write a C program to check if a given number is a prime number
3. Write a C program to find the GCD (Greatest Common Divisor) of two numbers using a function

UNIT II Arrays, Strings, And Pointers (Blooms Learning Levels: L3 – Apply) 15

Working with arrays: One dimensional array: declaration, initialization, and accessing elements – Two dimensional arrays: Declaration -Initialization – Accessing elements – Operations: Read – Print – Sum – Transpose, Strings in C: string functions and manipulation – Selection sort, linear and binary sort – Introduction to pointers and memory management – Pointer operators – Pointer arithmetic - Pointers and arrays

Coding Exercises:

1. Implement a program that finds the largest element in an array of integers
2. Write a C program to count the number of vowels and consonants in a given string
3. Write a program to reverse a string without using the standard string library functions

Problems-solving Assignments:

1. Write a C program to merge two sorted arrays into a single sorted array
2. Write a C program to find the second largest element in an array
3. Write a program that finds the intersection of two arrays and stores the result in a third array

UNIT III Functions (Blooms Learning Levels: L3 – Apply) 15

Modular programming – Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Parameter passing: Pass by value, Pass by reference

Coding Exercises:

1. Write a C program to exchange the values of variables
2. Implement a recursive function to calculate the factorial of a given number

Problems-solving Assignments:

1. Write a C program to sort an array of strings in alphabetical order
2. Create a program to implement a binary search algorithm to search for an element in a sorted array

UNIT IV Structure And Union (Blooms Learning Levels: L3 – Apply) 15

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list (creation, insertion & deletion) – Typedef – Union – Storage classes and Visibility

Coding Exercises:

1. Write a C program to find the average and total marks of students using a struct

Problems-solving Assignments:

1. Write a C program to create a structure representing a book with title, author, and publication year. Implement functions to add, display, and search for books in a library
2. Implement a program to manage a student database using structs, including functions to add, delete, and display student records

UNIT V File Processing (Blooms Learning Levels: L3 – Apply) 15

Files – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments – Code optimization and best practices

Coding Exercises:

1. Create a program that reads data from a file and calculates the average of a set of numbers
2. Write a program to copy the contents of one file into another file

Problems-solving Assignments:

1. Write a C program to read student records from a file and calculate their total and percentage
2. Develop a program to read employee details from a file, sort them based on salary, and write the sorted data back to the file

Final Project (sample): Design a simple inventory management system for a small store using structs and file handling. The program should allow users to add, update, and delete items in the inventory and display the current stock

TOTAL HOURS (45+30): 75

COURSE OUTCOMES:

CO1: Demonstrate knowledge on C Programming constructs
CO2: Design and implement applications using arrays, strings and pointers
CO3: Develop and implement modular applications in C using functions
CO4: Develop applications in C using structures and unions
CO5: Develop applications using sequential and random-access file processing

TEXT BOOKS:

1.Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2.Reema Thareja, "Programming In C", Second Edition, Oxford University Press India, 2016.

REFERENCES:

1.Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2.E Balagurusamy, "Programming in ANSI C", Eighth Edition, McGraw Hill Education, 2019.
3.Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4.Peter van der Linden, "Expert C Programming", Pearson, 1994.

YOUTUBE RESOURCES:

1.**My code school**: This channel offers tutorials and lectures on programming concepts, data structures, algorithms, and problem-solving using C and C++ programming languages.
2.**Programming Knowledge**: Programming Knowledge provides tutorials on C programming basics, data structures, algorithms, problem-solving techniques, and coding exercises for beginners and intermediate learners.
3.**Saurabh Shukla Classes**: Saurabh Shukla Classes offer tutorials on C programming, data structures, algorithms, problem-solving strategies, and coding practice sessions for competitive programming and interviews.
4.**Geeks for Geeks**: Geeks for Geeks' YouTube channel provides tutorials, lectures, and coding examples on C programming, data structures, algorithms, problem-solving techniques, and interview preparation.
5.**Code With Harry:** Code With Harry offers tutorials on C programming basics, problem-solving exercises, programming projects, and tips for improving problem-solving skills using C language.

Course Code	ENGINEERING GRAPHICS	L	T	P	C
ME4101		2	0	4	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

COURSE DESCRIPTION

Engineering Graphics is a foundational course that focuses on the principles and techniques of graphical communication in engineering. The course covers topics such as technical drawing, computer-aided design (CAD), geometric construction, dimensioning, and visualization of engineering designs. Students will learn how to create, interpret, and communicate engineering drawings and models using industry-standard methods and software tools.

PREREQUISITES

- Basic knowledge of geometry, technical mathematics, and computer literacy is recommended for students enrolling in this course.
- Familiarity with drawing tools, CAD software, and engineering design concepts will be beneficial.

CONCEPTS AND CONVENTIONS (Not for Examination)

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

UNIT I Plane Curves 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II Projection Of Points, Lines And Plane Surface 6+12

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III Projection Of Solids And Freehand Sketching 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three-Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV Projection Of Sectioned Solids And Development Of Surfaces 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three-dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V Isometric And Perspective Projections 6+12

Principles of isometric projection — isometric scale - lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three-dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL HOURS: (L=30; P=60) 90

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1.Use BIS conventions and specifications for engineering drawing.

CO2.Construct the conic curves, involutes and cycloid.

CO3.Solve practical problems involving projection of lines.

CO4.Draw the orthographic, isometric and perspective projections of simple solids.

CO5.Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore,27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi,2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

YOUTUBE RESOURCES:

1. **SolidWorks Tutorials - Tutorial Point**: This playlist provides tutorials on using Solid Works, a popular CAD software, for engineering graphics and design.
2. **Engineering Graphics - NPTEL**: NPTEL (National Programme on Technology Enhanced Learning) offers video lectures on Engineering Graphics covering topics such as projections, isometric views, sections, and developments.
3. **Auto CAD Tutorials - CAD in Black**: CAD in Black provides tutorials on using Auto CAD, a widely used CAD software, for creating engineering drawings and graphics.
4. **Engineering Graphics – Edu Mation**: Edu Mation offers tutorials and lectures on Engineering Graphics covering topics such as projections, section views, dimensioning, and tolerancing.

Course Code	ENGINEERING MECHANICS	L	T	P	C
ME4102		3	0	0	3

COURSE OBJECTIVES

- To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To study and understand the distributed forces, surface, loading on beam and intensity.
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forecast the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy.

COURSE DESCRIPTION

Engineering Mechanics is a foundational course that introduces students to the principles of mechanics and their application to engineering problems. The course covers topics such as statics, dynamics, kinematics, kinetics, and the behavior of particles and rigid bodies under various forces and constraints. Students will learn how to analyze and solve problems related to equilibrium, motion, and forces in engineering systems.

PREREQUISITES

- Basic knowledge of physics, mathematics (calculus, algebra), and engineering fundamentals is recommended for students enrolling in this course.
- Familiarity with vectors, forces, and basic kinematics concepts will be beneficial.

UNIT I STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections. Trusses and frames; virtual work.

UNIT III DISTRIBUTED FORCES **9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION **9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL HOURS (THEORY): 45

COURSE OUTCOMES

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

CO1: Illustrate the vector and scalar representation of forces and moments

CO2: Analyse the rigid body in equilibrium

CO3: Evaluate the properties of distributed forces

CO4: Determine the friction and the effects by the laws of friction

CO5: Calculate dynamic forces exerted in rigid body

TEXT BOOKS

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.

2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.

2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.

3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.

4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7thedition, Wiley student edition, 2013.

5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

YOUTUBE RESOURCES

1.**Structure free** - This channel offers comprehensive tutorials on Engineering Mechanics, covering topics such as statics, dynamics, equilibrium, and forces.

2. **LearnEngineering** - provides animated video lectures and tutorials on various engineering subjects, including Engineering Mechanics.

3.**Mechanical Engineering** - This channel features lectures and tutorials on Engineering Mechanics, mechanics of materials, and other mechanical engineering topics.

4. **Statics the Easy Way** - Statics the Easy Way offers explanations and examples related to statics, equilibrium, and force analysis in Engineering Mechanics.

Course Code	Employability Enhancement Skills – I	L	T	P	C
ES4101	**Foundations of Mathematics and Reasoning**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

UNIT I Numbers **6**

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – Face Value – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions – Scientific Notation.

UNIT II Problems on Letters, Numbers and Symbols **6**

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square, Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

UNIT III Verbal and Non-Verbal Reasoning **6**

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

UNIT IV Ratio and Proportion **6**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

UNIT V Percentage **6**

Introduction – Percentages in real life – Profit and Loss – Discount– Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop the arithmetic ability and properties of numbers that we use in day-to-day life.
CO2: Demonstrate the logic behind the formation of numbers, alphabets series.
CO3: Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers

CO4: Use the concept of ratios and proportion in ages and partnership problems.
CO5: Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving.

TEXT BOOKS:

1. Aggarwal, R.S, "Quantitative Aptitude for Competitive Examinations (Revised edition)", S Chand Publishing, 2017.
2. Arun Sharma, "Teach Yourself Quantitative Aptitude", McGraw Hill Education, 2017
3. Aggarwal, R.S, "A Modern Approach to Verbal & Non-Verbal Reasoning" 2nd edition, S Chand Publishing, 2018.

REFERENCES:

1. Akhilesh Khare, "Shortcuts in Mathematics", Createspace Independent Pub, 2015.
2. Ravi Shankar, "Vedic Maths for Competitive Exams", Pustak Mahal, 2016.
3. Abhijit Guha, "Quantitative Aptitude for Competitive Examinations", 7th edition, McGraw Hill Education, 2020.

TOTAL: 30 PERIODS

Semester II

Course Code	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
HS4201		1	0	0	1

அலகு I நெசவு மற்றும் பாணைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக தெம்பு மற்றும் தங்க நாணயங்கள் – அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைமக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு தெய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம

TOTAL:15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	TAMILS AND TECHNOLOGY	L	T	P	C
HS4201		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY **3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY **3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY **3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads –Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	PROBABILITY AND STATISTICS	L	T	P	C
MA4201	(COMMON TO ALL DEPARTMENTS)	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic concepts of probability and distributions.
- To learn the basic concepts of two -dimensional random variables.
- To acquire the knowledge in random processes, stationary, Markov and Poisson process.
- To acquire the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To summarise the design of experiments in the field of agriculture.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability: Axioms – Sample space – Events - Conditional Probability – Baye's Theorem - Discrete and continuous random variables - Moments - Moment generating functions - Standard distributions: Binomial - Poisson - Geometric - Uniform - Exponential and Normal distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and conditional distributions - Covariance - Correlation - linear regression - Transformation of random variables - Central limit theorem (excluding proof).

UNIT III RANDOM PROCESSES AND MARKOV CHAINS 12

Random Processes: Introduction and Classification -Stationary Processes -Markov Processes - Poisson Processes -Discrete Parameter Markov Chains -Chapman-Kolmogorov Equations (Statement only) -Limiting Distributions.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters **-**Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, F and Chi-square distributions for mean, variance **-** Contingency table (test for independent) - Goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 12

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of

Standard distributions which can describe real life phenomenon.

CO2: Recognize the basic concepts of two - dimensional random variables and apply in engineering applications.

CO3: Develop the basic concepts of random processes which are widely used in engineering fields.

CO4: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO5: Investigate of design of experiments in the field of agriculture.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

Course Code	DATA STRUCTURES	L	T	P	C
MT4201		3	0	0	3

COURSE OBJECTIVES

- To introduce students to the fundamental concepts of data structures and their significance in computer science and engineering.
- To enable students to understand, implement, and analyze basic data structures like arrays, linked lists, stacks, and queues.
- To impart knowledge about tree data structures, including binary trees, binary search trees.
- To introduce students to graph theory, graph representations, and traversal algorithms.
- To introduce to advanced data structure algorithms.

UNIT I INTRODUCTION TO DATA STRUCTURES 9

Overview of Data Structures, Importance and application of data structures in problem-solving. Abstract Data Types (ADTs), Time and Space Complexity, Big O Notation, Arrays, One-dimensional arrays, Multi-dimensional arrays, Array operations (insertion, deletion, traversal), Linked Lists Singly linked list: operations (insertion, deletion, traversal), Doubly linked list: operations, (insertion, deletion, traversal), Circular linked lists.

UNIT II STACKE AND QUEUES 9

Introduction to Stacks, Stack operations: push, pop, peek, Applications of stacks (e.g., expression evaluation, recursion), Queues, Queue operations: enqueue, dequeue, front, rear, Types of queues: simple queue, circular queue, priority queue, Applications of Queues, Job scheduling, buffering, etc., Stack implementation, Queue implementation (Array based and Link list based).

UNIT III TREES 9

Introduction to Trees, Basic terminology (node, root, leaf, etc.), Tree properties, Binary Trees , Binary tree representation, Tree traversal techniques (in-order, pre-order, post-order), Binary tree operations (insertion, deletion), Binary Search Trees (BST) Properties of BST, Operations on BST (insertion, deletion, search).

UNIT IV GRAPHS 9

Introduction to Graphs, Graph terminology (vertices, edges, etc.), Types of graphs (directed, undirected, weighted, unweighted), Graph Representation Adjacency matrix, Adjacency list, Graph Traversal Techniques, Floyd-Warshall algorithm.

UNIT V ADVANCED DATA STRUCTURE CONCEPTS 9

Introduction to heaps, Binary heap operations (insert, delete, heapify), Applications of heaps (priority queue), **Hashing,** Introduction to hashing, Hash functions, Collision resolution techniques (chaining, open addressing), **Sorting and Searching,** Overview of sorting algorithms (quick sort, merge sort, heap sort), Searching techniques (binary search, linear search).

TEXT BOOKS

1. Data Structures and Algorithm Analysis in C++, 3e Paperback – 1 January 2007,by Weiss, Tata McGrawhill Publications.

2. Data Structures and Algorithms in C++, by Adam Drozdek, 4th Edition, Misc Supplies.
3. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

REFERENCES

1. Data Structures Using C" by Reema Thareja, 11 June 2014, Oxford Publications.
2. Fundamentals of Data Structures in C" by Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed
3. Data Structures and Algorithms: Concepts, Techniques, and Applications" by G.A.V. Pai
4. The Art of Computer Programming, Volume 1: Fundamental Algorithms" by Donald E. Knuth

COURSE OUTCOMES

CO1: Students will be able to understand the application of Basic Data Structures.
CO2: Students will be able to understand and implement the concept of stacks and queues.
CO2: Students will gain proficiency in implementing and utilizing tree-based data structures, including binary trees, binary search trees.
CO4: Students will understand graph theory concepts, represent graphs using various data structures, and apply graph traversal algorithms.
CO5: Students will be able to implement and use advanced data structures such as heaps and hash tables.

Course Code	COMMUNICATIVE ENGLISH – II	L	T	P	C
HS4202		3	0	2	4

COURSE OBJECTIVES

- To engage learners in meaningful language activities to improve their LSRW skills
- To enhance learners' awareness of general rules of writing for specific audiences
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To cultivate the learners to understand job applications and interviews for internship and placements.

COURSE DESCRIPTION

Communicative Higher English is an advanced-level course designed to enhance students' proficiency in the English language, focusing on advanced communication skills, critical analysis, and literary appreciation. The course emphasizes practical application of language skills in various contexts, including academic writing, public speaking, debates, and literary analysis. Students will engage with a wide range of texts, both literary and non-literary, to develop analytical thinking, language fluency, and communication strategies.

PREREQUISITES

This course is suitable for students with an intermediate to advanced level of English proficiency.
A strong foundation in grammar, vocabulary, reading comprehension, and basic writing skills is recommended.

UNIT I MAKING COMPARISONS 9

Listening – Evaluative Listening: Advertisements, Product Descriptions, – Audio/ video Speaking– Marketing a product, Persuasive Speech Techniques. Reading – Reading advertisements, user manuals, brochures Writing – Letter to the editor; Compare and Contrast Essay Grammar – Impersonal passive voice; Prepositional phrases Vocabulary –Contextual meaning of words

UNIT II EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING 9

Listening – Listening to longer technical talks and completing–gap filling exercises. Listening technical information from podcasts Speaking –Describing and discussing the reasons of accidents or disasters based on news reports Reading – Reading longer technical texts/Novels Writing – Writing responses to complaints; Problem solution Essay Grammar –Subject – Verb Agreement, Infinitive and Gerunds Vocabulary – Adverbs.

UNIT III PROBLEM SOLVING 9

Listening–Watching movie scenes/documentaries depicting a technical problem and suggesting solutions. Speaking – Group Discussion (based on case studies), – techniques and Strategies. Reading – Case Studies, excerpts from literary texts, news reports etc. Writing – Checklists, Argumentative Essay Grammar –Error correction; If conditional sentences Vocabulary – Compound Words, Sentence Completion.

UNIT IV REPORTING OF EVENTS AND RESEARCH 9

Listening – Listening Comprehension based on news reports and documentaries. Speaking – Interviewing, presenting an oral report, Mini presentations on select topics Reading –Newspaper articles Writing – Industrial visit Report, Accident Report, Survey Report Grammar–Reported Speech, Modals Vocabulary– Conjunctions, use of prepositions.

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 9

Listening – Listening to TED Talks, Presentations, Formal job interviews Speaking – Mock Interview, Making presentations with visual aids Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals Writing –Job / Internship application – Cover letter with Resume Grammar – Numerical adjectives, Relative Clauses Vocabulary–Idioms.

TOTAL HOURS (THEORY): 45

LIST OF EXERCISES:

1. Listening /Reading Comprehension
2. Introducing Oneself
3. Summary of a Podcast
4. Mini Presentation on General topic (ICT tools)
5. Autobiography of a famous Personality
6. Narrating an unforgettable event
7. Drafting an Email (printed format)
8. Developing a story using given Vocabulary
9. Group Discussion
10. Mock Interview

TOTAL HOURS (LAB): 30 TOTAL HOURS (45+30): 75

COURSE OUTCOMES

After the completion of the course, students will be able to

CO1. Compare and contrast products and ideas in technical texts.

CO2. Identify cause and effects in events, industrial processes through technical texts

CO3. Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.

CO4. Report events and the processes of technical and industrial nature.

CO5. Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

TEXT BOOKS

1.English for Engineers & Technologists (2020edition) Orient Blacks wan Private Ltd. Department of English, Anna University.

2.English for Science & Technology Cambridge University Press 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

3.Professional English-II, V.K.Publications, Dr.S.N. Mahalakshmi.

REFERENCES

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.

2. Improve Your Writing. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.

3. Learning to Communicate–Dr.V. Chellammal. Allied Publishers, New Delhi,2003

4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.

YOUTUBE RESOURCES:

1. TED-Ed: TED-Ed offers a wide range of videos on communication skills, public speaking, storytelling, and critical thinking, which are all relevant to higher English communication.
2. BBC Learning English: BBC Learning English provides videos and resources focused on improving English language skills, including speaking, listening, vocabulary, and pronunciation.
3. Rachel's English: Rachel's English is a channel dedicated to helping learners improve their American English pronunciation, intonation, and speaking skills.
4. EnglishLessons4U - Learn English with Ronnie! [engVid]: Ronnie from engVid offers lessons on English communication, grammar, vocabulary, idioms, and expressions to enhance language fluency.

Course Code	MATERIAL SCIENCE	L	T	P	C
PH4201		3	0	2	4

COURSE OBJECTIVES

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To inculcate the knowledge of phase relationship for the understanding of material properties.
- To understand the knowledge of mechanical properties of materials
- To enhance fundamental knowledge in transformation of heat in conducting materials.
- To instill knowledge of new engineering materials and its applications.

COURSE DESCRIPTION

The Materials Science course offers an interdisciplinary exploration of the structure, properties, processing, and applications of materials across various engineering and scientific disciplines. It covers fundamental principles, theories, and techniques related to the study of materials, including metals, ceramics, polymers, composites, and semiconductors. Students will learn about material properties, microstructure analysis, mechanical behavior, thermal properties, electrical properties, and material selection criteria.

PREREQUISITES

- Basic knowledge of physics, chemistry, and mathematics is recommended.
- Familiarity with engineering principles and scientific concepts will be beneficial for understanding advanced topics in materials science.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: BCC, FCC and HCP – directions and planes – linear and planar densities – crystal imperfections – edge and screw dislocations – grain and twin boundaries – Burgers vector and elastic strain energy – , plastic deformation of materials – Millers indices – d spacing – crystal growth technique – Bridgmann and Czohralski method.

UNIT II PHASE DIAGRAM 9

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one – component system of iron – binary phase diagrams – Isomorphism systems – the tie – line rule – the lever rule – application to Isomorphism system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – Iron – Iron carbide phase diagram – Temperature – Time – Transformation(TTT)Diagram

UNIT III MECHANICAL PROPERTIES 9

Tensile test – plastic deformation mechanisms – slip and twinning – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – fracture – the Griffith criterion – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness –Knoop and Vickers micro hardness(quantitative)

UNIT – IV HEAT TRANSFER 9

Modes of heat transfer – thermal conductivity – heat capacity and diffusivity – rectilinear flow of heat – conduction through bodies in series and parallel – determination of thermal conductivity: good conductor: Forbe’s method – bad conductor: Lee’s disc method – applications

of heat transfer – formation of ice in ponds – conductivity of earth's crust and age of earth– practical applications.

UNIT V NEW MATERIALS **9**

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics–metallic glasses: types, glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications– nanomaterials: preparation (bottom up and top down approaches), properties and applications–carbon nanotubes: types

TOTAL HOURS (THEORY): 45

PRACTICAL EXERCISES (FIVE ONLY)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia ofregular and irregular objects.
2. Testing of material Hardness – Brinell method
3. Testing of material Hardness – Rockwell method
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Non – uniform bending – Determination of Young's modulus
6. Determination of Band gap of a semiconductor.
7. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
8. Determination of particle size using Laser and compact disc – width of the groove.

TOTAL HOURS (LAB): 30 TOTAL HOURS (45+30): 75

COURSE OUTCOMES

After the completion of the course, students will be able to

CO1. Know the basics of crystallography and its importance for varied material properties

CO2. Understand the properties of materials through the study of phase relationships.

CO3. Gain knowledge on mechanical properties of materials and their measurement

CO4. Acquire knowledge on the concepts of thermal properties of materials and their applications.

CO5. Appreciate the importance of ceramics, composites and nanomaterials

TEXT BOOKS

1.V. Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.

2.S.O. Kasap, Principles of Electronic Materials and Devices, Mc – Graw Hill, 2018.

3.Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.

4.Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc – Graw Hill India (2019)

5.G.W. Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES

1.R. Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.

2.Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.

3.Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006

4.Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017

5.Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

YOUTUBE RESOURCES:

1.**MIT Open Course Ware -** Materials Science and Engineering: MIT's Open Course Ware program offers free access to lectures, course materials, and resources related to Materials Science and Engineering.

2.**Khan Academy - Chemistry:** Khan Academy covers various topics related to chemistry, including materials science concepts such as atomic structure, chemical bonding, and properties of materials.

3.**ASM International:** ASM International's channel provides videos on materials science, metallurgy, materials testing, and engineering materials.

4.**Materials Science and Engineering at Georgia Tech**: Georgia Tech's materials science and engineering department offers videos and lectures on various topics related to materials science.

Course Code	PROBLEM SOLVING USING PYTHON PROGRAMMING	L	T	P	C
CS4212		3	0	2	4

COURSE OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python

COURSE DESCRIPTION

This course is designed to introduce students to problem-solving techniques and programming skills using the Python programming language. It covers fundamental programming concepts, data structures, algorithm design, and their practical applications in solving computational problems.

PREREQUISITES

- No prior programming knowledge is required, but familiarity with basic mathematical concepts and logical reasoning is beneficial for successful completion of this course.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -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, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if- if-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. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

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; Illustrativnumerie programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL HOURS (THEORY): 45

LAB EXERCISES

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list &tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1. Develop algorithmic solutions to simple computational problems.
CO2. Develop and execute simple Python programs.
CO3. Write simple Python programs using conditionals and looping for solving problems.
CO4. Decompose a Python program into functions.
CO5. Represent compound data using Python lists, tuples, dictionaries etc.

TOTAL HOURS (LAB): 30 TOTAL HOURS (45+30): 75

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner' s Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition,2021.

2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, & Quot; Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data “, Third Edition, MIT Press 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

YOUTUBE RESOURCES

1. **Programming with Mosh:** This channel offers comprehensive tutorials on Python programming, including problem-solving techniques, data structures, algorithms, and practical coding projects.
2. **Corey Schafer** - Python Tutorials: Corey Schafer's tutorials cover various aspects of Python programming, including problem-solving strategies, Python libraries, web development, data analysis, and machine learning.
3. **Sentdex** - Python Programming: sentdex provides tutorials on Python programming, data analysis, machine learning, and artificial intelligence, focusing on problem-solving techniques and coding projects.
4. **Free Code Camp.org** - Python Programming: free Code Camp.org offers tutorials on Python programming for beginners, covering basic syntax, data structures, algorithms, and problem- solving approaches.

Course Code	Employability Enhancement Skills – II	L	T	P	C
ES4201	**Exploring Mathematical Concepts and Reasoning**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

UNIT I Time and Distance **9**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

UNIT II Probability and Statistics **9**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations – Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median – Mode – Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

UNIT III Arithmetic and Logical Reasoning **9**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures – Distance & Direction.

UNIT IV Applied Mathematics **9**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm – Geometry.

UNIT V Verbal and Logical Reasoning **9**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
CO2: Solve questions related to Time etc. from company specific and other competitive tests.
CO3: Illustrate and solve puzzle related questions from specific and other competitive tests.

TEXT BOOKS:

1. Aggarwal, R.S, "Quantitative Aptitude for Competitive Examinations (Revised edition)", S Chand Publishing, 2017.
2. Arun Sharma, “Teach Yourself Quantitative Aptitude”, McGraw Hill Education, 2017

3. Aggarwal, R.S, “A Modern Approach to Verbal & Non-Verbal Reasoning” 2nd edition, S Chand Publishing, 2018.

REFERENCES:

1. Akhilesh Khare, “Shortcuts in Mathematics”, Createspace Independent Pub, 2015.
2. Ravi Shankar, “Vedic Maths for Competitive Exams”, Pustak Mahal, 2016.
3. Abhijit Guha, “Quantitative Aptitude for Competitive Examinations”, 7th edition, McGraw Hill Education, 2020.

TOTAL: 30 PERIODS

Course Code	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
EC4212		3	0	2	4

COURSE OBJECTIVES

To understand the structure of basic electronic devices.
To be exposed to active and passive circuit elements.
To familiarize the operation and applications of transistor like BJT and FET.
To explore the characteristics of amplifier, gain and frequency response.
To learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES **9**

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance – Rectifiers – Half Wave and Full Wave Rectifier– Display devices- LED, Laser diodes, Zener diode characteristics- Zener diode Reverse characteristics – Zener diode as regulator.

UNIT II TRANSISTORS AND THYRISTORS **9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing, UJT, Thyristors – SCR, DIAC, TRIAC and IGBT –Structure and characteristics.

UNIT III AMPLIFIERS **9**

BJT small signal model using H parameter – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS and Source follower– Gain and frequency response- High frequency analysis - Basics of cascade amplifier, Differential amplifier – Common mode and Difference mode analysis

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback–voltage/current, series, Shunt feedback–positive feedback–Condition for oscillations, phase shift– Wienbridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC CONVERTERS **9**

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

THEORY:45 PERIODS

PRACTICAL EXERCISES:

1. Characteristics of Semiconductor diode, Zener diode, photo diode, and photo transistor.
2. Characteristics of Single-Phase half-wave and full wave rectifiers with inductive and capacitive filters
3. Characteristics of NPN Transistor under common emitter, common collector, common base configurations and plot the frequency response characteristics of a Common Emitter amplifier
4. Characteristics of JFET, draw the equivalent circuit and analysis of CS and Source follower models.
5. Characteristics of UJT and generation of saw tooth wave forms
6. Design of Differential amplifiers using FET
7. Design and testing of RC phase shift and LC oscillators
8. Design and testing of Wienbridge, Hartley, Colpitts and Crystal oscillators
9. Design a audio amplifier using SPICE simulation

10. Design an automation circuit using SPICE simulation

PRACTICAL: 30 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to:

CO1: Explain the structure and operation of PN junction devices diode, zener diode, LED and Laser diode, half wave and full wave rectifier, regulator circuits.

CO2: Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO3: Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO4: Explain the characteristics of cascade and differential amplifier

CO5: Explain the operation of various feedback amplifiers and oscillators

TOTAL: 75 PERIODS

TEXTBOOKS:

1. David A. Bell," Electronic devices and circuits", Oxford University higher education, 5th Edition 2008.

2. Sedra and smith, "Microelectronic circuits",7th Edition., Oxford University Press, 2017

3. Balbir Kumar, Shail.B. Jain,"Electronic devices and circuits "PHI learning private limited, 2nd edition 2014.

REFERENCES:

1.ThomasL.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall,10th Edition,2017.

2. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.

3. Robert L.Boylestad, "Electronic devices and circuit theory",11th edition, Pearson prentice Hall 2013.

4. Robert B.Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, Second edition, 2012.

Semester III

Course Code	MATHEMATICAL METHODS FOR ENGINEERING (Common to B.E - CIVIL, MECH, MCT, EEE, ECE, EC(ACT) and EE(VLSI))	L	T	P	C
MA4301		3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To apply the concept of Laplace transforms in engineering problems.
- To introduce the concepts of Z transforms.
- To learn the basic concepts of Fourier series and Fourier transforms.
- To use the numerical techniques of differentiation and integration in engineering and technology disciplines.

UNIT I ANALYTIC FUNCTION & COMPLEX INTEGRATION 12

Analytic functions - Cauchy-Riemann equations (statement only) - Complex integration - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Zeros - Singular points - Residues - Cauchy's residue theorem (statement only) - Evaluation of contour integrals on simple closed curves.

UNIT II LAPLACE TRANSFORMS 12

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorem - Transforms of derivatives and integrals - Initial and final value theorem - Inverse transforms - Convolution theorem - Transform of periodic functions - Application - solution of linear second order ordinary differential equations with constant coefficients.

UNIT III Z-TRANSFORMS 12

Elementary properties - Inverse Z-transform (using partial fraction and residues) - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

UNIT IV FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Change of interval - Half range Sine series –Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT V FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Evaluate real and complex integrals using the Cauchy‘s integral formula and residue theorem.
CO2: Apply Laplace transform and inverse transform of simple functions, properties, various related problems.
CO3: Understand the characteristics and properties of Z – transform.
CO4: Recognize the concepts of Fourier series and Fourier Transform and applying engineering problems.
CO5: Develop the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration in Engineering problems.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John WileyandSons,10th Edition, New Delhi, 2016.
3. Sankara Rao . K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

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REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. O‘Neil, P.V. Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
7. S. Ponnusamy, “Foundations of Complex Analysis” 2nd Edition, Narosa Publishing House, 2014.

TOTAL: 60 PERIODS

Course Code	DIGITAL ELECTRONICS AND MICROCONTROLLER	L	T	P	C
MT4301		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the Digital fundamentals, Boolean algebra and its applications in digital systems
- Familiarize with the design of various combinational digital circuits using logic gates and the analysis and design procedures for synchronous sequential circuits
- Introduce the analysis and design procedures for asynchronous sequential circuits and explain the various semiconductor memories and related technology
- Understand 8051Microcontroller hardware architecture and pin diagram.
- Comprehend instruction format and addressing modes and Gain proficiency in programming using assembly language.

Course Description

This course provides a comprehensive understanding of digital electronics, covering fundamental concepts such as number systems and Boolean algebra, along with practical design skills in combinational and sequential circuits. Students explore memory devices, programmable logic devices, and delve into the architecture and programming of the 8085 processor, including peripheral interfacing, to develop a strong foundation in digital systems.

Prerequisites

- Strong understanding of digital logic and Boolean algebra.
- Proficiency in basic electronics principles including circuits and components.
- Familiarity with programming concepts and languages, particularly assembly language.

UNIT I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization, TTL, CMOS.

UNIT II COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder - Multiplexer, Demultiplexer, Decoder, Priority Encoder, Comparator. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register

UNIT III ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

UNIT IV INTRODUCTION TO MICROCONTROLLER 9

Fundamentals Functions of ALU - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.

UNIT V PROGRAMMING AND COMMUNICATION 9

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and Wi-Fi interfacing of 8051 Microcontroller.

45 PERIODS

DIGITAL ELECTRONICS AND MICROCONTROLLERS LAB

List of Experiments:

4. Verification of Gates.
5. Half adder and Full adder
6. MUX/DEMUX
7. Encoders and Decoders
8. Counters and Shift Registers
9. Assembly Language Programming in 8051 Microcontroller.
10. Boolean & Logical Instructions (Bit manipulations).
11. Code conversions.
12. Stepper and Servo Motor control interface to 8051.
13. LED interfacing using 8051.

30 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the fundamental principles in number systems, Boolean algebra, and logic gates, enabling them to analyze and design digital circuits effectively.
CO2: Ability to design and implement combinational circuits, sequential circuits
CO3: Ability to design and implement Asynchronous sequential circuits and understanding of various memory devices.
CO4: Understanding the architecture and operation of the 8051 Microcontroller.

CO5: Ability in programming the 8051 Microcontroller using assembly language, enabling them to write efficient code.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and
4. Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
5. Mohammed Ali Mazidi, "The 8051 Microcontrollers and Embedded Systems", 2e, Pearson education, 2007.

YouTube Resources:

1. **Neso Academy:** Neso Academy offers comprehensive tutorials on electrical and electronics engineering topics, including microprocessors and digital electronics. The channel features playlists dedicated to digital logic design, microprocessor architecture, programming, and interfacing. The tutorials are well-structured and suitable for both beginners and intermediate learners.
2. **AllAboutEE:** This channel offers tutorials, lectures, and demonstrations on various electrical engineering topics, including digital electronics. It covers fundamental concepts such as logic gates, flip-flops, sequential circuits, and more, presented in an accessible and engaging manner.
3. **Circuit Digest:** Circuit Digest covers a wide range of electronics topics, including microcontrollers and microprocessors. The channel provides tutorials, projects, and reviews of development boards, components, and tools for electronics enthusiasts and hobbyists.

TOTAL: 75 PERIODS

Course Code	FLUID MECHANICS AND THERMAL SYSTEM	L	T	P	C
MT4302		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
- To impart basic knowledge of the boundary layer concept and expose to the applications of the conservation laws to a) flow measurements b) flow through pipes and c) forces on pipe bends.
- To understand the importance of dimensional analysis.
- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics and entropy of the system.

Course Description

This course provides students with a comprehensive understanding of the fundamental principles and concepts in fluid mechanics and thermodynamics. Through a combination of theoretical knowledge and practical applications, students will explore the behavior of fluids in motion and at rest, as well as the principles governing energy transfer and transformation.

Prerequisites

- A basic understanding of classical mechanics and principles of physics.
- Familiarity with mechanics, including topics such as forces, motion, and equilibrium.
- Basic mathematical knowledge.
- Knowledge of fundamental engineering concepts, such as material properties, system analysis, and problem-solving techniques

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation – Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV BASICS OF THERMODYNAMICS AND FIRST LAW OF THERMODYNAMICS 9

Thermodynamics – Microscopic and macroscopic point of view – Systems, properties, process, path, cycle. Thermodynamic equilibrium – Zeroth law of Thermodynamics – internal energy, enthalpy, specific heat capacities CV and CP, Relationship between CV and CP. First law of Thermodynamics – Application to closed and open systems – Steady Flow Energy Equation (SFEE) – Simple problems.

UNIT V SECOND LAW OF THERMODYNAMICS AND ENTROPY **9**

Second Law of thermodynamics – Kelvin Planck and Clausius Statements – Equivalents of Kelvin Planck and Clausius statements. Reversibility – Irreversibility, reversible cycle – Heat engine, heat pump and refrigerator. Carnot cycle and Clausius theorem, the property of entropy, the inequality of Clausius – Entropy principle – General expression for entropy – Simple problems in entropy.

45 PERIODS

FLUID MECHANICS AND THERMAL SYSTEM LABORATORY

LIST OF EXPERIMENTS:

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

30 PERIODS

Course Format

Lectures and discussions, Hands-on Practical exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the fluid properties fluid characteristics and flow measurements.
CO2: Interpret the problems related to energy losses in flow through pipes, fluid flow and significance of boundary layer theory and its thicknesses.
CO3: Mathematically predict the nature of physical quantities
CO4: Recognize the thermal properties and laws of thermodynamics.
CO5: Analyze the thermal process and entropy of the system.

TEXT BOOKS:

1. Bansal R.K., —Fluid Mechanics and Hydraulic Machines||, 11th Edition, Laxmi Publications, New Delhi, 2019
2. Nag P.K., —Engineering Thermodynamics, 6th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017

REFERENCES:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Cengel Yunus A. and Boles Michael A., —Thermodynamics: An Engineering Approach||, 7th Edition, McGraw-Hill, New York, 2011.
3. Frank M. White., —Fluid Mechanics, 9th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2022.

4. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016

YouTube Resources:

1. **Jeff Hanson -** This channel offers comprehensive lectures on fluid mechanics and covers topics such as fluid properties, flow through pipes, and dimensional analysis. Jeff Hanson provides clear explanations and example problems.
2. **LearnChemE** - LearnChemE offers a series of videos on thermodynamics, including lectures on the first and second laws of thermodynamics, entropy, and thermodynamic processes. The channel provides visual explanations and problem-solving techniques.
3. **NPTEL -** Mechanical Engineering: The NPTEL (National Programme on Technology Enhanced Learning) Mechanical Engineering playlist covers various topics related to fluid mechanics and thermodynamics. It includes lectures by experienced professors and covers the fundamentals as well as advanced concepts.
4. **The Organic Chemistry Tutor -** This channel offers lectures and tutorials on fluid mechanics, including topics such as Bernoulli's equation, Reynolds number, and boundary layer concepts. The videos provide step-by-step explanations and example problems.
5. **MIT OpenCourseWare** - MIT OpenCourseWare provides access to full courses from the Massachusetts Institute of Technology. You can find courses on fluid mechanics and thermodynamics, which include lecture videos, lecture notes, and assignments.
6. **Mechanical Engineering Explained -** This channel covers various topics in fluid mechanics and thermodynamics, offering visual explanations and demonstrations. It includes tutorials on concepts such as the first law of thermodynamics and the Carnot cycle.

TOTAL:75 PERIODS

Course Code	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
MT4303		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals
4. Study of supervised learning algorithms.
5. Study about unsupervised learning algorithms.

Course Description

Artificial Intelligence and Machine Learning Fundamentals begins by introducing to Python and discussing AI search algorithms. You will cover in-depth mathematical topics, such as regression and classification, illustrated by Python examples. In machine learning, the supervised and unsupervised learning algorithms will also be dealt with.

Prerequisites

1. Knowledge of Mathematics such as Linear Algebra.
2. Knowledge of any programming Language.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 9

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - **Intelligent Agents** - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - **Uninformed Search** - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 9

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - **Game theory** - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - **Constraint Satisfaction Problems (CSP)** - Examples - Map Colouring - Job Scheduling - Backtracking Search for CSP

UNIT III MACHINE LEARNING 9

Machine Learning: Definitions — Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra — Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - **Regression**: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 9

Neural Network: Introduction, Perceptron Networks — Adaline - Back propagation networks - **Decision Tree:** Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - **Naïve Bayesian classification** - **Support Vector Machines** (SVM)

UNIT V UNSUPERVISED LEARNING 9

Unsupervised Learning – Principal Component Analysis - **Neural Network**: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – **Clustering**: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.

Course Format

Lectures and discussions, Tutorials, Video presentations, Guest lectures by industry Experts, Group discussions, Online resources and tutorials

Assessments & Grading

3 Internal Assessments, Quizzes, Assignments, Mini Projects, Final Examination.

COURSE OUTCOMES:

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

CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed,

REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Bratko, "Prolog: Programming for Artificial Intelligence||, Fourth edition, Addison-WesleyEducational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

You tube resources

1. https://www.youtube.com/playlist?list=PLqXS1b2lRpYTpUIEu3oxfhhTuBXmMPppA
2. https://www.youtube.com/watch?v=-KLnurhX-Pg&list=PLqXS1b2lRpYTpUIEu3oxfhhTuBXmMPppA&index=3
3. https://www.youtube.com/watch?v=xpPX3fBM9dU&list=PLqXS1b2lRpYTpUIEu3oxfhhTuBXmMPppA&index=6

Course Code	OBJECT ORIENTED PROGRAMMING	L	T	P	C
MT4304		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand Object Oriented Programming concepts and basics of Java programming language
- Know the principles of packages, inheritance and interfaces
- Define exceptions and use I/O streams
- Develop a java application with threads and generic classes
- Perform string manipulations

Course Description

Encapsulation of data and behaviour within classes to ensure data security and modularity. Abstraction through interfaces and abstract classes for hiding implementation details. OOAD methodologies like Unified Modelling Language (UML) for modelling of t ware systems. Use case diagrams, class diagrams, sequence diagrams, and other UML diagrams for visualizing system architecture.

Prerequisites

- Basic mathematical skills including arithmetic operations, logic, and Boolean algebra. Understanding of mathematical concepts used in programming, such as comparisons and logical operations. Proficiency in using command-line interfaces (CLI) for compiling and running programs.
- Familiarity with text editors or integrated development environments (IDEs) for writing and editing code. Understanding of basic data structures such as arrays, linked lists, stacks, queues, and trees. Knowledge of common algorithms such as searching, sorting, and recursion

UNIT – I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming– objects and classes - OOP in Java – Characteristics of Java – The Java Environment - Java Source File Structure – Compilation Fundamental Programming Structures in Java – Packages – Java Doc comments - Defining classes in Java -access specifiers - static members - Data Types, Variables, Operators, Control Flow – methods - constructors - Arrays.

UNIT – II ABSTRACTION- ENCAPSULATION- INHERITANCE – POLYMORPHISM 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists – Strings

UNIT – III EXCEPTION H AND L IN G AND I/O 9

Exceptions-exceptionhierarchy-throwingandcatchingexceptions-built in exceptions, creating own exception-User defined Exception. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT – IV MULTI THREADING **9**

Differences between multi-threading and multitasking, thread lifecycle, creating threads, synchronizing threads, Inter thread communication, daemon threads, thread groups.

UNIT – V GENERIC PROGRAMMING **9**

Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods, String Buffer Class & String Builder class.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop Java programs using OOP principles
CO2: Develop Java programs with the concepts inheritance and Polymorphism
CO3: Build Java applications using exceptions and I/O streams
CO4: Develop Java applications with threads and generics classes.
CO5: Develop interactive Java programs using strings

TEXT BOOKS:

1. Herbert Schildt, "Java: TheCompleteReference",11thEdition, Mc Graw Hill Education, New Delhi, 2019
2. Cay S. Horstmann, "Core Java Fundamentals", Volume1,11thEdition, Prentice Hall,2018.

REFERENCES:

1. Paul Deitel Harvey Deitel, Java How to Program, PrenticeHall;9thedition,2018.

YouTube Resources:

1. **MIT OpenCourseWare -** MIT OCW offers a wide range of lectures and courses on manufacturing systems and related topics, providing in-depth insights into advanced manufacturing concepts.
2. **Manufacturing Hub -** This channel covers various aspects of manufacturing, including lean manufacturing, agile manufacturing, and smart manufacturing techniques, offering practical tips and insights for students studying advanced manufacturing systems.
3. **The Engineer Guy -** While not specifically focused on advanced manufacturing, this channel provides insightful videos on engineering principles and processes, which can complement the understanding of manufacturing systems.

4. **Festo Learning -** Festo Learning offers videos on industrial automation, robotics, and smart manufacturing technologies, providing valuable insights into the latest advancements in manufacturing systems.
5. **The Lean Thinker-** This channel focuses on lean manufacturing principles and techniques, offering tutorials, case studies, and discussions to help viewers understand and implement lean practices in manufacturing processes.

30 HOURS

LIST OF EXPERIMENTS

1. Java program to demonstrate the concept of objects and classes.
2. Java program to demonstrate the fundamental programming structures.
3. Java class with private, protected, and public access specifiers.
4. Java program to demonstrate the concepts of inheritance and polymorphism.
5. Java program to demonstrate exception handling using try-catch blocks.
6. Java program to demonstrate basic input/output operations in Java using streams.
7. Java program to read and write data to/from files using file input/output streams.
8. Java program for multiple threads in a program to perform concurrent tasks.
9. Java program to demonstrate generic programming concepts of generic classes and methods.
10. Java program for String class, String Buffer class, and StringBuilder class to perform string manipulation operations.

TOTAL: 75 PERIODS

Course Code	ELECTRICAL DRIVES AND ACTUATORS	L	T	P	C
MT4305		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize a relay and power semiconductor devices
- To get a knowledge on drive characteristics
- To obtain the knowledge on DC motors and drives.
- To obtain the knowledge on AC motors and drives.
- To obtain the knowledge on Stepper and Servo motor

Course Description

The course provides a comprehensive understanding of switching devices, motor types, control techniques, and their applications in electrical drive systems, making it essential for students interested in the field of electrical drives control.

Prerequisites

- Knowledge of semiconductor devices such as diodes, transistors (including BJT and MOSFET), and thyristors (like SCR, TRIAC, GTO).
- Familiarity with DC and AC machines, including their construction, operating principles, and performance characteristics.
- Understanding of digital logic circuits and systems, which are relevant for stepper motor control and logic sequencing.
- Strong analytical and problem-solving skills are essential for troubleshooting and optimizing UAV systems during development and operation.

UNIT – I RELAY AND POWER SEMICONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT – II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.

UNIT – III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT – IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives –Starting and Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control. No load and blocked rotor test, Types of losses and efficiency calculations of electric machines.

UNIT – V TRANSFORMER, STEPPER MOTOR AND SERVO MOTORS 9

Single phase transformer: working principle and construction, Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation-Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the principles and working of relays, drives and motors.
CO 2: Explain the working and characteristics of various drives and motors.
CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications

TEXT BOOKS:

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

REFERENCES:

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
3. Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

YOUTUBE RESOURCES:

1. ht https://www.youtube.com/watch?v=YUIrTBg6Sh8
2. https://www.youtube.com/watch?v=7o8CSHFl7cY
3.https://www.youtube.com/watch?v=Zoqha05VxMY4.
4.https://www.youtube.com/watch?v=4Dl0as5HJ0A

5. https://www.youtube.com/watch?v=C0BkFVRcNRw
6. https://www.youtube.com/watch?v=B6Bx5Ew5gYk
7. https://www.youtube.com/watch?v=fU7DEa6GZpE
8. https://www.youtube.com/watch?v=h4fhm8bhcCo

LIST OF EXPERIMENTS:

1. Load test on DC Motor
2. Load test on 3 Phase Induction Motor
3. Load test on 3 Phase Synchronous Motor.
4. Rheostat based Speed control of motors (AC and DC)
5. Switching circuits of MOSFET, IGBT, SCR and TRAIC.
6. Speed control of DC motor using Power Electronic Drive.
7. Position and direction control DC servomotor using Power Electronic Drive.
8. Position, direction and speed control of BLDC and PMDC motors using Power Electronic Drive.
9. Position, Direction and speed control of stepper Motor.
10. AC servomotor position, direction and speed control using Power Electronic Drive. (Any 8 experiments)

Course Code	Employability Enhancement Skills – III	L	T	P	C
ES4301	**Professional Communication and Teamwork Skills**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize students with various forms of communication.
- To develop effective team communication skills.
- To enhance stakeholder communication skills.
- To cultivate ethical communication practices.
- To explore digital communication tools and trends.

UNIT I **9**

Introduction to Communication - Verbal Communication Skills: - Written Communication Skills - Nonverbal Communication - Interpersonal Communication.

UNIT II **9**

Characteristics of Effective Teams - Team Building and Group Cohesion - Conflict Resolution - Decision Making in Teams - Cross-Cultural Communication.

UNIT III **9**

Stakeholder Communication - Presentation Skills - Effective Meetings - Feedback and Evaluation.

UNIT IV **9**

Professional Codes of Conduct - Integrity in Communication - Addressing Ethical Challenges - Analyzing real-world ethical communication dilemmas.

UNIT V **9**

Digital Communication Tools - Social Media and Networking - Emerging Trends in Communication.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Demonstrate proficiency in various forms of communication.
CO2: Exhibit strong team communication skills.
CO3: Display competence in stakeholder communication.
CO4: Apply ethical communication principles.
CO5: Utilize digital communication tools effectively.

TEXT BOOKS:

1. Sharon J. Gerson and Steven M. Gerson. "Technical Communication: Process and Product", Pearson, 2014
2. Karl A. Smith. “Teamwork and Project Management”, McGraw-Hill Education, 2013
3. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins. "Engineering Ethics: Concepts and Cases", Cengage Learning, 2012
4. Christoph Meinel and Harald Sack. "Digital Communication: Communication, Multimedia, Security", Springer, 2014.

REFERENCES:

1. Katherine L. Adams and Gloria J. Galanes. "Communicating in Groups: Applications and Skills", McGraw Hill Education, 2018
2. Lawrence Holpp. "Managing Teams: Strategies for Success", McGraw Hill, 1998.
3. Caroline Whitbeck (ed) "Ethics in Engineering Practice and Research", Cambridge University Press, 2011.

TOTAL: 30 PERIODS

Semester IV

Course Code	Numerical Methods	L	T	P	C
MA4401	(Common to B.E - CIVIL, MECH, MCT, EEE, ECE, EC(ACT) and EE(VLSI))	3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Understand the basic concepts and techniques of solving algebraic and transcendental equations.

CO2: Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
CO3: Apply the numerical techniques of differentiation and integration for engineering problems.
CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014 47.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6 th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

Course Code	MECHANICS OF MATERIALS	L	T	P	C
MT4401		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Applying the principle concepts behind stress, strain and deformation of solids for various engineering applications.
- Analyzing the transverse loading on beams and stresses in beam for various engineering applications.
- Analyzing the torsion principles on shafts and springs for various engineering applications.
- Analyzing the deflection of beams for various engineering applications.
- Analyzing the thin and thick shells and principal stresses in beam for various engineering applications

Course Description

The Mechanics of Materials course provides students with a comprehensive understanding of the behavior of engineering materials under various loading conditions. Through theoretical analysis and practical applications, students will explore the concepts of stress, strain, and deformation in structural components and systems.

Prerequisites

- Knowledge of mechanics, including topics such as forces, motion, and equilibrium
- Familiarity with the fundamental principles of mechanics of materials
- Basic mathematical knowledge
- Understanding of engineering mechanics principles.

UNIT I STRESS AND STRAIN **9**

Introduction, Hooke's law, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Generalized Hooke's law, Bulk modulus, Relationship between elastic constants.

UNIT II ANALYSIS OF STRESS AND STRAIN **9**

Plane stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions.

Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, thick cylinders: Lames equations.

UNIT III SHEAR FORCES AND BENDING MOMENTS **9**

Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads and uniformly distributed constant / varying loads.

Stress in Beams: Pure bending, Curvature of a beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses, Deflection of beams (Curvature).

UNIT IV TORSION **9**

Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, thin-walled sections

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

UNIT V STRAIN ENERGY **9**

Castiglioni's theorem I and II, Load deformation diagram, Strain energy due to normal stresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion.

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Apply the principle concepts behind stress, strain and deformation of solids for various engineering applications.

CO2: Analyze the transverse loading on beams and stresses in beam for various engineering applications.

CO3: Analyze the torsion principles on shafts and springs for various engineering application.

CO4: Analyze the deflection of beams for various engineering applications.

CO5: Understanding the concept of theories of failure.

TEXT BOOKS:

1. Bansal, R.K., Strength of Materials, Laxmi Publications (P) Ltd.,6th edition., 2018
2. Jindal U.C., Strength of Materials, Asian Books Pvt. Ltd., New Delhi, 2007
3. S. Ramamrutham, R. Narayanan, Strength of Materials., Dhanpat Rai Publishing Company (P) Ltd., 2020

REFERENCES:

1. Egor. P.Popov " Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole Mechanics of Materials, Tata McGraw Hill publishing 'co. Ltd., New Delhi.
3. Hibbeler, R.C., Mechanics of Materials, Pearson Education, Low Price Edition, 10th Edition, 2016
4. Subramanian R., Strength of Materials, oxford University Press, Oxford Higher Education Series, 2007.
5. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004.

YouTube Resources:

1. **Structurefree:** This channel provides comprehensive tutorials on structural engineering topics, including stress and strain analysis, beams, columns, and torsion. The videos offer clear explanations and example problems to help understand complex concepts.
2. **Engineer4Free:** Engineer4Free offers free engineering tutorials covering various topics, including mechanics of materials and structural analysis. The channel provides lectures on stress and strain, shear forces and bending moments, and torsion, among other topics.

3. **Mechanical Engineering Explained:** This channel covers a wide range of mechanical engineering topics, including stress analysis, strain energy, and failure theories. The videos provide visual explanations and demonstrations to aid understanding.
4. **NPTEL -** Mechanical Engineering: NPTEL (National Programme on Technology Enhanced Learning) offers lectures by experienced professors on various engineering subjects. The Mechanical Engineering playlist includes topics related to stress and strain analysis, including beams, torsion, and columns.
5. **LectureNotes.in:** LectureNotes.in provides lecture videos and notes on engineering topics, including mechanics of materials and structural analysis. The channel covers stress and strain analysis, including concepts such as Hooke's law, Mohr's circle, and theories of failure.
6. **The Organic Chemistry Tutor:** While primarily focused on chemistry, this channel offers tutorials on mathematics and engineering topics.

Course Code	CONTROL SYSTEM ENGINEERING	L	T	P	C
MT4402		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the components and their representation of control systems.
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the system frequency analysis.
- To understand the concept of stability analysis.
- To know about the state variable methods of control system analysis system.

Course Description

This course provides a comprehensive understanding of control systems, focusing on their components, representation, and analysis techniques. This course also describes time and frequency response analysis, concepts of stability analysis, introduces students to state variable representation and analysis techniques in control systems.

Prerequisites

- A strong understanding of calculus, particularly differential equations, Laplace transforms, and complex variables, is essential for analyzing system dynamics and developing control algorithms.
- Familiarity with basic control theory concepts such as feedback, feed forward, stability, transient response, steady-state response, and frequency response analysis will provide a foundation for studying advanced control techniques covered in the syllabus.
- Familiarity in programming language like MATLAB will be useful for simulating and analyzing control systems, implementing control algorithms, and solving state equations.
- Familiarity with mechanical systems, including mass-spring-damper systems, is important for understanding mechanical transfer function models and their behavior in control systems.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS SYSTEMS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI, PID control systems.

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot-Design of compensators using Bode plots- Cascade lead, lag and lag-lead compensation.

UNIT IV CONCEPTS OF STABILITY ANALYSIS **9**

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS **9**

State variable representation-Conversion of state variable models to transfer functions Conversion of transfer functions to state variable models-Solution of state equations Concepts of Controllability and Observability.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

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

CO1: State the various control terminologies and concepts.
CO2: Know the procedures in developing the transfer function, state space models and time and frequency domain analysis methods.
CO3: Apply the procedures on developing the systems in transfer function and state space approach and apply to evaluate the performance of system in time and frequency domain techniques.
CO4: Illustrate the time and frequency response characteristics of system response.
CO5: Analyze the performance of system using various time and frequency domain techniques.

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
2. K.Ogata, "Modern Control Engineering", PHI, 5 th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. S.K.Bhattacharya, "Control System Engineering", Pearson, 3 rd Edition, 2013.
3. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.
4. Nagoor Kani, "Conrol Systems", RBA Publications, 2017.
5. Norman. S. Nise, "Control Systems Engineering", Wiley India edition, 2018.,

YouTube Resources:

1. https://www.youtube.com/watch?v=bEpVOdcSABU
2. https://www.youtube.com/watch?v=LE9oZG-l4wU
3. https://www.youtube.com/watch?v=OXwFcFzP-dk
4. https://www.youtube.com/watch?v=wz5WqmPjtvk
5. https://www.youtube.com/watch?v=i50n4l9lyQw

6. https://www.youtube.com/watch?v=N5Zb9N5sQ-o
7. https://www.youtube.com/watch?v=ArWXtI12hpQ
8. https://www.youtube.com/watch?v=I3X7uRgVV_U
9. https://www.youtube.com/watch?v=6U1FzgHBmfA
10. https://www.youtube.com/watch?v=k1YkjnCpqas

Course Code	SENSORS, MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
MT4403		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of measurements and bridge circuit.
  used in mechatronics system development
- To learn about the optical, pressure and temperature sensor
- To understand the fundamentals of signal conditioning, data acquisition and communication systems

Course Description

This course provides an introduction to the theory and practical applications of measurement technology. Students will learn the fundamental concepts and techniques related to sensor models and gain hands-on experience with and using sensors and instrumentation systems.

Prerequisites

- Basic knowledge of measurement technology.
- Familiarity with a data acquisition and communication system.

UNIT I INTRODUCTION **9** Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors, Torque, Vibration and Motion Sensors – Potentiometers- Resistive, Inductive, Capacitive, Piezoelectric, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Gyroscope -Hall effect -Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III MEASUREMENTS **9**

D.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), Q-meter, transformer ratio bridges, self-balancing bridges. Interference & screening — Multiple earth and earth loops — Electrostatic and electromagnetic Interference — Grounding techniques.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9** Photo-diode, Photo conductive cell, photo voltaic, Photo resistive, LED, laser, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - MEMS, Nano Sensors, & LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel

data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Determination of Load, Torque and Force using Strain Gauge.
2. Determination of the characteristics of Pressure Sensor and Piezoelectric Force Sensor
3. Determination of Displacement using LVDT.
4. Determine the Characteristics of Various Temperature Sensors.
5. Determine the Characteristics of Various Light Detectors (Optical Sensors).
6. Distance Measurement using Ultrasonic and Laser Sensor.
7. Speed, Position and Direction Measurement Using Encoders.
8. Data acquisition, visualization and analysis of signals.
9. Measurement of Resistance using bridges
10. Measurements of self-induction and capacitance using brides.

TOTAL: 30 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize with various calibration techniques and signal types for sensors.
CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.
CO3: Understanding the comparison of measuring instruments.
CO4: Select the appropriate sensor for different applications.
CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawhney A K and Puneet Sawhney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. . C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.

4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.
6. K. Thyagarajan, Ajoy Ghatak “Lasers Fundamentals and Applications” , 2nd edition, Springer.
7. Robert .H.Kingston :Optical Sources ,Detectors and Systems - Fundamentals and Application “Academic Press inc,1995 .

YouTube Resources:

1. **SPEC e-learn -** It provides information regarding measurement and sensors.
2. **Online video lectures for electronics measurement -** Includes topics like signal conditioning, data acquisition, instrument calibration, sensors, and transducers, and measurement basics**.**
3. **The IEEE Sensors Council** - focuses on the theory, design, fabrication, manufacturing and application of devices for sensing and transducing physical, chemical, and biological phenomena.
4. **Real Pars -** What is a Sensor? Different Types of Sensors, Applications.

TOTAL:75 PERIODS

Course Code	KINEMATICS AND DYNAMICS OF MACHINERY	L	T	P	C
MT4404		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the basic components and layout of linkages in the assembly of a system / machine and also learn about the mechanisms
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
- To learn about the concepts in friction.
- To understand the principles in force analysis.
- To learn about the basic concept of static and dynamic balancing and vibration.

Course Description

The Mechanisms and Machine Dynamics course offers students a comprehensive understanding of the principles governing the behaviour and analysis of mechanical systems and components. Through theoretical study and practical applications, students will explore the kinematics, dynamics, and performance characteristics of various mechanisms and machines.

Prerequisites

- A basic understanding of classical mechanics.
- Familiarity with mechanics, including topics such as forces, motion, and equilibrium.
- Basic mathematical knowledge.
- A basic understanding of physics principles, such as Newton's laws of motion, work and energy, and principles of friction.

UNIT I INTRODUCTION **9**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of follower's motion – circular arc and tangent cams.

UNIT II GEARS AND GEAR TRAINS **9**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III FRICTION **9**

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Belt and rope drives.

UNIT IV FORCE ANALYSIS **9**

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND VIBRATION **9**

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft.

45 PERIODS

KINEMATICS AND DYNAMICS OF MACHINERY LABORATORY

LIST OF EXPERIMENTS:

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   b) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
3. Motorized gyroscope – Study of gyroscopic effect and couple.
4. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
5. Cams – Cam profile drawing, Motion curves and study of jump phenomenon.
6. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
7. a) Balancing of rotating masses.
   b) Balancing of reciprocating masses.
8. Vibration of Equivalent Spring mass system – undamped and damped vibration.
9. Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and Damped Natural frequencies

30 PERIODS

Course Format

Lectures and discussions, Hands-on Practical exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the basic terminologies of kinematics of machines and CAM.
CO2: Analyze the working of various mechanism, gears and gear train.
CO3: Interpret the various concepts of kinematics and dynamics including forces and frictions in drives.
CO4: Calculate static and dynamic forces of mechanisms.
CO5: Calculate the balancing masses and compute the frequency of free vibration.

TEXT BOOKS:

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2017.
2. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
3. Gordon R. Pennock & Joseph E. Shigley John J. Uicker, "Theory Of Machine And Mechanisms" Oxford University Press; 4th edition, 2014

REFERENCES:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh. A, and A.K. Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi,1988.
3. Rao. J. S. and Dukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi,1992.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low Prices Student Edition, 1999.
5. Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Ambekar A. G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi,

YouTube Resources:

1. **Learn Engineering:** This channel offers comprehensive tutorials on various engineering topics, including mechanisms and machine dynamics. The videos cover concepts such as kinematics, cams, gears, friction, force analysis, and balancing. The explanations are clear and concise, making complex topics easier to understand.
2. **Engineering Explained:** Engineering Explained provides in-depth explanations of engineering concepts related to mechanisms and machine dynamics. The channel covers topics such as gear trains, friction drives, force analysis, and vibration analysis. The videos often include animations and simulations to illustrate key principles.
3. **Mechanical Engineering Channel:** This channel focuses on mechanical engineering topics, including mechanisms and machine dynamics. The videos cover a wide range of topics from basic principles to advanced analysis techniques. The channel provides practical examples and demonstrations to help viewers understand the concepts better.
4. **MIT OpenCourseWare:** MIT Open Course Ware offers free lecture videos and course materials from MIT's mechanical engineering courses. The lectures cover topics such as kinematics, gears, friction, force analysis, and vibration analysis in detail. The content is presented by experienced professors and provides a comprehensive understanding of the subject matter.
5. **NPTEL Mechanical Engineering:** NPTEL (National Programme on Technology Enhanced Learning) offers lectures by professors from various Indian Institutes of Technology (IITs) on mechanical engineering topics. The Mechanical Engineering playlist covers topics such as mechanisms, gears, friction, force analysis, and vibration analysis. The lectures provide a solid foundation for understanding the subject matter.

TOTAL:75 PERIODS

Course Code	MANUFACTURING TECHNOLOGY	L	T	P	C
MT4405		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes
- To analyse the working principles of bulk deformation of metals
- To learn the working principles of sheet metal forming process
- To study and practice the working principles of metal cutting.

Course Description

This course covers fundamental metal casting processes, special techniques like pressure die casting and investment casting. It also delves into metal joining methods such as fusion welding, resistance welding, and brazing. Additionally, sheet metal processes, are explored, along with the mechanics of metal cutting, including chip formation, tool materials, and surface finish optimization.

Prerequisites

- Knowledge of materials properties would be beneficial for understanding the processes involved in metal casting, joining, deformation, and cutting.
- Familiarity with the basic principles of manufacturing processes, such as machining, forming, joining, sand casting, welding, forging, and sheet metal forming

UNIT I METAL CASTING PROCESSES **9**

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Riser and gating design - Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell - investment – Pressure die casting - Centrifugal Casting - Defects in Sand casting process-remedies

UNIT II METAL JOINING PROCESSES **9**

Fusion welding processes – Oxy fuel welding – Filler and Flux materials-–Arc welding, Electrodes, Coating and specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding –– Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – inspection &remedies – Brazing - soldering – Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES **9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. load estimation for bulk metal forming processes, Introduction to shaping operations.

UNIT IV SHEET METAL PROCESSES **9**

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods – Load estimation for sheet metal forming processes - special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming.

UNIT V METAL CUTTING PROCESSES **9**

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods - Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

45 PERIODS

MANUFACTURING TECHNOLOGY LABORATORY

LIST OF EXPERIMENTS

1. Preparing green sand moulds with cast patterns.
2. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
3. Taper Turning, Knurling, external and internal thread cutting on circular parts using lathe machine.
4. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
5. Drilling and Reaming using vertical drilling machine.
6. Milling contours on plates using vertical milling machine.
7. Cutting spur using milling machine.
8. Generating gears using gear hobbing machine.
9. Grinding components using surface grinding and cylindrical / centerless grinding machine.

30 PERIODS

Course Format

Lectures and discussions, Lecture Notes, Guest lectures by industry Experts, Industrial Visit and, Online resources and tutorials

Assessments & Grading

Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1. Explain the principle of different metal casting processes.
CO2. Describe the various metal joining processes.
CO3. Illustrate the different bulk deformation processes.
CO4. Apply the various sheet metal forming process.
CO5. Apply suitable technique for metal cutting process.

TEXT BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,4th Edition, 2013
2. P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition,2018.

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
5. 5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004

YouTube Resources:

1. **MetalForge Creations**: This channel is dedicated to showcasing the art and process of metal casting. From intricate sculptures to functional pieces, the channel provides insights into various casting techniques, such as sand casting, investment casting, and lost-wax casting
2. **WeldingWonders:** This channel dedicated to showcasing the art and techniques of welding. Hosted by skilled welders and craftsmen, the channel provides a range of content including tutorials, project walkthroughs, welding tips, and demonstrations of various welding methods and equipment.
3. **MetalForgeMastery:** This channel provides viewers with insights into various metalworking techniques, including forging, molding, and casting. With a focus on mastering the craft, MetalForgeMastery offers tutorials, tips, and inspiring projects for both beginners and experienced metalworkers alike.
4. **SheetMetalSavvy:** This channel provides tutorials on various techniques such as cutting, bending, and welding, to showcasing innovative projects and showcasing the latest tools and equipment in the field.

TOTAL 75 PERIODS

Course Code	COMPUTER AIDED DESIGN AND MODELLING LABORATORY	L	T	P	C
MT4406		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are to:

- To prepare assembly drawings both manually and using standard CAD packages.
- To familiarize the commands and procedure for 2D drawing and 3D models in computer-oriented Modelling environment.
- To assemble the parts and generate the motion simulation of 3D models.

Course Description

This is a hands-on course designed to equip students with the skills necessary to create, analyse, and simulate mechanical designs using both manual techniques and computer-aided design (CAD) software. Throughout the course, students will engage in practical exercises aimed at enhancing their understanding of 2D and 3D modelling principles, assembly techniques, and motion simulation of mechanical components and systems.

Prerequisites

- Basic knowledge of engineering drawing principles.
- Understanding of mechanical components and mechanisms.

LIST OF EXPERIMENTS

2D and 3D Modelling of Components

1. Bearing and Couplings.
2. Ball Screw and Gears
3. Sheet Metal Components
4. Jigs, Fixtures and Die Assemblies.

Modelling and Simulation of Mechanism

5. 4 Bar Chain
6. Slider Crank
7. Quick Return and Elliptical Trammel.
8. Screw jack.

Assembly and Simulation of Parts

9. Basic Serial Robots
10. Simple Machines

Course Format

Lectures and discussions, Demonstration and laboratory Sessions, projects, Guest lectures by Industry Experts, Online resources, and tutorials.

Assessments & Grading

Project, Internal Assessments and Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Create 2D drawing and 3D models for part design and model developments.
CO2: Integrate the parts and capable to simulate motion functionality of the model virtually.
CO3: Analyse the Design, assembly and visualize the motion of machines and robots.

TEXT BOOKS:

1. David A. Madsen, David P. Madsen, Emeritus, "Engineering Drawing and Design", Cengage Learning, 2016.
2. Mikell P. Groover, Emory W. Zimmers Jr., "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson, 2003.
3. Joseph E. Shigley, Charles R. Mischke, "Mechanical Engineering Design", McGraw Hill Education, 2015.
4. John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson, 2017.

REFERENCES:

1. Paul Tran, "Solidworks 2023 Basic Tools", SDC Publications, 2023.
2. CADArtifex, "AutoCAD 2023: A Power Guide for Beginners and Intermediate Users", Independently published, 2023.
3. Prof. Sham Tickoo, "CATIA V5-6R2023 for Designers", CADCIM Technologies, 2023.

YouTube Resources:

1. **SolidWorks Tutorial -** Provides step-by-step tutorials covering various aspects of SolidWorks, including sketching, 3D modelling, assembly, and simulation.
2. **TutorialsPoint -** Offers a comprehensive playlist of AutoCAD tutorials for beginners and intermediate users, covering topics such as drawing tools, editing commands, and dimensioning.
3. **CATIA V5 Tutorial - Tutorial for Beginner -** A beginner-friendly tutorial series on CATIA V5, covering basic to advanced functionalities of the software.
4. **Siemens NX Software -** Official tutorials from Siemens NX Software covering NX CAM, guiding users through machining operations and strategies.
5. **RoboDK Official –** It provides tutorials on robot simulation, offline programming, and virtual commissioning using its software. The channel covers various robot brands and applications.
6. **KUKA Robotics Corporation -** KUKA Robotics provides tutorials and demonstrations on robot programming, simulation, and applications using KUKA robots and simulation software.

TOTAL:60 PERIODS

Course Code	Employability Enhancement Skills – IV	L	T	P	C
ES4401	**Leadership and Project Management Skills**	0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand leadership within the context of project management.
- To differentiate between leadership and management roles.
- To learn project initiation processes and setting SMART objectives.
- To build high-performing teams through motivation, empowerment, and effective communication.
- To develop skills in project planning, estimation, resource allocation, risk management, and scheduling.

UNIT I **9**

Understanding Leadership - Introduction to Project Management - Leadership vs. Management - Project Initiation - Setting SMART Objectives.

UNIT II **9**

Building High-Performing Teams - Motivation Theories - Empowering Team Members - Leadership Communication - Handling Team Conflicts.

UNIT III **9**

Work Breakdown Structure (WBS) - Estimation Techniques - Gantt Charts and Network Diagrams - Resource Allocation - Risk Management.

UNIT IV **9**

Leading Project Teams - Monitoring and Controlling Progress - Change Management - Quality Management - Stakeholder Communication.

UNIT V **9**

Project Closure Activities - Lessons Learned - Celebrating Success - Transition Planning.

COURSE OUTCOMES:

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

CO1: Apply leadership principles to project management scenarios.
CO2: Distinguish between leadership and management functions in project environments.
CO3: Initiate projects effectively by setting SMART objectives.
CO4: Foster high-performing teams through motivation, empowerment, and conflict resolution.
CO5: Proficiently plan, schedule, and manage project activities, resources, risks, and stakeholder communications.

TEXT BOOKS:

1. Peter G. Northouse. "Leadership: Theory and Practice", SAGE Publications, 2021
2. Patrick Lencioni. "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 2011
3. Robert K. Wysocki. "Effective Project Management: Traditional, Agile, Extreme", Wiley, 2019

4. Clifford F. Gray and Erik W. Larson. "Project Management: The Managerial Process", McGraw-Hill Education, 2017
5. Harold Kerzner. "Project Management Case Studies", Wiley, 2008.

REFERENCES:

1. Harold Kerzner. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 10th edition, Wiley, 2009
2. Gregory P. Shea and Cassie A. Solomon. "Leading Successful Change: 8 Keys to Making Change Work", Gildan Media, LLC, 2013.

TOTAL: 30 PERIODS

Semester V

Course Code	DESIGN OF MACHINE ELEMENTS	L	T	P	C
MT4501		3	0	0	3

COURSE OBJECTIVES

- To learn the various steps involved in the Design Process.
- To Learn designing shafts and couplings for various applications.
- To Learn the design of temporary and permanent Joints.
- To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
- To Learn designing and select sliding and rolling contact bearings, seals and gaskets.(Use of PSG Design Data book is permitted)

COURSE DESCRIPTION

Design of Machine Elements is a fundamental course in mechanical engineering that focuses on the principles, methods, and techniques involved in designing machine components and systems. The course covers topics such as stress analysis, material selection, design factors, failure theories, and design considerations for various machine elements. Emphasis is placed on understanding the design process, applying engineering principles, and ensuring the functionality, reliability, and safety of machine elements.

PREREQUISITES

- Basic knowledge of mechanics, strength of materials, materials science, and engineering design fundamentals
- Familiarity with mathematics (calculus, differential equations) and computer-aided design (CAD) software is beneficial
- Understanding of manufacturing processes, machine components, and engineering drawing standards

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs -

rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines - Solid and Rimmed flywheels- connecting rods and crank shafts

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi& Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

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

CO 1. Explain the design machine members subjected to static and variable loads.
CO 2. Apply the concepts design to shafts, key and couplings.
CO 3. Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
CO 4. Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
CO 5. Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition , Tata Mc Graw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition,Tata McGraw-Hill , 2015.

REFERENCES:

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw- Hill Book Co,2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements"8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition,Wiley, 2017.
4. Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai,2003.
5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup,et al. | 25 March 2019

YOUTUBE RESOURCES:

1. **Design of Machine Elements by Learn Engineering:** This playlist offers a comprehensive overview of machine design principles, including stress analysis, material selection, and design considerations.
2. **Machine Design by NPTEL (National Programme on Technology Enhanced Learning):** NPTEL lectures on various aspects of machine design, covering topics such as design of fasteners, bearings, gears, shafts, and mechanical joints.
3. **Machine Design Tutorials by The Engineering Mindset**: This series includes tutorials on machine fundamentals, design calculations, stress analysis, and practical design examples.
4. **Design of Machine Elements by Mechanical Engineering Lectures:** Mechanical Engineering Lectures covers topics such as design of shafts, keys, couplings, springs, brakes, and clutches in machine elements design.
5. **Machine Design and Analysis by MIT Open Course Ware:** MIT Open Course Ware offers lectures on design and analysis, covering design methodologies, design optimization, and case studies.

TOTAL:45 PERIODS

Course Code	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
MT4502		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide an overview of how computers are being used in mechanical component design.
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

Course Description

This course is designed to provide students with a comprehensive understanding of the integration of computers in mechanical component design and manufacturing processes. The course covers various topics including CAD system architecture, geometric modeling, CAD standards, CNC fundamentals, part programming, cellular manufacturing, and flexible manufacturing systems (FMS). Through theoretical instruction and practical exercises, students will gain knowledge and skills essential for utilizing computer-based tools in mechanical engineering design and manufacturing.

Prerequisites

- Basic understanding of engineering drawing principles.
- Familiarity with mechanical components and manufacturing processes.
- Basic mathematical knowledge.
- Familiarity with programming concepts.

UNIT I Introduction **9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts ––Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance

UNIT II Geometric Modelling **9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT III CAD Standards **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

UNIT IV Fundamental of CNC and Part Programming **9**

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools Principle of operation CNC- Construction features including structure- Drives and CNC controllers-2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming (FANUC) on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT V Cellular Manufacturing and Flexible Manufacturing System (FMS) 9

Group Technology (GT), Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS

45 PERIODS

LIST OF EXPERIMENTS

1. Modelling of a part using any CAD package.
2. Modelling and assembling of the mechanical assembly using any CAD package.
3. Structural analysis using FEA software – any analysis package.
4. Beam deflection analysis using FEA software – any analysis package.
5. Modelling and tool path simulation – turning using any CAM package.
6. Modelling and tool path simulation – milling using any CAM package.
7. NC code generation for milling using any CAM package.
8. NC code generation for turning using any CAM package.

30 PERIODS

Course Format

Lectures and discussions, Hands-on Practical exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.
CO2: Explain the fundamentals of parametric curves, surfaces and Solids. Create 3D engineering components.
CO3: Summarize the different types of Standard systems used in CAD and Perform various analyses on simple structures for the application of different loads.
CO4: Apply NC & CNC programming concepts to develop, simulate and generate part programme for Lathe & Milling Machines.
CO5: Summarize the different types of techniques used in Cellular Manufacturing and FMS.

TEXT BOOKS:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill PublishingCo.2007.
2. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
3. Radhakrishnan P, Subramanyan S. and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi,2000.

REFERENCES:

1. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “, Second Edition, Pearson Education, 1999.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc,1992.
3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003
4. William M Neumann and Robert F. Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
5. Prof. Sham Tickoo, "CATIA V5-6R2023 for Designers", CADCIM Technologies, 2023.

YouTube Resources:

1. **Fusion 360 Official -** Offers tutorials and tips for Autodesk Fusion 360, covering CAD, CAM, and other design and manufacturing topics.
2. **SolidWorks Tutorial -** Tutorial for Beginner - Provides beginner-friendly tutorials for SolidWorks, covering various features and functions for mechanical design.
3. **NX CAM Tutorial -** Offers tutorials for Siemens NX CAM, covering topics such as toolpath generation, simulation, and post-processing for CNC machining.
4. **MasterCAM Official -** Provides tutorials and demonstrations for MasterCAM, a widely used CAM software for CNC programming and machining.
5. **Manufacturing Hub -** A channel offering a wide range of tutorials on manufacturing processes, CAD/CAM software, and CNC machining techniques.

TOTAL:75 PERIODS

Course Code	FLUID POWER SYSTEM FOR AUTOMATION	L	T	P	C
MT4503		3	0	2	4

Course Objectives:

The main objectives of this course are to:

- This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic components and systems and their application in manufacturing and Automation sectors.

Course Description

This course provides an introduction to the applications of fluid power systems. Students will learn the fundamental concepts and techniques related to Hydraulic and pneumatic power systems.

Prerequisites

- Basic knowledge on mechanical & Electronic concepts.
- Familiarity with Industrial manufacturing process.

UNIT I Fluid Power Principles and Hydraulic Pumps 9

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids-Properties of fluids – Basics of Hydraulics – Pascal's Law- Principles of flow – Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification-Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems

UNIT II Hydraulic Actuators and Valves 9

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning - Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves-Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuations. Accessories: Reservoirs, Pressure Switches- Applications- Fluid Power ANSI Symbols – Problems

UNIT III Hydraulic Systems 9

Accumulators, Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and
Forklift applications – Troubleshooting.

UNIT IV Pneumatic Systems 9

Properties of air– Perfect Gas Laws - Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine-Troubleshooting.

UNIT V Introduction to PLC and SCADA 9

Introduction – Principles of operation – PLC Architecture and specifications- Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions - – PLC ladder diagram - PLC

programming- Simple instructions - Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries

45 PERIODS

List of Experiments

1. Experimental Verification of Speed Control Circuits in Pneumatic and Hydraulic Trainer.
2. Experimental Verification of Single and Double Acting Cylinder Circuits Using Different Directional Control Values.
3. Experimental Verification of Electro-Pneumatic Circuits.
4. Experimental Verification of Pneumatic Sequencing Circuits.
5. Experimental Verification of Logic, Metre-in and Metre-out Pneumatic Circuits.
6. Experimental Verification of Electro Pneumatic Sequencing Circuits.
7. Control of PLC Based Electro Pneumatic Sequencing Circuits.
8. Control of PLC Based Electro Hydraulic Sequencing Circuits.

30 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

Course Outcomes:

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

CO1: Understand concepts and components of fluid power system.
CO2: Understand operating principles and constructional features of hydraulic and pneumatic systems.
CO3: Knowledge with selection of hydraulic / pneumatic components
CO4: Understand designing and layout of Hydraulic Power package and trouble shooting.
CO5: Knowledge on PLC basics and concepts of SCADA

Text Books:

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. Gary Dunning, “Introduction to Programmable Logic Controllers”, 3rd India edition, Cengage Learning, 2007.

References:

1. Majumdar, S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata Mc Graw Hill, 2001.
2. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata Mc Graw Hill, 2007.
3. B. G. Liptak “Instrument Engineer’s Handbook – Process Software and Digital Network”, 3rd edition, CRC Press,2002.

4. Jose A. Romagnoli, Ahmet Palazoglu, “Introduction to Process control”, CRC Taylor and Francis group, 2005.
5. William T. Shaw, Cybersecurity for SCADA systems, Penn Well Books, 2006

YouTube Resources:

1. **Jim Pytel –** This channel gives a complete knowledge on hydraulic systems.
2. **Ms. Pneumatic** - This channel focuses on basics to advance levels of pneumatics.
3. **NPTEL NOC-IITM** - This channel offers complete course on oil hydraulics and pneumatics.
4. **Instrumentation tools**- This channel provides tutorials on PLC, SCADA and hands on simulation exercises for automation.

Total: 75 PERIODS

Semester VI

Course Code	DESIGN OF MECHATRONICS SYSTEM	L	T	P	C
MT4601		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To learn about Mechatronics system design and simulation, ergonomics and safety
- To understand theoretical and practical aspects of interfacing, real time data acquisition and control
- Design of motion converter, Pneumatic and Hydraulic Controller and temperature control.
- To learn the real time interfacing software and man machine interface.
- To know about the various applications in this system

Course Description

This course provides knowledge about design parameters and factors to be considered in designing a system. This provides the learning of major components of mechatronics system. This gives an exposure on real time interfacing and few case studies of Mechatronics system.

Prerequisites

- Basic knowledge of Machine design.
- Should be familiar with Automation components

UNIT I INTRODUCTION TO DESIGN OF MECHATRONICS SYSTEM 9

Key elements – Mechatronics design process – design parameters – mechatronics and traditional design – Advanced approaches in mechatronics design – Introduction to industrial design, modelling, simulation and analysis – Ergonomics and safety.

UNIT II BASIC SYSTEM MODELLING 9

Introduction – model categories – model development – Simulation using software – verification and validation – Mathematical modelling: Basic system modelling – mechanical electrical, fluid and thermal.

UNIT III MECHATRONIC SYSTEM MODELLING 9

Engineering systems: Rotational – translational, electro-mechanical, pneumatic-mechanical, hydraulic-mechanical, micro electro mechanical system – Dynamic responses of system: first order, second order system – Performance measures.

UNIT IV REAL TIME INTERFACING 9

Introduction – Selection of interfacing standards- elements of data acquisition and control systems – Overview of I/O process – general purpose I/O cards and its installation – RS 232/422/485 communication – Data conversion process – Application software –IEEE 488 standard interface - Man machine interface.

UNIT V CASE STUDIES ON DESIGN OF MECHATRONICS SYSTEM 9

Motion control using DC Motor, AC Motor and Servomotor - Temperature control of hot/cold reservoir – Pick and place robot – Car parking barriers – Motion and temperature control of washing machine – Auto focus camera, exposure control - Fuzzy based washing machine – Surface measurement using image processing.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the basic concepts of Integration and familiar the elements of mechatronics
CO2: Develop the system models and familiar the Mechatronics design process
CO3: Apply Real-Time Mechatronics system integration.
CO4: Realize the data acquisition for Real Time application.
CO5: Analyse the various Mechatronics system

TEXT BOOKS:

1. Devdas Shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning 2012.
2. Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003

REFERENCES:

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.
3. De Silva,"Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013.

45 PERIODS

YouTube Resources:

1. **IIT Bombay July 2018 –** Prof. Prasanna Gandhi – This channel provides all the information about the design of mechatronics system
2. **Arizona State Univer –** This channel provides knowledge of Industrial Design
3. **Engineering Funda –** This channel provides knowledge of Mathematical modelling
4. **RealPars -** This channel completely explains about the interface and communication standards.

Course Code	ROBOTICS AND MACHINE VISION SYSTEM	L	T	P	C
MT4602		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the principles of robotics, including kinematics, dynamics and robot programming.
- Gain proficiency in designing and implementing robotic systems integrated with machine vision capabilities
- Analyse the complex robotics and machine vision challenges to identify key solution
- Apply the theoretical knowledge of robotics to solve practical problems, demonstrating the ability to design, implement, and optimize integrated solutions.
- Keep up-to-date with the latest advancements in robotics and machine vision technologies.

Course Description

This course explores the integration of robotics and machine vision systems, covering fundamental principles, programming, perception, and practical applications. Students gain hands-on experience in designing, implementing, and optimizing robotic systems with machine vision capabilities, preparing them for careers in fields such as automation, manufacturing, and robotics research.

UNIT I BASICS OF ROBOTICS **9**

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracy-resolution –repeatability of robot. Energy transfer network Rotary to rotary motion, Rotary to linear motion, Harmonic gearing – gear system - Belt transfer system.

UNIT II ROBOT END EFFECTORS **9**

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

UNIT III ROBOT MECHANICS **9**

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

UNIT IV ROBOT PROGRAMMING **9**

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

UNIT V MACHINE VISION FUNDAMENTALS **9**

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

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

TEXT BOOKS:

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

REFERENCES:

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

YouTube Resources:

1. **Michiganrobotics**- This channel provides the classification of robots and applications
2. **Cognex Industrial Machine Vision –** This channel provides the different concept in machine vision system and Industrial operations.
3. **Robot Kinematics Course Trailer:** This channel gives the details regarding the kinematics analysis and Dynamics control.

TOTAL:45 PERIODS

Course Code	INDUSTRIAL AUTOMATION	L	T	P	C
MT4603		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the construction, operation and installation of PLCs.
- Provide the knowledge on interfacing the PLCs and field devices with communication protocols.
- Understand the concepts of DCS and SCADA systems.

Course Description

This course provides a knowledge on PLC, SCADA and its programming, Industrial applications of PLC and SCADA. It also provides knowledge on Distributed control system and process control.

Prerequisites

- Knowledge on Sensors and Instrumentation
- Should be familiar with Automation components

UNIT I Programmable Logic Controller **9**

Introduction – Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules, CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram into ladder diagram. PLC programming- Simple instructions – Manually operated switches – Mechanically operated switches - Latching relays.

UNIT II Applications of PLC **9**

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Motor start and stop, Simple materials handling applications, Automatic water level controller, Automatic lubrication of supplier Conveyor belt, Automatic car washing machine, Bottle label detection and process control application.

UNIT III SCADA System & Architecture **9**

Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries - SCADA System Components: Schemes-Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA/HMI Systems Various SCADA architectures, advantages and disadvantages of each system

UNIT IV Distributed Control System **9**

Introduction to DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities Operator interfaces - Low level and high-level operator interfaces – Displays - Engineering interfaces – Low level and high-level engineering interfaces – Factors to be considered in selecting DCS – Case studies – Sugar industry and Power plant

UNIT V Industrial Process Control **9**

Study of Advanced Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control, PID Control

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Choose appropriate PLC and explain the architecture, installation procedures and troubleshooting.
CO2: Develop PLC programs using various functions of PLCs for a given application.
CO3: Explain the application development procedures in SCADA and manage data, alarm and storage.
CO4: Distinguish DCS, SCADA and PLC and explain the architecture of DCS
CO5: Describe the controller elements and program methods.

TEXT BOOKS:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", 3rd India edition, Cengage Learning, 2007
2. John Webb, "Programmable Logic Controllers: Principles and Applications", 5th edition Prentice Hall of India, 2012.
3. Krishna Kant "Computer Based Process Control", Prentice Hall of India, 2004.
4. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986

REFERENCES:

1. B. G. Liptak "Instrument Engineer's Handbook – Process Software and Digital Network", 3rd edition, CRC Press,2002.
2. Jose A. Romagnoli, Ahmet Palazoglu, "Introduction to Process control", CRC Taylor and Francis group, 2005.
3. Richard Cox, "Programmable Controllers", Delmer Thomson learning, 2001.
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
5. William T. Shaw, Cybersecurity for SCADA systems, Penn Well Books, 2006

45 PERIODS

List of Experiments:

1. Study of different PLCs and their specification
2. Study of installations and troubleshooting of PLC.
3. Development of Ladder Diagram (LD) and Structured Text (ST) programming in PLC for simple applications.
4. Development of an application by using timer and counter of PLC.

5. Solving simple problems using Functional Block Diagram (FBD) programming in PLC
6. Interfacing between PLC and Process loop (temperature)
7. Interfacing between PLC and Process loop (level)
8. Interfacing between PLC and Process loop (flow)
9. Verification and testing of PID controller in a process loop.
10. Develop one application using SCADA system.
11. AC motor speed control using PLC and VFD

30 PERIODS

YouTube Resources:

1. **Instrumentation tools –** This channel focuses on Basics to Advanced PLC programming and SCADA
2. **IT Educational Network –** This channel provides knowledge of SCADA and Data base
3. **Industrial Networks –** This channel provides HMI design and control
4. **RealPars -** This channel completely explains about the relationship between PLC, SCADA and DCS & industrial process control.

TOTAL:75 PERIODS

Semester VII

Course Code	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
GE4701		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide students with a comprehensive understanding of the fundamental ethical principles that guide engineering practice, such as honesty, integrity, fairness, and respect for others.
- To enable students to recognize and identify ethical issues and dilemmas that may arise in engineering practice, research, and decision-making processes.
- To engage students in the analysis of real-world case studies and scenarios to understand how ethical principles apply in complex engineering situations.
- To equip students with the skills and frameworks necessary to make ethically sound decisions in engineering practice, considering various stakeholders and potential consequences.
- To instil in students a sense of professional responsibility towards society, the environment, and future generations, emphasizing the importance of upholding ethical standards in engineering work.

Course Description

Throughout the course, there will be an emphasis on ethical decision-making processes and strategies. Students will engage in discussions, debates, and collaborative exercises to develop their skills in weighing competing ethical considerations, communicating effectively about ethical issues, and advocating for ethical behaviour within engineering organizations.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

CO1: Understanding Ethical Principles: Students will demonstrate an understanding of the fundamental ethical principles and values relevant to the engineering profession, including integrity, honesty, responsibility, and respect for human life and the environment.
CO2: Application of Ethical Frameworks: Students will be able to apply ethical decision-making frameworks and tools to analyze and resolve ethical dilemmas commonly encountered in engineering practice, considering factors such as safety, sustainability, societal impact, and legal requirements.
CO3: Awareness of Codes of Ethics: Students will become familiar with and understand the significance of professional codes of ethics and conduct established by engineering organizations and regulatory bodies, and recognize their role in guiding ethical behaviour in the profession.
CO4: Critical Thinking and Reflection: Students will develop critical thinking skills through the examination of case studies, ethical scenarios, and real-world examples, enabling them to critically evaluate ethical issues, perspectives, and potential solutions in engineering practice.
CO5: Professional Responsibility and Leadership: Students will recognize their professional responsibilities as engineers, including the obligation to prioritize public safety, protect the environment, and uphold the public trust.

TEXT BOOKS:

1. Mike W. Martin and Roland Scherzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann,“Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘Value Education’, Vetha thiri publications, Erode, 2011.

YouTube Resources:

1. www.onlineethics.org
2. www.nspe.org

3. www.globalethics.org
4. www.ethics.org

45 PERIODS

Course Code	EMBEDDED AND REAL TIME OPERATING SYSTEMS	L	T	P	C
MT4701		3	0	0	3

COURSE OBJECTIVES:

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS **9**

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II PERIPHERAL INTERFACING **9**

I/O Programming – Interfacing of Memory, KeyBoard and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servo Motor – Traffic Light.

UNIT III ARM PROCESSOR **9**

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN **9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication — synchronization between processes- semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT **9**

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine – Digital camera

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

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

CO1: Know the various functional units of microcontroller, processors and system-on-chip based on the

features and specifications.
CO2: Recognize the role of each functional units in microcontroller, processors and system-on- chip based on the features and specifications
CO3: Interface the sensors, actuators and other I/O 's with microcontroller, processors and system on chip-based interfacing
CO4: Design the circuit and write the programming microcontroller, processors and system on chip.
CO5: Develop the applications using Embedded system.

TEXT BOOKS:

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003.

REFERENCES:

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.

YouTube Resources:

1. **Learn Embedded Systems** - This channel is dedicated to teaching you the basics of embedded systems through coding tutorials and electronics prototyping guides. They cover basic to advanced programming tutorials
2. **Quantum Leaps, LLC -** This channel is about the modern way of programming real-time embedded systems. The unique presentation style of this channel is to explain the main concepts by showing how they work at a low level.
3. **O'Reilly**- O'Reilly is best known for helping tech teams stay ahead - This channel provides tutorials on embedded system.
4. **TechVedas. learn**- This platform is an attempt to identify such untouched topics and concepts which are known to be the fundamentals and building blocks for Embedded System and make them easy to understand with the knowledge.

45 PERIODS

Course Code	INTERNET OF THINGS - CONCEPTS AND APPLICATIONS	L	T	P	C
MT4702		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To apprise students with basic knowledge of IoT that paves a platform to understandphysical and logical design of IOT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things (IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Piopen platform.
- To apply the concept of Internet of Things in real world scenario.

Course Description

This course provides an introduction to Internet of Things, components of IoT, the protocols followed for setting up an IoT system, programming with Arduino and raspberry Pi and use cases of IoT.

Prerequisites

- Basic knowledge of Networking and Communication.
- Familiarity with different types of Microcontrollers.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II COMPONENTS IN INTERNET OF THINGS 9

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)

UNIT III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 9

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.

UNIT IV OPEN PLATFORMS AND PROGRAMMING 9

IOT deployment for Raspberry Pi /Arduino Platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V IOT APPLICATIONS 9

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system

30 PERIODS

Course Format

Lectures and discussions, Role play, Video presentations, Guest lectures by industry Experts, Group discussions, Online resources and tutorials

Assessments & Grading

3 Internal Assessments, Quizzes, Assignments, Projects, Final Examination.

COURSE OUTCOMES:

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

CO 1: Explain the concept of IoT.

CO 2: Understand the communication models and various protocols for IoT.

CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform

CO 4: Apply data analytics and use cloud offerings related to IoT.

CO 5: Analyze applications of IoT in real time scenario.

TEXTBOOKS

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015.

REFERENCES

1. Perry Lea, "Internet of things for architects", Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT KindleEdition.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

5. ArshdeepBahga, Vijay Madisetti, “Internet of Things — A hands-on approach”, Universities Press, 2015.

YouTube Resources:

1. https://www.youtube.com/watch?v=WUYAjxnwjU4 – NPTEL course on IoT – Part I
2. https://www.youtube.com/watch?v=LlhmzVL5bm8&list=PL9ooVrP1hQOGccfBbP5tJWZ1hv5sIUWJl – IoT tutorials for beginners
3. https://www.youtube.com/watch?v=BXDxYh1EV2w – NPTEL course on IoT – Part II
4. https://archive.nptel.ac.in/courses/106/105/106105166/ - All courses in NPTEL – IoT
5. https://www.arduino.cc/
6. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

75 PERIODS

Semester VIII

PROJECT WORK.

APPENDIX A: PROFESSIONAL ELECTIVES

Applied Robotics	Electronics, Networking and Automation	Design and Manufacturing
Robot Control System	Linear Integrated Circuits	Product Life Cycle Management
Robot Operating Systems	ARM Architecture and Programming	Lean Manufacturing
Collaborative Robotics	Micro Electro Mechanical Systems	Advanced Manufacturing Systems
Robots and Systems in Smart Manufacturing	Power Electronics	Welding Technology and Automation
Microrobotics	Virtual Instrumentation	Additive Manufacturing
Mobile Robotics	Total Integrated Automation	Computer Integrated Manufacturing
Humanoid Robotics	Digital Twin and Industry 5.0	Process Planning and Cost Estimation
Drone Technologies	Industrial Network Protocols	Production Planning and Control

Autonomous Vehicle Technology	Cognitive Automation Systems	Management Courses
Automobile Engineering	Cognitive Computing	Principles of Management
Electric and Hybrid Vehicles	Deep Learning	Total Quality Management
Automotive Mechatronics	Natural Language Processing	Engineering Economics and Financial Accounting
Automotive System Modelling and Simulation	Computer Vision and Image Processing	Human Resource Management
Vehicle Dynamics and Controls	Reinforcement Learning	Knowledge Management
Advanced Driver Assistance Systems	Big Data Analytics	Industrial Management
Battery Management System	Robotic Process Automation	
Unmanned Aerial Vehicles	Optimization Techniques	

Vertical 1: <Applied Robotics >

Course Code	ROBOT CONTROL SYSTEM	L	T	P	C
MT4V11		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand the theoretical foundations of robot control systems, encompassing kinematics, dynamics, and feedback control principles.
- Gain practical skills in modelling and simulating robot behaviours using software tools and programming languages.
- Develop proficiency in designing and implementing various control algorithms for tasks such as trajectory planning, motion control, and manipulation.
- Explore advanced topics such as perception, localization, and multi-robot coordination to address real-world challenges in robotics.
- Apply learned concepts to hands-on projects, fostering the ability to analyze, troubleshoot, and optimize robot control systems in diverse applications.

Course Description

This course provides a comprehensive exploration of robot control systems, covering theoretical principles, practical implementation, and advanced applications. Students will learn to model, analyze, and design control strategies for robotic manipulators and mobile robots, gaining hands-on experience through simulations and projects. Topics include kinematics, dynamics, feedback control, perception, and emerging trends in robotics.

Prerequisites

- Proficiency in calculus, linear algebra, and differential equations is essential for understanding the mathematical principles underlying robot control systems.
- Familiarity with programming languages such as MATLAB, Python, or C/C++ is necessary for implementing control algorithms and simulations.
- Basic knowledge of mechanics and dynamics is beneficial for comprehending the motion and behaviour of robotic systems.
- Knowledge on basic concepts in signals and systems theory can aid in grasping feedback control principles and signal processing techniques used in robot control.
- Knowledge of electronic components and circuits may be helpful for understanding sensor and actuator interfacing in robotic systems.

UNIT I INTRODUCTION TO ROBOTICS AND CONTROL SYSTEMS 9

Overview of Robotics: history, applications, and types of robots - Introduction to control systems: Basic Principles-Feedback Loops-Control architectures-Sensors and actuators in robotic systems-Types-characteristics-Selection Criteria-Programming Languages-Software tools used in robot control.

UNIT II KINEMATICS AND DYNAMICS OF ROBOTS 9

Forward and inverse kinematics-coordinate transformations-Jacobian Matrices-Dynamic analysis: Newton-Euler equations-Lagrange's equations-manipulator dynamics-Trajectory planning and control-Interpolation

methods-motion profiles-Path planning algorithms-Introduction to robot simulation software for kinematic and dynamic analysis.

UNIT III CONTROL STRATEGIES FOR ROBOTS 9

Classical control techniques-PID control-root locus-Frequency response analysis-Modern control methods: state-space representation-Linear quadratic regulators (LQR)-optimal control-Nonlinear control techniques: Feedback linearization-Sliding mode control-Adaptive control-Implementation of control algorithms on robotic platforms: real-time considerations-stability analysis-performance evaluation.

UNIT IV ROBOT PERCEPTION AND LOCALIZATION 9

Sensor fusion techniques: integration of data from multiple sensors for perception-Computer vision algorithms for object detection-recognition-tracking-Localization methods: odometry-inertial navigation-simultaneous localization-mapping (SLAM)-Integration of perception-localization with control systems for autonomous robot navigation.

UNIT V ADVANCED TOPICS IN ROBOT CONTROL 9

Robotic manipulation: Modelling-planning-control of robotic arms and grippers-multi-robot systems: Coordination-Collaboration-Task allocation algorithms-Human-robot interaction: Design considerations-Safety mechanisms-user interface design-Emerging trends in robot control: soft robotics-swarm robotics - bio-inspired control approaches.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

Course Outcomes:

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

CO1: Understand the theoretical foundations of robot control systems, encompassing kinematics, dynamics, and feedback control principles.
CO2: Gain practical skills in modelling and simulating robot behaviours using software tools and programming languages.
CO3: Develop proficiency in designing and implementing various control algorithms for tasks such as trajectory planning, motion control, and manipulation.
CO4: Explore advanced topics such as perception, localization, and multi-robot coordination to address real-world challenges in robotics.
CO5: Apply learned concepts to hands-on projects, fostering the ability to analyze, troubleshoot, and optimize robot control systems in diverse applications.

TEXT BOOKS:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar,"Robot Modeling and Control", John Wiley & sons, inc., 2020.
2. Kevin M. Lynch and Frank C. Park, “Modern Robotics: Mechanics, Planning, and Control", Cambridge University Press, 2017

REFERENCES:

1. Gene F. Franklin, J. Da Powell, and Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 6th edition,
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics".

YouTube Resources:

1. **Northwestern Robotics** – The explanation of the modern robotics given by Mr. Kevin M. Lynch, one of the other of Modern robotics text book.
2. **Roboticsprofessor-redwanal220** - This channel focuses on Robot kinematics and dynamics.
3. **Mansoor mughal** - This channel offers complete course on computer vision.
4. **Robotics System Control** – This channel can explain the Modelling representations Dynamics of Robotic Manipulators.
5. **Control Systems Lab-** This Channel explains the Trajectory tracking and control systems of robots.
6. **Mikerobot science –** Explanation of Robot build electronics for robotics and Industrial control systems.

45 PERIODS

Course Code	ROBOT OPERATING SYSTEM	L	T	P	C
MT4V12		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce ROS and programming
- To develop the Robot environment
- To obtain the simulation robots in ROS with GAZEBO
- To simulate robots with V-Rep
- To understand mapping, navigation and motion planning ROS with Move-it

Course Description

This course covers the fundamentals of ROS framework, programming in C++ and Python, robot modeling, simulation using tools like Gazebo and V-REP, and implementation of mapping, navigation, and motion planning using MoveIt, enabling students to develop skills in robotic software development and simulation.

Prerequisites

- Proficiency in programming languages
- Familiarity with basic robotics concepts including kinematics, and motion planning

UNIT I ROS Essentials **9**

Introduction to ROS- Advantages and Disadvantages of ROS - ROS Framework- ROS package C++, Python – ROS computation Graph – nodes, Messages, topics, services, bags, ROS Master- ROS Community- Basic programming and Syntax overview in C++ and Python – start with ROS programming - Creating Environment - Services-Actions and Nodes- Simple Interaction with the Simulation environment.

UNIT II Build Your Own Robot Environment **9**

CAD Tools for Robot Modelling – ROS Packages for robot modelling – Unified Robot Description Format and Tags- Kinematics and Dynamics Library – Create URDF Model - Robot Modelling using Unified Robot Description Format (URDF), -ROS parameter server and adding real-world object representations to the simulation environment _ Create Robot description using 7 DOF: joint number, name, type and angle limits – Xacro – Rviz – viewing of 7 DOF arm – creation of wheeled robot.

UNIT III Simulation Robots in Ros with Gazebo **9**

Robot simulation - Gazebo –create simulation model at Gazebo- Adding colors, textures, transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS controllers- ROS controller interacts with Gazebo, interfacing state controller, simulation of moving the robot joints – simulation of differential wheeled robot in Gazebo.

UNIT IV ROS with VREP **9**

V-REP is a multi-platform robotic simulator - Simulating the robotic arm using V-REP - Adding the ROS interface to V-REP joint - Simulating a differential wheeled robot, adding a laser sensor, 3D vision sensor

UNIT V Mapping, Navigation and Motion Planning Ros with Moveit 9

Move it Instattion - Generating the Self-Collision matrix. virtual joints, planning groups, robot poses, robot end effector - MoveIt Architecture Diagram - Trajectory from RViz GUI executing in Gazebo - Planning scene overview diagram- Collision Checking **-** Motion Planning, Pick and Place Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB - ROS with Industrial.

Course Format

Lectures and discussions, Lecture Notes, Guest lectures by industry Experts, Industrial Visit and, Online resources and tutorials

Assessments & Grading

Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1. Recognize the concept of ROS and programming.
CO2. Evaluate various robot algorithms in ROS programming
CO3. Deploy mapping, navigation and motion planning ROS with Move-it.
CO4. Simulate robots in ROS with GAZEBO and V-REP
CO5. Program a robot using ROS and its tool boxes.

TEXT BOOKS:

1. Lentin Joseph, Jonathan Cacace, "Mastering ROS for Robotics Programming", Second Edition, Pack Publishing, 2018.

REFERENCES:

1. Lentin Joseph, Aleena Johny, "Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy", Second Edition, A press, 2022.
2. Lentin Joseph, "ROS Robotics Projects", Packt publishing, 2017.

YouTube Resources:

1. **ROS Mastery Hub**: This channel provides tutorials, tips, and resources to help enthusiasts and professionals master ROS and its various applications in robotics development. Content may cover topics such as ROS basics, navigation, perception, manipulation, and more, catering to both beginners and experienced users in the field of robotics and automation.

2. **URDF Explorers**: This channel is dedicated to exploring and demonstrating URDF (Unified Robot Description Format), which is a popular file format used in the field of robotics for describing robot models. The channel provides tutorials, demonstrations, and discussions related to URDF creation, manipulation, and utilization, catering to both beginners and experienced users in the robotics community.

3. **SimuBotics**: This channel explores the world of robotics through simulations. It offers a variety of content ranging from tutorials on simulation software to demonstrations of virtual robots in action. The channel aims to educate and inspire viewers interested in robotics by providing engaging and informative videos

4. **ROS Robotics Hub:** The channel offers tutorials, demonstrations, and insights into various aspects of ROS, including programming, simulation, navigation, and applications in robotics. It aims to support both beginners and experienced users in learning and mastering ROS for their robotic projects and endeavors.

45 PERIODS

Course Code	COLLABORATIVE ROBOTICS	L	T	P	C
MT4V13		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- know the fundamentals of Collaborative Robotics
- introduce Swarm robot and trajectory planning for Swarm
- introduce Modular Robotics and its Mechanics
- learn about various Natural models of robot collaboration
- introduce the concept of Reconfigurable robot

Course Description

This course explores the realm of collaborative robotics, delving into properties and challenges within modern mobile robots, including swarm robotics and modular designs. Students will investigate collective decision-making processes inspired by nature and reconfigurable robot formations, offering a comprehensive understanding of cutting-edge robotics technologies and methodologies.

Prerequisites

- Basic understanding of robotics principles and proficiency in programming languages such as C++, Python, or ROS
- Solid foundation in mathematics is crucial for grasping the mathematical models and algorithms employed in collaborative robotics.

UNIT I INTRODUCTION TO COBOTICS **9**

Collaborative Robotics- Properties - Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Robot Manipulators-Current Challenges.

UNIT II SWARM ROBOTICS **9**

Introduction, mapping, kinematics and trajectory error compensation, state transitions, collective decision making and methodologies, swarm robot scenarios-aggregation, clustering dispersion, pattern formation, sorting, flocking and collective motion, shepherding, heterogeneous swarms, Error Detection and Security.

UNIT III MODULAR ROBOTICS **9**

Module Designs - Modular Robot Representation -Modular Serial Robot Kinematics - Kinematic Calibration for Modular Serial Robots- Modular Serial Robot Dynamics - Modular Parallel Robot Kinematics.

UNIT IV NATURALLY INSPIRED COLLABORATION **9**

Collective Decision-Making. Group Decision Making in Animals, Collective Motion as Decision Process, Models for Collective Decision-Making Processes, Urn Models, Voter Model, Majority Rule, Hegselmann and Krause, Kuramoto Model, Axelrod Model, Ising Model, Fiber Bundle Model, Sznajd Model, Bass Diffusion Model, Sociophysics and Contrarians.

UNIT V RECONFIGURABLE ROBOTS **9**

V-Shaped Formation Control for Robotic Swarms Constrained by Field of View – formation of reconfigurable virtual linkage - Reconfigurable Formation Control of Multi-Agents - Self- Assembly Modular Robot Platform Based on Sambot - Swarm Dynamics Emerging from Asymmetry.

Course Format

Lectures and discussions, Lecture Notes, Guest lectures by industry Experts, Industrial Visit and, Online resources and tutorials

Assessments & Grading

Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1. Recognize the fundamentals of Collaborative Robotics.
CO2. Apply Swarm robots technology in real time applications.
CO3. Analyze and select the suitable concept of Modular Robotics and its Mechanics for modelling a collaborative robot.
CO4. Create various Natural models for robot collaboration
CO5. Develop collaborative robots for various requirement in industrial tasks

TEXT BOOKS:

1. Guilin Yang, I-Ming Chen, "Modular Robots: Theory and Practice", Springer, 2022.
2. GiandomenicoSpezzano, "Swarm Robotics", Applied Sciences, MDPI, 2019.

REFERENCES:

1. Heiko Hamann, "Collective Decision-Making in Swarm Robotics: A Formal Approach", Springer, 2019.

YouTube Resources:

1. **Robotics and Automation:** This channel offers in-depth discussions on various aspects of robotics, including collaborative robots, swarm robots, and mobile robot manipulators. It covers a wide range of topics related to robotics technology and its applications.
2. **Boston Dynamics:** While mainly showcasing their own robots, Boston Dynamics occasionally delves into topics like collective motion, state transitions, and error detection in robotics.
3. **Robotics Institute:** The channel offers valuable insights into kinematic calibration and dynamics, catering to enthusiasts, researchers, and professionals alike. Whether you're a beginner or an expert in robotics, Robotics Institute provides engaging and informative content to satisfy your curiosity and expand your knowledge in the field.
4. **Complexity Explorer:** The channel aims to foster understanding and collaboration in the complex systems community, making complex concepts digestible and applicable to real-world problems. Whether you're a novice or an expert, Complexity Explorer offers valuable insights into the fascinating world of complex systems.

45 PERIODS

Course Code	ROBOTS AND SYSTEMS IN SMART MANUFACTURING	L	T	P	C
MT4V14		3	0	0	3

Course Objectives:

The main objectives of this course are to:

- get a knowledge of working on Industrial robots and their load handling
- capacity to enlist with an application of robots in various operation
- familiar with a material handling system
- impart the knowledge on robotic welding
- obtain the knowledge on various type of robot welding operation

Course Description

This course provides a comprehensive overview of robotics in industrial applications. Students will learn about the load handling capacity of industrial robots, factors influencing robot selection, principles of material handling system design, and the integration of robotics in various industries including automotive, aerospace, and manufacturing.

Prerequisites

- Students should have a basic understanding of robotics principles and programming concepts commonly used in industrial applications.
- Familiarity with engineering principles, particularly in areas such as mechanical engineering, electrical engineering, or industrial engineering

UNIT I Introduction **9**

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

UNIT II Selection of Robots and Other Applications **9**

Factors influencing the choice of a robot - robot performance testing - economics of robotisation - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting -assembly operation - cleaning - robot for underwater applications.

UNIT III Material Handling **9**

Concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - industrial trucks - monorails - rail guided vehicles - conveyor systems -cranes and hoists - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems (ASRS) - bar code technology - radio frequency identification technology -Introduction to Automation Plant design software.

UNIT IV Robotic Welding **9**

Robotic welding system, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding, Welding simulation, Welding sequences, Profile welding

UNIT V Applications of Robots in Welding and Allied Processes **9**

Application of robot in manufacturing: Exploration of practical application of robots in welding: Robots for car body's welding, robots for box fabrication, robots for microelectronic welding and soldering – Applications in nuclear, aerospace and ship building, case studies for simple and complex applications

Course Format

Lectures and discussions, Lecture Notes, Guest lectures by industry Experts, Industrial Visit and, Online resources and tutorials

Assessments & Grading

Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1. Recognize various concepts of Industrial Robot.
CO2. Select the appropriate manufacturing procedure for Robots.
CO3. Apply various manufacturing process in Robot manufacturing.
CO4. Learn about the Welding operation and also related to Programming.
CO5. Produce a manufacturing plan for developing a robot.

TEXT BOOKS:

1. Richard D Klafter, Thomas Achmielewski, MickaelNegin , "Robotic Engineering – An integrated Approach", Prentice Hall India, New Delhi, 2006.
2. Mikell P Groover , "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, New York, 2019.
3. Pires J N, Loureiro A, Bolmsjo G, "Welding Robots: Technology, System Issues and Application", Springer, London, 2010.

REFERENCES:

1. Parmar R S , "Welding Processes and Technology", Khanna Publishers, New Delhi, 2nd Edition, 2013.
2. John A. piotrowski, William T. Randolph , "Robotic welding: A Guide to Selection and Application, Welding Division, Robotics International of SME", Publications Development Dept., Marketing Division, 1987.
3. Mikell P Groover, Mitchel Weiss, Roger N Nagel, N.G.Odrey, AshishDutta , "Industrial Robotics (SIE): Technology, Programming and Applications", 2nd Edition, McGraw Hill Education India Pvt Ltd, 2012.
4. YoramKoren , "Robotics for Engineers", McGraw-Hill, 1987.

YouTube Resources:

1. **Universal Robots**: Universal Robots is known for its collaborative robot (cobots) solutions, but their YouTube channel also covers topics related to industrial robots, including load handling, material transfer, and machine loading and unloading processes.
2. **Robotics Online**: This channel covers a wide range of topics related to robotics, including factors influencing the choice of robots, robot performance testing, and the economics of robotization. It also delves into the impact of robots on industry and society.

3. **Engineering Explained**: This channel provides detailed explanations and tutorials on concepts of material handling, principles in system design, various types of material handling systems including industrial trucks, conveyor systems, cranes, and hoists.
4. **Lincoln Electric**: This channel often features videos related to robotic welding systems, welding techniques, and tutorials on programming robotic welding systems

45 PERIODS

Course Code	MICROROBOTICS	L	T	P	C
MT4V15		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

COURSE OBJECTIVES:

- expose students to the fundamental aspects of the emerging field of micro robotics.
- expose students to micro scale, technologies for fabricating small devices, bioinspired design, and applications of the field.
- expose students to various Mathematical formalism for flexures, Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuator and other sensors.
- apply micro robotics to various applications.
- engage students in implementation of micro robotics.

Course Description

The course will include lectures, laboratory sessions, design projects, and discussions to provide students with both theoretical knowledge and practical skills in microrobotics. Students will also have the opportunity to work on hands-on projects to design, build, and control their own microrobotic systems. By the end of the course, students will have a solid understanding of the principles of microrobotics and the ability to apply this knowledge to solve real-world problems in various domains.

UNIT – I Introduction to Microrobotics **9**

Introduction to Micro robotics -MST (Micro System Technology) - Micromachining – Working principles of Microsystems Applications of Microsystems - Micro-fabrication principles-Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators

UNIT – II Scaling Laws and Materials for MEMS **9**

Introduction - Scaling laws - Scaling effect on physical properties scaling effects on Electrical properties - scaling effect on physical forces - Physics of Adhesion - Silicon – compatible material system - Shape memory alloys - Material properties - Piezoresistivity, Piezoelectricity and Thermoelectricity.

UNIT III Flexures, Actuators and Sensors **9**

Elemental flexures - Flexure systems - Mathematical formalism for flexures – Electrostatic actuators - Piezo-electric actuators - Magneto-strictive actuators - Electromagnetic sensors - Optical-based displacement sensors - Motion tracking with microscopes

UNIT IV Microrobotics **9**

Introduction - Task specific definition of micro-robots - Size and Fabrication Technology based definition of micro- robots - Mobility and Functional-based definition of micro-robots - Applications for MEMS based micro-robots.

UNIT V Evaluation and Ethical Considerations Implementation of Microrobots **9**

Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators- Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices – Microgrippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots – Multi robot system: Micro-robot powering, Micro-robot communication.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Explain and apply the concepts of mass, energy, and momentum balance in microrobotics.
CO2: Apply adapt, and synthesize learned engineering skills to create microrobot.
CO3: Model microrobots for different robotics applications
CO4: Formulate the specifications and design of mechatronic systems.
CO5: Program the Microrobot for different robotics applications.

TEXT BOOKS:

1. Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019.
2. Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2019.

REFERENCES:

1. NadimMaluf and KirtWilliams, "An Introduction to Microelectromechanical systems Engineering", 2nd edition, Artech House, 2004.
2. Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007.
3. MetinSitti, "Mobile Microrobotics", MIT Press, 2017.
4. Nicolas Chaillet, Stephane Rangier,"Microrobotics for Micromanipulation", John Wiley & Sons, 2013.

45 PERIODS

Course Code	MOBILE ROBOTICS	L	T	P	C
MT4V16		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- introduce the concept of mobile robots locomotion.
- understand the mobile robot kinematics and dynamics.
- expose the localization and mapping techniques.
- know about motion control.
- learn advanced mobile robots.

Course Description

This course introduces theory and applications of Mobile Robotics. Students learn fundamental concepts, including locomotion, sensing, mapping, navigation, and control. Through practical exercises, they gain hands-on experience in designing, programming, and optimizing mobile robots for diverse real-world applications in industries like automation and healthcare.

Prerequisites

- Proficiency in basic robotics concepts, including kinematics, dynamics, and sensors.
- Familiarity with programming for robotics applications using languages such as C++ or Python.

UNIT I INTRODUCTION TO MOBILE ROBOTS **9**

Introduction to mobile robots and mobile manipulators. Principle of locomotion and types of locomotion. Types of mobile robots: ground robots (wheeled and legged robots), aerial robots, underwater robots and water surface robots.

UNIT II KINEMATICS AND DYNAMICS **9**

Kinematics of wheeled mobile robot, degree of freedom and maneuverability, generalized wheel model, different wheel configurations, holonomic and non-holonomic robots. Dynamics of mobile robot: Lagrange-Euler and Newton-Euler methods. Computer based dynamic (numerical) simulation of different wheeled mobile robots.

UNIT III LOCALIZATION AND MAPPING **9**

Magnetic and optical position sensor, gyroscope, accelerometer, magnetic compass, inclinometer, tactile and proximity sensors, ultrasound rangefinder, laser scanner, infrared rangefinder, visual and motion sensing systems. Localization, Map based localization, Markov localization, Kalman filter localization Error propagation model, Probabilistic map based localization, Autonomous map building, Simultaneous localization and mapping (SLAM)

UNIT IV MOTION CONTROL **9**

Collisions free path planning and sensor-based obstacle avoidance. Motion controlling methods, kinematic control, dynamic control and cascaded control.

UNIT V MODERN MOBILE ROBOTS **9**

Introduction, Swarm robots, cooperative and collaborative robots, mobile manipulators, autonomous mobile robots.

Course Format

Lectures and discussions, Hands-on exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Differentiate different types of robots.
CO2: Analyze the mobile robot kinematics and dynamics.
CO3: Summarize the different types of localization approach.
CO4: Design collisions free path planning.
CO5:Summarize the different types of Swarm robots, Cooperative and Collaborative robots.

TEXT BOOKS:

1. Kelly, A "Mobile Robotics: Mathematics, Models, and Methods", Cambridge University Press, USA,2013
2. Dudek, M Jenkin, Computational Principles of Mobile Robotics, Cambridge University Press, USA, 2010.

REFERENCES:

1. Siegwart,R Nourbakhsh, and Scaramuzza, "Introduction to Autonomous Mobile Robots", MIT Press, USA, 2011.
2. Tzafestas, "Introduction to Mobile Robot Control, Elsevier", USA, 2014.
3. Choset, Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, "Principles of Robot Motion:Theory, Algorithms, and Implementations", MIT Press, 2005.

YouTube Resources:

1. **Robotics at MIT:** This channel showcases research and projects from the Massachusetts Institute of Technology (MIT) in the field of robotics, including mobile robots and autonomous systems.
2. **ROS Developers:** The ROS Developers channel offers tutorials, demonstrations, and discussions about Robot Operating System (ROS), which is a widely used framework for developing robotic systems, including mobile robots.
3. **Boston Dynamics:** Boston Dynamics is known for its cutting-edge robotic technologies, including mobile robots such as Spot and Atlas. Their YouTube channel provides insights into the latest developments in robotics and showcases their robots in action.
4. **Robohub:** Robohub is a platform for sharing news, interviews, and discussions about robotics. Their YouTube channel covers a wide range of topics in robotics, including mobile robotics research and applications.

5. **IEEE Spectrum:** IEEE Spectrum's YouTube channel features videos on various topics in technology, including robotics. They often cover advancements in mobile robotics and autonomous systems.
6. **The Construct:** The Construct offers tutorials and resources for learning robotics, including mobile robot simulation using tools like ROS and Gazebo. Their YouTube channel provides step-by-step guides and demonstrations.
7. **MathWorks:** MathWorks, the company behind MATLAB and Simulink, provides tutorials and webinars on robotics and autonomous systems. Their YouTube channel covers topics such as robot modeling, simulation, and control.
8. **ANYbotics:** ANYbotics develops autonomous mobile robots for industrial applications. Their YouTube channel showcases their robots in real-world scenarios and provides insights into the challenges of mobile robotics.

45 PERIODS

Course Code	HUMANOID ROBOTICS	L	T	P	C
MT4V17		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- know the basic knowledge about Humanoid robots.
- impart knowledge in kinematics of humanoids.
- learn about the dynamics in humanoid robots.
- understand the basic in biped walking.
- know about the different walking patterns.

Course Description

This course offers an in-depth exploration into the theory, design, and practical applications of humanoid robots. Students will delve into the fundamental concepts underlying humanoid robotics, including kinematics, dynamics, perception, and control. Through a combination of lectures, hands-on projects, and laboratory sessions, students will gain a comprehensive understanding of the principles governing the development and operation of humanoid robots.

Prerequisites

- Proficiency in programming languages like Python and C++, along with understanding robotics fundamentals such as kinematics, dynamics, and control theory.
- Knowledge of machine learning and deep learning techniques, computer vision, sensor fusion, motion planning, and ROS (Robot Operating System) for developing perception, decision-making, and control systems in humanoid robots.

UNIT I Introduction to Human Robotics **9**

Historical development of Humanoids, Human Likeness of a Humanoid Robot, Trade-Offs in Humanoid Robot Design, Human-Friendly Humanoid Robot Design, characteristics of humanoid robots.

UNIT II Kinematics for multi DOF Models **9**

Kinematic structure, forward and inverse kinematic problems, differential kinematics, Twist, Spatial Velocity, and Spatial Transform, Inverse Differential Kinematic Relations. Differential kinematics at singular configurations- Gait Analysis

UNIT III ZMP AND DYNAMICS **9**

ZMP Overview,2D Analysis,3D Analysis, Measurement of ZMP, General Discussion- ZMP of Each Foot, ZMP for Both Feet Contact, Dynamics of Humanoid Robots, Humanoid Robot Motion and Ground Reaction Force, Momentum, Angular Momentum, Angular Momentum and Inertia Tensor of Rigid Body, Calculation of Robot's Center of Mass, Link Speed and Angular Velocity, Calculation of Robot's Momentum and Angular Momentum**.**

UNIT IV BIPED WALKING **9**

Two-Dimensional Walking Pattern Generation, Two-Dimensional Inverted Pendulum, Behavior of Linear Inverted Pendulum, Orbital Energy, Support Leg Exchange, Planning a Simple Biped Gait, Extension to a Walk on Uneven Terrain.

UNIT V WALKING PATTERN GENERATION **9**

ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles of Stabilizing Control, Stabilizing Control of Honda Humanoid Robot, Advanced Stabilizers.

Course Format

Lectures and discussions, Hands-on exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO 1: Describe about the evolution of Humanoid robots
CO 2: Expose the basic knowledge in kinematics of humanoids.
CO 3: Calculate the Humanoid Robot Motion and Ground Reaction Force.
CO 4: Identify Two-Dimensional Walking pattern on different terrain.
CO 5: Create the Walking Pattern models.

TEXT BOOKS:

1. Dragomir N. Nenchev, Atsushi Konno, “Humanoid Robots Modeling and Control”, Butterworth Heinemann, 2019
2. Shuuji K, Hirohisa H, Kensuke H, Kazuhito, Springer-Verlag GmbH ”Introduction to Humanoid Robotics”, Springer, London, 2014.
3. GoswamiAmbarish, VadakkepatPrahlad, "Humanoid Robotics: A Reference", Springer, 2019.
4. J. Craig, "Introduction to Robotics: Mechanics and Control", Fourth Edition, Pearson, 2022.

REFERENCES:

1. A. Goswami, P. Vadakkepat (Eds.), “Humanoid Robotics: A Reference”, Springer, Netherlands, Dordrecht, 2018
2. J K. Harada, E. Yoshida, K. Yokoi (Eds.), “Motion Planning for Humanoid Robots”, Springer, London, 2010.
3. Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators", second edition, Springer, 2000.
4. Jean-Claude Latombe, "Robot Motion Planning", Kluwer Academy Publishers, 2004.

YouTube Resources:

1. **Boston Dynamics:** Known for their cutting-edge robotics technology, Boston Dynamics' YouTube channel offers insights into the development of advanced robots like Atlas and Spot.
2. **Robots Everywhere:** This channel explores various aspects of robotics, including tutorials, project showcases, and discussions on the latest advancements in the field.

3. **Robotics at MIT:** The Massachusetts Institute of Technology's robotics program shares lectures, demonstrations, and research updates on their YouTube channel.
4. **ROS Developers:** ROS (Robot Operating System) is a widely used framework in robotics. This channel offers tutorials, tips, and tricks for working with ROS and building robotic applications.
5. **RoboPhil:** RoboPhil provides educational content on robotics, covering topics such as programming, electronics, and mechanical design, with a focus on making robotics accessible to beginners.
6. **James Bruton - XRobots:** James Bruton's channel features DIY robotics projects, including humanoid robots, with detailed build logs and explanations of the underlying principles.
7. **Humanoid Robot Hub:** This channel focuses specifically on humanoid robots, showcasing their capabilities, developments, and applications in various fields.
8. **Robots Podcast:** The Robots Podcast channel features interviews with experts in robotics, discussing research, industry trends, and the societal impact of robotics.

45 PERIODS

Course Code	DRONE TECHNOLOGIES	L	T	P	C
MT4V18		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- understand the basics of drone concepts
- learn and understand the fundaments of design, fabrication and programming of drone
- impart the knowledge of a flying and operation of drone
- know about the various applications of drone
- understand the safety risks and guidelines of fly safely

Course Description

This course provides an introduction to the theory and practical applications of Generative Artificial Intelligence. Students will learn the fundamental concepts and techniques related to generative models and gain hands-on experience with creating and using generative AI systems.

Prerequisites

- Knowledge in mathematics, covering algebra, geometry, and calculus, Drone Technologies
- Proficiency in a Programming Language

UNIT – I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT IV DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT V FUTURE DRONES AND SAFETY **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO5:Create the programs for various drones

TEXT BOOKS:

1. "Introduction to UAV Systems" by Paul Fahlstrom and Thomas Gleason
2. "Drone Technology: A Comprehensive Guide to Unmanned Aircraft Systems" by James W. Hall III
3. "Small Unmanned Aircraft: Theory and Practice" by Randal W. Beard and Timothy W. McLain
4. "Drones: The Complete Manual" by Aaron Asadi (Editor)
5. "Practical Drone Applications: A Business Perspective" by Kjersti Aas and Jay Nagley
6. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
7. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016

REFERENCES:

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

YouTube Resources:

1. **FliteTest:** Known for its engaging content on RC aircraft and drones, FliteTest offers tutorials, reviews, and DIY projects related to drones and UAVs.
2. **Rotor Riot:** Rotor Riot is a popular channel among FPV (First Person View) drone enthusiasts, featuring exciting flight footage, product reviews, and tutorials on FPV drone flying and building.

3. **Drone Camps RC:** This channel provides comprehensive reviews of drones, accessories, and related gear, along with tutorials on drone flying techniques, setup, and maintenance.
4. **DroningON:** DroningON covers a wide range of drone-related topics, including reviews, news, tutorials, and industry updates, catering to both beginners and experienced drone enthusiasts.
5. **Ready Set Drone:** With a focus on consumer drones and quadcopters, Ready Set Drone offers reviews, comparisons, and tips for drone pilots of all skill levels.
6. **Joshua Bardwell:** This channel is dedicated to FPV drone racing and freestyle flying, featuring in-depth tutorials, product reviews, and troubleshooting guides for FPV enthusiasts.

45 PERIODS

Vertical 2: <Electronics, Networking and Automation>

Course Code	LINEAR INTEGRATED CIRCUITS	L	T	P	C
MT4V21		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers.
- To introduce the concept of Phase Locked Loop.
- To introduce the concepts of waveform generation and introduce some special function ICs

Course Description

This course provides an introduction to Linear Integrated circuits, the design of various circuits such as operational amplifiers, various analog ICs which are used in different applications. The course also includes waveform generators and special function ICs.

Prerequisites

- Basic knowledge of electronic devices and circuits.
- Familiarity with different circuits using electronic devices.

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band- pass, Butterworth filters, Oscillators.

UNIT III ANALOG MULTIPLIER AND THEIR APPLICATIONS 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications.

UNIT IV PHASE LOCKED LOOP 9

Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out (LDO) Regulators - Switched capacitor filter IC MF10**.**

Course Format

Lectures and discussions, Tutorials, Video presentations, Guest lectures by industry Experts, Group discussions, Online resources and tutorials

Assessments & Grading

3 Internal Assessments, Quizzes, Assignments, Mini Projects, Final Examination.

COURSE OUTCOMES:

At the end of the course the students will be able to**CO1:** Understand basics of Operational amplifiers.
CO2: Design linear and nonlinear applications of OP – AMPS
CO3: Design applications using analog multiplier.
CO4: Generate waveforms using OP – AMP Circuits
CO5: Analyze special function ICs

TEXT BOOK

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits",4th Edition, Tata Mc Graw-Hill, 2016.

REFERENCES

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall /Pearson Education, 2015.
2. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. S. Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

YouTube Resources:

1. https://www.youtube.com/watch?v=lDeyJMVNScI – Instrumentation amplifier basics.
2. https://www.youtube.com/playlist?list=PLtmB4Xi1QiUB_IdBMnZnFJa416Wt3xdUP–Differential amplifier configurations.
3. https://www.youtube.com/watch?v=gJJx4Lo-_CI – Analog Electronics GATE 2023 questions solved.
4. https://www.youtube.com/watch?v=Y4uXn2SS0gM – Analog Electronics – GATE 2024 questions solved.
5. https://www.youtube.com/playlist?list=PLe25ovnCxlLT1g7Sjreg883v_6marKppa–Operational Amplifier.

45 PERIODS

Course Code	ARM ARCHITECTURE AND PROGRAMMING	L	T	P	C
MT4V22		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the architecture of the ARM processor.
- To train students in ARM programming.
- To discuss memory management, append location development with an ARM processor.
- To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts
- To impart the knowledge on single board embedded processors.

Course Description

This course aims to provide students with a comprehensive understanding of ARM-based embedded systems, from architecture and programming to interfacing peripherals and communication protocols.

Prerequisites

- Basic knowledge of Embedded systems.
- Familiarity with a high-level programming (e.g., C or C++).

UNIT I ARM ARCHITECTURE **9**
Architecture – Memory Organization – addressing modes -Registers – Pipeline - Interrupts – Coprocessors – Interrupt Structure

UNIT II ARM MICROCONTROLLER PROGRAMMING **9**
ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT III PERIPHERALS OF ARM **9**
ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART - Serial Communication with PC – ADC/DAC Interfacing- Sensors - Relays - Solenoid Valve and Heater stepper motor interfacing.

UNIT IV ARM COMMUNICATION **6**
ARM With CAN, I2C, and SPI protocols

UNIT V INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR **12**
Raspberry Pi Architecture - Booting Up RPi- Operating System and Linux Commands -Working with RPi using Python and Sensing Data using Python-programming - GPIO and interfacing peripherals With Raspberry Pi.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1Interpret the basics and functionality of processor functional blocks.
CO2: Observe the specialty of RISC processor Architecture.
CO3: Incorporate the I/O hardware interface of processor with peripherals.
CO4: Emphasis the communication features of the processor.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.

TEXT BOOKS:

1. Steve Furber, 'ARM system on chip architecture',Addisonn Wesley,2nd Edition,2015.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2004, 1st Edition.

REFERENCES:

1. William Hohl, ' ARM Assembly Language' Fundamentals and Techniques, CRC Press, 2nd Edition 2014.
2. Rajkamal," Microcontrollers Architecture, Programming, Interfacing, & System Design, Pearson,2012, 2nd Edition.
3. ARM Architecture Reference Manual, LPC214x User Manual www.Nuvoton .com/websites on Advanced ARM Cortex Processors
4. ARM System Developer's Guide: Designing and Optimizing System Software 1st Edition (Designing and Optimizing System Software) Publisher: Morgan Kaufmann Publishers, 2011.

YouTube Resources:

1. https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9BJHK4Bfh .
2. https://maxembedded.com/2013/07/introduction-to-single-board-computing/
3. https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
5. https://nptel.ac.in/courses/117106111

Course Code	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
MT4V23		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMSdevices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical andMechanical engineering.

Course Description

This course is offered to students to gain basic knowledge on MEMS (Micro Electro Mechanical System) and various fabrication techniques. This enables them to design, analyze, fabricate and test the MEMS based components.

Prerequisites

1. Calculus and Differentiation
2. Fundamentals of Physics and Inorganic chemistry

UNIT I INTRODUCTION

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Reviewof Electrical and Mechanical concepts in MEMS – Semiconductor devices –Polymers in MEMS– Polyamide - SU-8 - Liquid Crystal Polymer (LCP) — PDMS — PMMA — Parylene —Fluorocarbon.

UNIT II MICRO SENSORS **9**

Characteristics of sensors - Electrostatic sensors – Parallel plate capacitors – Piezoresistivesensors – Piezoresistive sensor materials - Stress and strain analysis – Flexural beam bending- Torsional deflection– Applications to Inertia, Pressure, Tactile and Flow sensors — Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials.

UNIT III MICRO ACTUATORS **9**

Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications –Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators -Actuation using Shape Memory Alloys.

UNIT IV MICRO MACHINING **9**

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching– Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antirestriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process

UNIT V APPLICATIONS OF MEMS INERTIAL SENSORS **9**

Application to Acceleration, Inertia, Acoustic, Tactile, Pressure, Flow and Tactile sensors- Optical MEMS –

Lenses and Mirrors -Actuators for Active Optical MEMS.– RF MEMS and Microfluidics.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES

Upon Successful completion of the course, students should be able to:
CO 1: Recognize MEMS Energy Domains and Transducers, Sensors and actuators.
CO 2: Select the Various MEMS sensors and its Stress and strain
CO 3: Apply various MEMS actuators in Real time system.
CO 4: Demonstrate various micro machining processes, Structural and Sacrificial Materials
CO5: Analyze the various MEMS inertial, tactile, pressure and flow sensors in real time system

TEXT BOOKS

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2014, 2nd edition .
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2001.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, NewDelhi, 2008.

REFERENCES

1. Smart Devices", John Wiley & Son LTD,2002
2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000
3. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House,2000.
4. Thomas M Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2001.

Course Code	POWER ELECTRONICS	L	T	P	C
MT4V24		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

Course Description

This course explores essential concepts and techniques for modern power conversion systems. Topics include switching power supplies, inverters, rectifiers, and AC phase controllers. Students learn about MOSFET and IGBT behavior, converter topologies, waveform control, harmonic elimination, and power quality considerations. Practical examples enhance understanding of system operation, control, and optimization for industrial applications.

Prerequisites

- Circuit analysis and electronic devices understanding.
- Basics of power systems and electrical machines.
- Proficiency in mathematics, including algebra, trigonometry, and calculus

UNIT I SWITCHING POWER SUPPLIES **9**

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS **9**

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters – VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

UNIT III UNCONTROLLED RECTIFIERS **9**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

UNIT IV CONTROLLED RECTIFIERS **9**

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor -power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V AC PHASE CONTROLLERS **9**

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the operation of semiconductor devices and dynamic characteristics and to design &analyze the low power SMPS
CO2: Analyze the various uncontrolled rectifiers and design suitable filter circuits
CO3: Analyze the operation of the n-pulse converters and evaluate the performance parameters
CO4: Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5: Understand the operation of AC voltage controllers and its applications.

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

REFERENCES:

1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

YouTube Resources:

1. **EEVblog:** Provides in-depth technical analysis and practical demonstrations related to electronics, including power electronics topics such as converter design and testing.
2. **Learn Engineering:** Offers clear and concise explanations of engineering concepts, including videos on power electronics fundamentals and applications.
3. **Rachit Jain:** Covers a wide range of electrical engineering topics, including tutorials on power electronics components and circuits.
4. **Dr. Bimal Gopalakrishnan: Presents** lectures and tutorials on power electronics, focusing on theory, design, and practical applications.
5. **Danilo Rodrigues:** Provides tutorials and demonstrations on power electronics topics, including converter circuits, control techniques, and troubleshooting.

45 PERIODS

Course Code	VIRTUAL INSTRUMENTATION	L	T	P	C
MT4V25		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce virtual instrumentation concepts and applications.
- To train to program virtual instrumentation software for biomedical applications.
- To understand the data acquisition and control in VI
- To obtain the knowledge in instrument interfaces
- To analyze the applications of VI in Bio Medical Engineering

Course Description

This course provides an in-depth understanding of Virtual Instrumentation (VI) using LabVIEW software, focusing on its applications in various fields including engineering and biomedical sciences.

Prerequisites

- Basic Understanding of Electronics
- Proficiency in a Programming Language
- Familiarity with Mathematics

UNIT I INTRODUCTION 9

History of Virtual Instrumentation (VI), advantages, block diagram and architecture of a v instrument, Programming paradigms Virtual Instrumentation Lab VIEW software Lab View basics Lab VIEW environment.

UNIT II VI USING LABVIEW 9

Creating, Editing and debugging a VI in Lab VIEW Creating a sub VI-Loops and charts Case and sequence structures File I/O VI customization.

UNIT III DATA ACQUISITION AND CONTROL IN VI 9

Plug-in DAQ boards Organization of the DAQ VI System - Performing analog input and analog output - Scanning multiple analog channels. Driving the digital I/Os Buffered data acquisition, Simple problems.

UNIT IV INSTRUMENT INTERFACES 9

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V APPLICATION OF VI IN BIOMEDICAL ENGINEERING 9

Design of Virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality & 3D graphical modeling, Virtual Prototyping.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1 To comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Identify salient traits of a virtual instrument.
CO3: Understand the use of VI for data acquisition.
CO4: Experiment, analyze and document different types of interfaces.
CO5: Apply the virtual instrumentation technologies for medical applications

TEXT BOOKS:

1. Gary Johnson, "LABVIEW Graphical Programming", McGraw Hill, 4th edition, 2006.
2. Lisa K. Wells and Jeffrey Travis, "LABVIEW for Everyone", PHI, 1997.
3. Skolkoff, "Basic concepts of LABVIEW 4", PHI, 1998.
4. Jerome, Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010.
5. Sanjay Gupta and Joseph John, "Virtual Instrumentation using Lab VIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2010.

REFERENCES:

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2003.
2. S. Gupta, J.P. Gupta, "PC Interfacing for Data Acquisition and Process Control", ISA, 2nd Edition, 1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in Lab VIEW" Pearson Education, 2001.

YouTube Resources:

1. **LabVIEW & MULTISIM** - This channel is dedicated to LabVIEW & Multisim Programming, which are the products of National Instruments. They also cover, NI myDAQ, myRIO, cDAQ, cRIO, and other products of NI's..
2. **EEE - E Learning**- This channel focuses on basic of vitual instrumentation. It includes tutorials on various topics .
3. **Exeliq Tech Talks**- It is for beginner in LabVIEW and teach LabVIEW from scratch .
4. **LabVIEW Exercises** - Viewers will learn LabVIEW programming by following example tutorial videos. LabVIEW beginners can watch and learn the functionality and implementation of functions and different logics of programming in LabVIEW.

45 PERIODS

Course Code	TOTAL INTEGRATED AUTOMATION	L	T	P	C
MT4V26		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and
- their applications.
- To know about the basic in SCADA and DCS systems.
- Understand communication protocols in an integrated system
- To know about the advanced in automation industries

Course Description

This course covers Totally Integrated Automation (TIA) systems, including components, advantages, and Programmable Automation Controllers (PAC). It explores Human Machine Interface (HMI) systems, types, and integration with automation processes. Additionally, it delves into Supervisory Control And Data Acquisition (SCADA) systems, covering architecture, scripting, and communication protocols. Furthermore, it examines Communication Protocols of SCADA, including configuration for interfacing with PLCs and field devices. Finally, it explores Distributed Control Systems (DCS) architecture, programming, and applications, with case studies comparing SCADA and DCS in automation

Prerequisites

- Fundamental understanding of automation principles and concepts.
- Proficiency in basic electrical engineering and control systems.
- Familiarity with programming languages commonly used in industrial automation, such as ladder logic or structured text.

UNIT I Totally Integrated Automation **9**

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II Human Machine Interface (HMI) **9**

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI).

UNIT III Supervisory Control And Data Acquisition (SCADA) **9**

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal & External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV Communication Protocols of Scada **9**

Proprietary and open Protocols – OLE/OPC- UPC UA/DA – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device.

UNIT V Distributed Control Systems (DCS) 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO 1: Knowledge of PLC & PAC automation
CO 2: Knowledge in HMI systems and to integrate it with other systems.
CO 3: Ability to apply SCADA and usage of C programming for report generation
CO 4: Acquiring information's on communication protocols in automation systems
CO 5: Ability to design and develop automatic control system using distributed control systems.

TEXT BOOKS:

1. John. W. Webb& Ronald A. Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2009.
2. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company"1995

REFERENCES:

1. Win C C Software Manual, Siemens, 2003
2. RS VIEW 32 Software Manual, Allen Bradly, 2005
3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

YouTube Resources:

1. **Siemens Industry:** Siemens is a leading provider of automation solutions, and their YouTube channel offers a wealth of videos covering various aspects of Totally Integrated Automation (TIA), Human Machine Interface (HMI), SCADA, Communication Protocols, and Distributed Control Systems (DCS).
2. **AutomationDirect:** Automation Direct's YouTube channel provides tutorials and demonstrations on PLC programming, HMI configuration, SCADA systems, and communication protocols, catering to both beginners and experienced professionals.
3. **RealPars:** RealPars offers in-depth tutorials and practical tips on PLC programming, HMI design, SCADA development, and industrial communication protocols. Their videos are structured and easy to follow, making complex concepts more accessible.

45 PERIODS

Course Code	DIGITAL TWIN AND INDUSTRY 5.0	L	T	P	C
MT4V27		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- understand the basics concepts in digital twin
- Introduce the concepts in digital twin in a discrete Industry
- Introduce the concepts in digital twin in a process Industry
- obtain the knowledge in industry 5.0
- know about the advantages in industry 5.0

Course Description

This course aims to explore the impact of Digital Twins Technology on industrial manufacturing in the context of Industry. The background and system architecture of Industry 5.0 are also introduced.

Prerequisites

- Knowledge in Manufacturing Technology.
- Exposure to industrial revolution and Industrial Automation.

UNIT I INTRODUCTION 9

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

UNIT II DIGITAL TWIN IN A DISCRETE INDUSTRY 9

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection& analysis for product & production improvements, Automation simulation, Digital Enterprise

UNIT III DIGITAL TWIN IN A PROCESS INDUSTRY 9

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise

UNIT IV INDUSTRY 5.0 9

Industrial Revolutions, Industry 5.0 — Definition, principles, Application of Industry 5.0 in process & discrete industries, Benefits of Industry 5.0, challenges in Industry 5.0, Smart manufacturing, Internet of Things 5.0, Industrial Gateways, Basics of Communication requirements – cognitive systems 5.0

UNIT V ADVANTAGES OF DIGITAL TWIN 9

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market

Course Format

Lectures and discussions, Video presentations, Guest lectures by industry Experts, Group discussions, Online resources and tutorials

Assessments & Grading

3 Internal Assessments, Quizzes, Assignments, Mini Projects, Final Examination.

COURSE OUTCOMES:

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

CO 1: Analyze the basics concepts in digital twin.
CO 2: Recognize the concepts in digital twin in a discrete Industry
CO 3: Recognize the concepts in digital twin in a process Industry
CO 4: Obtain the knowledge in industry 5.0
CO 5: Apply the advantages in industry 5.0 with various applications

TEXT BOOK

1. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2018.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.

REFERENCES

1. Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press, 2022.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress., United States ,2015.
3. Christoph Jan Bartodziej, "The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics", Springer Gambler., Germany, 2017.
4. Ibrahim Garbie, "Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0", Springer., Switzerland, 2016.
5. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.
6. Ulrich Sendler, "The Internet of Things, Industries 4.0 Unleashed", Springer., Germany, 2018

YouTube Resources:

1. https://www.youtube.com/watch?v=V8QrWJvUBTU – The future of digital twin technology.
2. **https://www.youtube.com/watch?v=c9fuPgub-ao -** TECH Perspectives - Leveraging Digital Twin Technology.
3. https://www.youtube.com/watch?v=WBKRdV6fxWA - Building a Digital Twin for Sustainable Resource Management

45 PERIODS

Course Code	INDUSTRIAL NETWORK PROTOCOLS	L	T	P	C
MT4V28		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- study the various types wired protocols for electronic system.
- know the various types wireless protocols for electronic system.
- understand the various industrial wired protocols in automation.
- study the various types wireless protocols for industrial automation.
- develop the wired and wireless functions of various protocols.

Course Description

This course delves into wired and wireless communication protocols like RS232, Bluetooth, and Wi-Fi, alongside industrial standards such as Modbus, CAN, and Ethernet/IP. It explores antenna technology, network topologies, and industrial automation protocols like EtherCAT and ISA100 Standards. Practical applications include machine and industry-wide networking, integrating with Cloud Computing and IoT, demonstrated through case studies in automation.

Prerequisites

- Foundational knowledge of electronics and networking principles.
- Proficiency in programming languages such as C/C++.
- Prior experience or coursework in industrial automation systems.

UNIT I Wired Protocols and Buses **9**

Wireless - Wired Networks Comparison - Serial Communication Protocols - RS232-UART-SPI - 2C –UNI/O Bus -1 Wire -Camera Link - Parallel Communication -PPI - Wishbone Bus – AMBA – JTAG - Fireware IEEE 1394 Bus - Ethernet Overview - RS485

UNIT II Wireless Protocols **9**

Antenna Technology- Network Topologies - Wireless Local Area Networks (WLAN) – Wireless Personal Area Networks (WPAN) - Wimedia – Wimax - RF – Bluetooth- Wi-Fi – Zigbee – Wireless Industrial Automation Protocols.

UNIT III Industrial and Autonomous Systems Wired Networks **9**

Overview of Industrial Wired Networks – Terminal Bus- Modbus - HART Network -Mechatrolink-II – EtherCAT- Sercos II/III – CAN- Canopen - Modbus IDA-PROFINETPROFIBUS-Ethernet/IP- Ethernet Powerlink- AG Automation and Drives (AS-I) - Device

UNIT IV Industrial Wireless Networks **9**

Overview of Industrial Wireless Networks - IWLAN - ISA100 Standards – Remote Networks Controller-Based Networks - Wireless HART Technology - 3G/4G for Automation – RFID Data Tags

UNIT V Application of Communication Protocols **9**

Wired Machine Networking of Sub-elements and Machines - Wireless Machine Networking of Sub-elements and Machines – Networking of Industry - Communication Network Layout Design - Networking for TIA-Cloud Computing – IOT - Case Studies in Automation Applications.

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Design wired protocols for electronic system.
CO2: Use wireless protocols for electronic system.
CO3: Practice industrial wired protocols in automation.
CO4: Select wireless protocols for industrial automation.
CO5: Demonstrate the wired and wireless functions of various protocols in application development.

TEXT BOOKS:

1. Borko Furht, "Encyclopaedia of Wireless and Mobile Communications - Three Volume Set", CRC Press, 2012.
2. Dick Caro, "Wireless Networks for Industrial Automation", 2014.

REFERENCES:

1. MMC-SD SERCOS Drive, "G&L Motion Control", Hardware Manual, 2005.
   Olaf Pfeiffer, Andrew Ayre and Christian Keydel, "Embedded Networking with CAN and CANopen", Copperhill Technologies Corporation, 2016.
2. Richard Zurawski, "Industrial Communication Technology", CRC Press, 2017.
   Siemens IK, "Industrial Ethernet: IEEE 802.3", 2005.
3. Wolfram Behardt and Jorg Wollert, "The wireless B: Evolution and Communication", Stetue Germany, 2016.

YouTube Resources:

1. **Control System Lectures by NPTEL:** NPTEL (National Programme on Technology Enhanced Learning) offers a series of lectures on control systems, which includes topics like wired and wireless communication protocols, industrial networking, and automation applications.
2. **Automation Engineering Academy:** This channel provides tutorials and lectures on various aspects of automation engineering, including wired and wireless communication protocols, industrial networks, and their applications.

3. **RealPars:** RealPars offers tutorials on industrial automation, PLC programming, and networking concepts. They have videos covering topics like Modbus, Ethernet/IP, and wireless protocols like Wi-Fi and Zigbee.

45 PERIODS

Vertical 3: < Design and Manufacturing>

Course Code	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
MT4V31		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study about the history, concepts and terminology in PLM.
- To learn the functions and features of PLM/PDM.
- To develop different modules offered in commercial PLM/PDM tools.
- To demonstrate PLM/PDM approaches for industrial applications.
- To use PLM/PDM with legacy data bases, Coax& ERP systems.

Course Description

Product Life Cycle Management (PLM) is an essential discipline for modern industries aiming to streamline their product development processes and enhance competitiveness. This course delves into the historical evolution, fundamental concepts, and terminologies associated with PLM. It explores the functionalities and features of PLM/PDM (Product Data Management) systems and their application in various industrial contexts. Through case studies and practical exercises, students will gain insights into the selection, implementation, and customization of commercial PLM/PDM tools. Furthermore, the course examines the integration of PLM/PDM with legacy databases, CAD (Computer-Aided Design), SLM (Service Lifecycle Management), and ERP (Enterprise Resource Planning) systems.

Prerequisites

- Basic engineering knowledge.
- Familiarity with manufacturing processes.
- Basic knowledge of enterprise resource planning (ERP) systems.

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT – II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault. -Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

UNIT – IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on Practical exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Summarize the history, concepts and terminology of PLM.
CO2: Develop the functions and features of PLM/PDM.
CO3: Discuss different modules offered in commercial PLM/PDM tools.
CO4: Interpret the implement PLM/PDM approaches for industrial applications.
CO5: Integrate PLM/PDM with legacy data bases, CAx & ERP systems.

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10: 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10: 0899303196

REFERENCES:

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.
4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

YouTube Resources:

1. **PTC University -** The channel often features insights and best practices from industry experts, making it a valuable resource for students seeking to deepen their understanding of PLM and its practical application in product design and development workflows.

Course Code	LEAN MANUFACTURING	L	T	P	C
MT4V32		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.

Course Description

Lean Manufacturing (LM) is a systematic approach to eliminating waste and optimizing processes to improve efficiency and productivity in manufacturing operations. This course provides students with a comprehensive understanding of Lean Manufacturing principles and tools and equips them with the skills to implement Lean methodologies in organizational settings. Through theoretical studies, practical exercises, and case studies, students will learn how to identify waste, streamline processes, and create value for customers while minimizing resources and maximizing productivity.

Prerequisites

- Basic understanding of manufacturing processes.
- Familiarity with fundamental concepts in production management.
- Proficiency in quantitative analysis and problem-solving skills.

UNIT I INTRODUCTION TO LEAN MANUFACTURING 9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II CELLULAR MANUFACTURING, JIT, TPM 9

Cellular Manufacturing – Types of Layouts, Principles of Cell layout, Implementation. JIT –

Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and

implementation of TPM.

UNIT III SET UP TIME REDUCTION, TQM, 5S, VSM 9

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV SIX SIGMA 9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

UNIT V CASE STUDIES 9

Various case studies of implementation of lean manufacturing at industries.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Differentiate between conventional and Lean Manufacturing, identify Lean principles, and recognize the importance of Lean tools.
CO2: Implement Cellular Manufacturing, JIT, and TPM principles to enhance operational efficiency and equipment reliability.
CO3: Analyze and reduce setup times, implement TQM and 5S principles, and conduct VSM exercises to eliminate waste and streamline processes.
CO4: Apply Six Sigma methodologies to identify and eliminate defects, improve process capability, and optimize production processes.
CO5: Analyze case studies to identify successful Lean practices and apply lessons learned to propose and implement Lean solutions in diverse organizational contexts.

TEXT BOOKS:

1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Rother M. and Shook J, 1999, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda, Lean Enterprise Institute, Brookline, MA

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005

YouTube Resources:

1. **LeanSmarts -** This channel offers comprehensive insights into Lean Manufacturing principles and methodologies, providing practical examples and case studies to enhance understanding and application in real-world scenarios.
2. **LeanVlog -** Focusing on Lean Manufacturing techniques and tools, this channel delivers informative tutorials and discussions to help viewers grasp key concepts and techniques for process optimization and waste reduction.
3. **Gemba Academy -** With a wide range of videos covering various aspects of Lean Manufacturing, including tutorials, case studies, and expert interviews, this channel provides valuable resources for learners at all levels seeking to deepen their understanding of Lean principles and implementation strategies.

4. **Lean Sigma Corporation -** Specializing in Lean Six Sigma methodologies, this channel offers practical guidance and best practices for implementing Lean Manufacturing principles effectively, making it an essential resource for individuals looking to improve operational efficiency and drive continuous improvement initiatives.

Course Code	ADVANCED MANUFACTURING SYSTEMS	L	T	P	C
MT4V33		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- The objective of this course is to teach the lean tools to attain optimum level in quality.
- To enhance the ability to make decisions for new product development.
- Aims to develop the students to conserve energy and natural resources, and to ensure that they have minimal impact on the environment and society.
- To give students an introduction to an advanced information process technique.
- To learn about the various smart manufacturing techniques and applications.

Course Description

This is a comprehensive course designed to equip students with the knowledge and skills necessary to thrive in modern manufacturing environments. The course covers various aspects of lean manufacturing, agile manufacturing, sustainable manufacturing, intelligent manufacturing, and smart manufacturing techniques and applications. Through theoretical studies, case analyses, and practical exercises, students will gain a deep understanding of these advanced manufacturing concepts and their implications for operational efficiency, product development, sustainability, and competitiveness in the global marketplace.

Prerequisites

- Fundamental understanding of manufacturing processes and systems.
- Familiarity with principles of operations management.
- Awareness of environmental sustainability concepts in manufacturing.
- Basic understanding of information technology and its applications in manufacturing.

UNIT – I INTRODUCTION TO LEAN MANUFACTURING 9

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

UNIT – II AGILE MANUFACTURING 9

Agile Manufacturing Vs Mass Manufacturing - Agile practice for product development - Manufacturing agile practices - Implementing new technology - A checklist, technology applications that enhance agility - agile technology make or buy decisions. - Costing for Agile Manufacturing practices.

UNIT – III SUSTAINABLE MANUFACTURING 9

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – IV INTELLIGENT MANUFACTURING **9**

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V SMART MANUFACTURING **9**

Introduction to various Smart Manufacturing Techniques-Supply chain management-Block chain of inventory management-Plant Digitization-Predictive Maintenance-Supply chain visibility-Warehouse-Cost Reduction-Waste Management-Automated Systems-Applications

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

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

TEXT BOOKS:

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

REFERENCES:

1. Black.J.T. and Kohser R.A, "DeGarmo's Materials and Processes in Manufacturing", Published by Wiley, 11th edition, 2011.
2. Christian N. Madu, "Handbook of environmentally conscious manufacturing", Springer US Publishers, 1st edition, 2001.
3. John Schey, "Introduction to Manufacturing Processes", Tata McGraw-Hill Education ,3rd edition,1999
4. Seliger G., "Sustainable Manufacturing: Shaping Global Value Creation", Springer, United States, 2012, ISBN 978-3-642-27289-9.

5. Rao R. V, “Advanced Modeling and Optimization of Manufacturing Processes”, 2nd edition, 2006.
6. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean Production Systems”, John Wiley and Sons, 2003.
7. Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., United States, 2007, ISBN: 978-0-471-72636-4.

YouTube Resources:

1. **MIT OpenCourseWare -** MIT OCW offers a wide range of lectures and courses on manufacturing systems and related topics, providing in-depth insights into advanced manufacturing concepts.
2. **Manufacturing Hub -** This channel covers various aspects of manufacturing, including lean manufacturing, agile manufacturing, and smart manufacturing techniques, offering practical tips and insights for students studying advanced manufacturing systems.
3. **The Engineer Guy -** While not specifically focused on advanced manufacturing, this channel provides insightful videos on engineering principles and processes, which can complement the understanding of manufacturing systems.
4. **Festo Learning -** Festo Learning offers videos on industrial automation, robotics, and smart manufacturing technologies, providing valuable insights into the latest advancements in manufacturing systems.
5. **The Lean Thinker -** This channel focuses on lean manufacturing principles and techniques, offering tutorials, case studies, and discussions to help viewers understand and implement lean practices in manufacturing processes.

Course Code	WELDING TECHNOLOGY AND AUTOMATION	L	T	P	C
MT4V34		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the basics of welding and to know about the various types of welding processes
- To elaborate various welding methods including advanced techniques, with emphasis on basic principles, limitations and application.
- To outline metallurgical aspects of welding and its defects
- To understand the different types of zones formed during welding.
- To study the weldability of carbon steel.

Course Description

This course covers various aspects of welding processes, metallurgy, automation, and testing. Students will learn about different welding methods, including arc welding, resistance welding, solid-state welding, and allied processes. Additionally, the course explores welding metallurgy, weldability of different materials, automation in welding, weld joint design, and testing techniques. Through theoretical lectures, practical demonstrations, and hands-on exercises, students will develop the knowledge and skills necessary to understand, apply, and innovate in the field of welding technology and automation.

Prerequisites

- Basic understanding of welding fundamentals and terminology.
- Familiarity with principles of metallurgy and materials science.
- Basic knowledge of manufacturing processes and systems.
- Awareness of safety protocols and practices in welding environments.

Unit I Arc Welding Processes 9

Classification of welding processes, arc physics, arc initiation methods; Modes of metal transfer; Manual metal arc welding, gas metal arc welding, gas tungsten arc welding, flux cored arc welding, submerged arc welding, Electro gas welding, Plasma arc welding, Cold metal transfer welding, Principles, process variables, significance, advantages, limitations and applications, Different types of electrodes and their specifications.

Unit II Resistance, Solid state and Allied welding Processes 9

Electrical Resistance Welding: General principle- heat generation in resistance welding, Electrical Characteristics of Resistance welding; Spot welding, Projection welding and Seam welding, High frequency resistance welding, Resistance butt welding, Flash butt welding: Principle, welding sequence, working principle, applications.

Solid state welding processes: Rotary Friction Welding, Friction Stir Welding, Diffusion bonding, Ultrasonic welding, Explosive welding, Magnetic Pulse Welding - working principle, process variables, applications and limitations.

Allied Processes: Under water welding, Thermit welding. Laser beam welding, Electron beam welding – Principles, Process characteristics, advantages and applications.

Unit III Welding Metallurgy 9

Heat flow in welding: heat flow equations, metallurgical effects of heat flow in welding. Regions of a Fusion Weld, Fusion Zone, Unmixed Zone (UMZ), Partially Melted Zone (PMZ), Heat Affected Zone (HAZ), Correlation with Iron-Carbon diagram; Heat Treatment Methods and TTT diagram, CCT diagrams – significance and applications of these diagrams in Welding.

Weldability of Carbon Steels, Stainless Steels, Aluminium alloys, Magnesium alloys, Titanium alloy and Nickel base alloys; Problems encountered during welding of these alloys; Causes and Remedies; Best welding methods to weld these alloys.

Unit IV Robotics and Automation in Welding 9

Robotics in welding - The concept of robotics, the robot design and its applications for welding, welding procedures adequate for robotics, programming of robot‟s welding tolerances of assemblies for robot welding, auxillary devices for robot welding, new generation of welding robots, self-alignment by current arc variation, light spot leading system, Some of the most common forms of robotic welding.

Introduction to Automation: Types of automation, Industry 4.0 concept, Factories of Future, Applications of Machine Learning, Artificial Intelligence and Internet of Things in welding and fabrication industries.

Unit V Weld Design and Testing 9

Types of weld joints, butt joint, lap joint, T-joint, cruciform joint, corner joint and edge joint, fillet and groove welds. complete and partial joint penetration, classification and types of grove welds, single and double fillet welds, combined partial joint penetration grove and fillet welds, size of fillet and grove welds, weld symbols, standard system of representation of welded joints, brazed and soldered joints. Welded joint design to control distortion and shrinkage, residual stresses and cracking.

Destructive Testing: Methods and Procedures of Tensile, Impact, Hardness of Welded joints; Non-Destructive Testing: Principle and Mechanism of Visual inspection, Magnetic Particle Inspection, Eddy current testing, Ultrasonic Testing and Radiography Testing

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the construction and working principles of arc welding process.
CO2: Understand the construction and working principles of resistance, solid state and Allied welding process.
CO3: Understand the interaction between heat and metals, and Predict the microstructure of different regions of a weldment.

CO4: Improve the welding performance through automation; apply the robots in critical components welding. Also, to design automation layout for specific component fabrication by integrating computers, robots and welding processes.
CO5: Understand the concepts on weld joint design, weldability and testing of weldments.

TEXT BOOKS:

1. Welding Handbook (Welding Processes), Volume II, 8th Edition, American Welding Society (AWS),1st June 1991.
2. John C. Lippold, Damian J. Kotecki, Welding metallurgy and weldability of stainless steels, 2005.
3. Resistance welding: Fundamentals and Applications, Hongyan Zhang and Jacek Senkara, Second Edition, CRC Press, 2011
4. John Norrish. "Advanced welding processes Technologies and process control" Wood head Publishing and Maney Publishing. Cambridge, England. 2006
5. Linnert G.E, Welding Metallurgy, Vol I & II, 4th edition, American Welding Society, 1994. 6. Gray T. G. E. "Rational Welding Design", Butterworth's, 1982
6. Kozyrev, "Industrial Robots Handbook", Mir Publishers, Moscow, 2011.

REFERENCES:

1. Parmer R. S., 'Welding Processes and Technology', Khanna Publishers
2. Little, R.L., Welding and Welding Technology, Tata McGraw Hill, New Delhi, 1996
3. Welding Engineering and Technology, R.S. Parmar, Khanna Publishers, 2013
4. O.P.Khanna, Welding Technology, Dhanpat Rai Publications, New Delhi, 2008
5. Saferian.D, The Metallurgy of Welding, Pergamon Press, 1985
6. Dieter G. "Mechanical Metallurgy", Tata McGraw Hill, 1988
7. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicolas G. Odery, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill Book Co., 1986.

ONLINE Resources:

1. **http://www.gowelding.com/**
2. **http://www.weldingsoftwarepro.com/**
3. **http://nptel.ac.in/courses/112107077/33**
4. **http://nptel.ac.in/courses/112107078/**
5. **http://kto.simtech.a-star.edu.sg/wsq-graduate-diploma-in-advance-welding-technologies**
6. http://www.albertatechfutures.ca/RDSupport/Petroleum/BitumenandHeavyOil/EngineeredMaterials /AdvancedWeldingTechnologies.aspx

Course Code	ADDITIVE MANUFACTURING	L	T	P	C
MT4V35		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

Course Description

Additive Manufacturing (AM) is a cutting-edge course designed to introduce students to the revolutionary technology of creating physical objects layer by layer from digital designs. The course covers various AM processes, including vat polymerization, directed energy deposition, powder bed fusion, material extrusion, binder jetting, material jetting, and sheet lamination. Students will explore the development, business opportunities, and applications of AM technology across industries such as automotive, aerospace, healthcare, and electronics. Additionally, the course delves into design considerations for AM, process principles, materials, advantages, limitations, and real-world case studies. Through lectures, demonstrations, and hands-on exercises, students will gain practical skills and knowledge to leverage AM technology in product development, prototyping, and manufacturing.

Prerequisites

- Basic understanding of manufacturing processes and materials.
- Familiarity with computer-aided design (CAD) software.
- Knowledge of engineering principles and concepts.
- Understanding of materials science and metallurgy.
- Awareness of industrial applications and business implications.

UNIT I INTRODUCTION **9**

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

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) **9**

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials – Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 9

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multi jet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.
CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

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

REFERENCES:

1. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States ,2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011, ISBN: 9780849334092.

YouTube Resources:

1. **Formlabs -** This channel provides insights into various aspects of 3D printing technology, including tutorials, case studies, and product demonstrations.
2. **Markforged -** Markforged's channel offers videos on industrial 3D printing, showcasing their printers, materials, and applications in different industries.
3. **Ultimaker -** Ultimaker's channel features tutorials, product reviews, and user stories related to 3D printing, including tips for optimizing prints and using slicing software.
4. **3D Printing Nerd -** This channel offers a mix of entertaining and informative content on 3D printing, including reviews of printers and filament, as well as project showcases.
5. **The 3D Printing Professor -** With a focus on educational content, this channel provides tutorials on 3D printing techniques, troubleshooting common issues, and using various software tools.

Course Code	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
MT4V36		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To provide the overview of evolution of automation, CIM and its principles.
- To learn the various Automation tools, include various material handling system.
- To train students to apply group technology and FMS.
- To familiarize the computer aided process planning in manufacturing.
- To introduce to basics of data transaction, information integration and control of CIM.

Course Description

This course introduces students to the principles and applications of Computer Integrated Manufacturing (CIM) systems. The course aims to provide an overview of automation, CIM, and its fundamental principles, preparing students to apply various automation tools and material handling systems effectively. Key components such as Group Technology (GT), Flexible Manufacturing Systems (FMS), computer-aided process planning, and process control techniques are covered extensively. The course also delves into the integration of CAD, CAM, and CIM, emphasizing the evolution of manufacturing technologies and the role of computers in modern manufacturing processes.

Prerequisites

- Basic understanding of manufacturing processes and principles.
- Familiarity with computer-aided design (CAD) and computer-aided manufacturing (CAM) concepts.
- Knowledge of fundamental engineering principles and terminology.

UNIT – I INTRODUCTION **9**

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

UNIT – II AUTOMATED MANUFACTURING SYSTEMS **9**

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing

UNIT – III GROUP TECHNOLOGY AND FMS **9**

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

UNIT – IV PROCESS PLANNING **9**

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

UNIT – V PROCESS CONTROL AND DATA ANALYSIS **9**

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

TOTAL :45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

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

TEXT BOOKS:

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

REFERENCES:

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

YouTube Resources:

1. **Learn Engineering -** Provides comprehensive explanations and visualizations of engineering concepts, including automation and manufacturing processes.
2. **RealPars -** Offers tutorials and guides on industrial automation, including PLC programming and process control.
3. **Automation Training -** Focuses on automation technologies, including PLCs, SCADA, and industrial networking.
4. **Learn CNC -** Covers CNC machining, CNC programming, and related topics, which are relevant to modern manufacturing processes.
5. **The Engineering Mindset -** Offers videos on various engineering topics, including CAD/CAM, automation, and robotics.

Course Code	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
MT4V37		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the process planning concepts to make cost estimation for various products after process planning
- To Learn the various Process Planning Activities
- To provide the knowledge of importance of costing and estimation.
- To provide the knowledge of estimation of production costing.
- To learn the knowledge of various Machining time calculations

Course Description

This course provides students with a comprehensive understanding of the principles and practices involved in process planning and cost estimation for manufacturing. The course aims to equip students with the necessary skills to effectively plan production processes and estimate costs for various industrial products.

Prerequisites

- Basic understanding of manufacturing processes
- Familiarity with engineering drawings
- Knowledge of fundamental mathematical concepts (e.g., algebra, geometry)

UNIT I INTRODUCTION TO PROCESS PLANNING **9**

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES **9**

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION **9**

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT IV PRODUCTION COST ESTIMATION **9**

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION **9**

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL:45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Discus select the process, equipment and tools for various industrial products.
CO2: Explain the prepare process planning activity chart.
CO3: Explain the concept of cost estimation.
CO4: Compute the job order cost for different type of shop floor.
CO5: Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

YouTube Resources:

1. **LearnEngg -** This channel offers a variety of engineering-related topics, including process planning and costing.
2. **Learn Mechanical -** Provides tutorials on various mechanical engineering subjects, including process planning and cost estimation.
3. **Engineer4Free -** Offers comprehensive tutorials on engineering concepts, including manufacturing processes and costing.
4. **MIT OpenCourseWare -** MIT's channel provides access to full courses and lectures on various engineering topics, including manufacturing processes and costing.
5. **NPTEL Mechanical Engineering -** NPTEL provides high-quality educational content in engineering disciplines, including lectures on process planning and costing.

Course Code	PRODUCTION PLANNING AND CONTROL	L	T	P	C
MT4V38		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP)

Course Description

This course designed to provide students with a comprehensive understanding of the concepts and techniques used in production planning and control. The course covers various aspects including work study, product planning, production scheduling, inventory control, and recent trends in production planning and control (PPC). Through theoretical instruction and practical exercises, students will learn how to effectively plan, manage, and control production processes to optimize efficiency and meet organizational goals.

Prerequisites

- Basic understanding of manufacturing processes and systems.
- Familiarity with fundamental concepts of industrial engineering.

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production- job-batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational Aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis Economics of a new design.

UNIT II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules Gantt Charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material

requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder Procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the objectives and benefits of production planning and control, recognize different production types, and analyze product development aspects.
CO2: Demonstrate proficiency in conducting method studies and work measurement techniques. CO3: Apply product planning strategies, undertake process planning, and analyze process capabilities in batch production.
CO4: Apply the skills to develop and implement production scheduling techniques and production control systems.
CO5: Demonstrate proficiency in inventory control techniques and be familiar with recent trends in production planning and control.

TEXT BOOKS:

1. James. B. Dilworth," Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

YouTube Resources:

1. **LeanVlog -** Provides videos on lean manufacturing principles, including production planning and control techniques such as kanban, value stream mapping, and 5S.
2. **Learn Engineering** - Offers animated videos explaining various engineering concepts, including topics related to production planning and control.
3. **The Audiopedia -** Provides concise explanations of industrial engineering concepts, including production planning and control fundamentals.
4. **The Lean Six Sigma Company -** Offers videos on lean manufacturing and Six Sigma methodologies, including topics relevant to production planning and control optimization.

Online Resources:

1. **APICS -** Offers online courses, webinars, and resources on production and inventory management, including topics related to production planning and control.
2. **Institute of Industrial and Systems Engineers (IISE) -** Provides access to publications, webinars, and educational resources covering industrial engineering topics, including production planning and control.
3. **Lean Enterprise Institute (LEI) -** Offers online workshops, articles, and case studies on lean manufacturing principles, including production planning and control techniques.
4. **LinkedIn Learning -** Provides online courses on production planning and control, inventory management, and related topics taught by industry professionals.
5. **Coursera -** Offers courses on operations management, supply chain management, and production planning and control from universities and institutions worldwide.

Vertical 4: <Autonomous Vehicle Technology>

Course Code	AUTOMOBILE ENGINEERING	L	T	P	C
MT4V41		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To study the construction and working principle of various parts of an automobile.
- To study the practice for assembling and dismantling of engine parts and transmission system
- To study various transmission systems of automobile.
- To study about steering, brakes and suspension systems
- To study alternative energy sources

Course Description

Automobile Engineering is designed to provide students with a comprehensive understanding of the construction, operation, and maintenance of automobiles. The course covers various aspects of automotive technology including engine components, transmission systems, steering mechanisms, braking systems, suspension systems, and alternative energy sources.

Prerequisites

- Fundamental understanding of principles in physics, mechanics, and basic engineering concepts.
- Knowledge in mathematics, particularly algebra and calculus.
- Proficiency in using engineering tools and software for analysis and design.

UNIT – I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT – II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT – III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT – V ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the various parts of the automobile and their functions and materials.
CO2: Discuss the engine auxiliary systems and engine emission control.
CO3: Distinguish the working of different types of transmission systems.
CO4: Explain the Steering, Brakes and Suspension Systems.
CO5: Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

1. Jain K.K. and Asthana. R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014

REFERENCES:

3. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2012.
4. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
5. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.
6. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
7. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart - Will Cox Company Inc, USA ,1978

YouTube Resources:

1. **Engineering Explained:** This YouTube channel covers various aspects of automotive engineering, including engine components, transmission systems, vehicle dynamics, and alternative energy sources.
   Link: Engineering Explained
2. **Learn Engineering:** Learn Engineering provides educational videos on automotive engineering topics such as engine design, transmission systems, steering mechanisms, and braking systems.
   Link: Learn Engineering
3. **Engineering Master:** This channel offers detailed explanations and visual demonstrations of automobile engineering concepts, including engine auxiliary systems, transmission systems, and vehicle dynamics.
   Link: Engineering Master
4. **Car Throttle Engineering:** Car Throttle Engineering covers a wide range of automotive engineering topics, including engine technologies, transmission systems, suspension systems, and alternative energy sources.
   Link: Car Throttle Engineering
5. **Engineering Explained Plus:** This channel offers in-depth explanations and demonstrations of automotive engineering concepts, including engine design, transmission systems, vehicle aerodynamics, and alternative energy sources.
   Link: Engineering Explained Plus

Course Code	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
MT4V42		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.

Course Description

This course offers an in-depth exploration of Electric and Hybrid Vehicles (EHVs), covering various aspects including architectures, modelling, sizing, subsystem design, and hybrid vehicle control. Students will gain a comprehensive understanding of the principles and technologies underlying electric and hybrid vehicles, enabling them to comprehend their design considerations and operational mechanisms.

Prerequisites

- Familiarity with Engineering Fundamentals including mechanics, thermodynamics, and electrical circuits.
- Mathematics and Physics Knowledge is essential for understanding the mathematical models and calculations involved in electric and hybrid vehicle systems.
- Knowledge of traditional vehicle systems, including internal combustion engines, drive train components, suspension systems, and braking systems.
- Understanding of Electrical Systems including voltage, current, resistance, and power, is necessary for comprehending the operation and control of electric motors, power converters, and battery management systems in electric and hybrid vehicles.
- Awareness of Environmental and Sustainability emphasis on electric and hybrid vehicles as environmentally friendly alternatives to traditional vehicles.

UNIT – I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems.

UNIT – II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT – III MOTORS AND BRAKING **9**

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT – IV POWER CONVERTERS AND CONTROLLERS **9**

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT – V HYBRID AND ELECTRIC VEHICLES **9**

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles – Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the operation and architecture of electric and hybrid vehicles
CO2: Identify various energy source options like battery and fuel cell
CO3: Select suitable electric motor for applications in hybrid and electric vehicles.
CO4: Explain the role of power electronics in hybrid and electric vehicles
CO5: Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

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

REFERENCES:

1. Black.J.T. and Kohser R.A, “DeGarmo’s Materials and Processes in Manufacturing”,Published by Wiley, 11th edition, 2011.
2. Christian N. Madu, “Handbook of environmentally conscious manufacturing”, SpringerUS Publishers, 1st edition, 2001.

3. John Schey, “Introduction to Manufacturing Processes”, Tata McGraw-Hill Education,3rd edition,1999
4. Seliger G., “Sustainable Manufacturing: Shaping Global Value Creation”, Springer,United States, 2012, ISBN 978-3-642-27289-9.
5. Rao R. V, “Advanced Modeling and Optimization of Manufacturing Processes”, 2nd edition, 2006.
6. Ronald G. Askin and Jeffrey B. Goldberg, “Design and Analysis of Lean ProductionSystems”, John Wiley and Sons, 2003.
7. Kutz M., “Environmentally Conscious Mechanical Design”, John Wiley & Sons., UnitedStates, 2007, ISBN: 978-0-471-72636-4.

YouTube Resources:

1. **Electric Vehicle Architecture and Design Considerations:**
Electric Vehicle Architecture Explained - Engineering Explained
Design Considerations for Electric Cars - Engineering Explained

2. **Energy Sources for Electric Vehicles:**
Types of Batteries for Electric Vehicles - Learn Engineering
How Do Fuel Cells Work? - TED-Ed
Ultracapacitors Explained - Real Engineering

3.**Motors and Drives:**
Types of Motors for Electric Vehicles - Engineering Explained
Working Principle of BLDC Motors - Electric Bike Conversion

4. **Power Converters and Controllers:**
Introduction to Power Electronics - The Engineering Mindset
How Do Inverters Work? - Learn Engineering

Course Code	AUTOMOTIVE MECHATRONICS	L	T	P	C
MT4V43		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.
- To study the Ignition and Injection system in Automobiles
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of Mechatronics control units used for control of fuel, ignition and exhaust systems.
- To learn about different types of chassis and Mechatronics safety systems in automobile

Course Description

Automotive Mechatronics aims to provide students with a comprehensive understanding of the integration of electronics, mechanics, and computer control systems in automobiles. The course covers fundamental concepts in electronics, emission controls, ignition and injection systems, sensors and actuators, engine control systems, chassis systems, and safety systems. Students will learn about the evolution of electronics in automobiles, emission laws, charging systems, ignition systems, fuel injection, sensor technologies, engine control subsystems, vehicle networks, chassis systems, and safety systems such as traction control, cruise control, anti-lock braking systems, and airbag systems.

Prerequisites

- Fundamental understanding of electronics principles and circuits.
- Basic knowledge of automotive systems and components.
- Familiarity with computer programming concepts.
- Understanding of mechanical engineering principles.
- Ability to use diagnostic tools and equipment.

UNIT – I INTRODUCTION **9**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT – II IGNITION AND INJECTION SYSTEMS **9**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT – III SENSOR AND ACTUATORS IN AUTOMOTIVES **9**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT – IV ENGINE CONTROL SYSTEMS **9**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECUs used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT – V CHASSIS AND SAFETY SYSTEMS **9**

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Know the importance of emission standards in automobiles.
CO2: Understand the electronic fuel injection/ignition components and their function.
CO3: Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.
CO4: Diagnose electronic engine control systems problems with appropriate diagnostic tools.
CO5: Analyze the chassis and vehicle safety system

TEXT BOOKS:

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.

REFERENCES

1. Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, 7th edition, 2019.
2. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication,4th edition, 2000.
3. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.
4. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2000.

YouTube Resources:

1. **Evolution of Electronics in Automobiles and Emission Laws:**

Title: "Evolution of Electronics in Automobiles | Emission Laws Explained"
Link: Evolution of Electronics in Automobiles

2. **Charging Systems and Starter Motors:**

Title: "Understanding Automotive Charging Systems and Starter Motors"
: Charging Systems and Starter Motors

3. **Ignition Systems and Fuel Control:**

Title: "Ignition Systems Explained | Electronic Fuel Control Basics"
Link: Ignition Systems and Fuel Control

4. **Sensors and Actuators in Automobiles:**

Title: "Automotive Sensors and Actuators Overview"
Link: Sensors and Actuators in Automobiles

5. **Engine Control Systems and Vehicle Networks:**

Title: "Introduction to Engine Control Systems and CAN Standard"
Link: Engine Control Systems and Vehicle Networks

6. **Chassis and Safety Systems:**

Title: "Understanding Automotive Chassis and Safety Systems"
Link: Chassis and Safety Systems

Course Code	AUTOMOTIVE SYSTEM MODELLING AND SIMULATION	L	T	P	C
MT4V44		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To understand the various steps involved in the design of automotive components
- To show their knowledge in designing engine components.
- To complete design exercise and arrive at important dimensions of chassis components.
- To learn the use of standard practices in design.
- To determine the dimensions of front and rear axles

Course Description

This course delves into the intricate process of designing automotive components, covering essential aspects such as cylinders, pistons, connecting rods, crankshafts, valves, clutches, gears, vehicle frames, suspensions, and axles. Students will learn the foundational principles and practices required to design components that meet industry standards and functional requirements.

Prerequisites

- Familiarity with engineering mechanics, mathematics, and physics.
- Knowledge of engine components, transmission systems, and chassis structures.
- Knowledge of common manufacturing processes used in automotive component fabrication.

UNIT – I DESIGN OF CYLINDER, PISTON AND CONNECTING ROD 9

Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on piston for car with Modelling and simulation.

UNIT – II DESIGN OF CRANK SHAFT AND VALVES 9

Material for crankshaft, design of crankshaft under bending and twisting. Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam& camshaft. Design of rocker arm. Cam profile generation. 3D Engine simulation: Introduction to thermal and flow analysis in engine cylinder, modeling of cylinder and piston for combustion analysis

UNIT – III DESIGN OF CLUTCHES AND GEARS 9

Design of single plate clutch, multiplate clutch and cone clutch assembly. Torque capacity of clutch. Design of clutch components. Gear train calculations, layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three speed and four speed gearboxes. Modelling and simulation: braking system.

UNIT – IV DESIGN OF VEHICLE FRAME AND SUSPENSION 9

Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Case study on development of frame for ATV. Modelling and simulation of suspension system

UNIT – V DESIGN OF FRONT AND REAR AXLE 9

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings. Analysis of loads moments and stresses at different sections of front axle. Determination of optimum dimensions and proportions for steering linkages, Design of front axle beam.. Modelling and simulation of steering system, transmission system

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination.

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Analyse the stress and strain imparted on automotive components.
CO2: Compute the design and find the dimension of the vehicle components.
CO3: Identify optimal design solutions to real-world problems in compliancewith industry standards.
CO4: Demonstrate the design skill by creating new design strategy with theapplication of the knowledge
CO5: Interpret the modern system in vehicle and would help in developing thesystem with less impact to the environment.

TEXT BOOKS:

1. Giancarlo Genta, Lorenzo Morello, “The Automotive Chassis Volume 1, ComponentsDesign”, Springer International Edition, 2nd edition,2020
2. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House(Pvt) Ltd, 25th edition, 2022.
3. Alec Stokes, “Manual gearbox design”, Butterworth-Heinemann 1992.

REFERENCES:

1. “Design Data Hand Book”, PSG College of Technology, 2013- Coimbatore.
2. Dean Averns, "Automobile Chassis Design", Il life Book Co., 2001.
3. Kolchin-Demidov , “Design of Automotive Engines”-Mir Publishers (1984)
4. Lukin P G G and Rodionov V, “Automobile Chassis Design and Calculations”, MirPublishers, Moscow, 1989.
5. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017.

YouTube Resources:

1. Design of Cylinder, Piston, and Connecting Rod:
Title: "Designing Automotive Cylinder, Piston, and Connecting Rod"
Link: Design of Cylinder, Piston, and Connecting Rod

2. Design of Crankshaft and Valves:
Title: "Understanding Crankshaft and Valve Design in Automotive Engineering"
Link: Design of Crankshaft and Valves

3. Design of Clutches and Gears:
Title: "Design Principles of Automotive Clutches and Gears"
Link: Design of Clutches and Gears

4. Design of Vehicle Frame and Suspension:
Title: "Automotive Frame and Suspension Design Techniques"
Link: Design of Vehicle Frame and Suspension

5. Design of Front and Rear Axle:
Title: "Exploring Front and Rear Axle Design in Automotive Engineering"
Link: Design of Front and Rear Axle

Course Code	VEHICLE DYNAMICS AND CONTROL	L	T	P	C
MT4V45		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To develop physical and mathematical models to predict the dynamic response of Vehicles.
- To Apply vehicle design performance criteria and how to use the criteria to evaluate vehicle dynamic response.
- To use dynamic analyses in the design of vehicles.
- To understand the principle behind the lateral dynamics.
- To evaluate the longitudinal dynamics and control in an automobile

Course Description

This course provides a comprehensive understanding of vehicle dynamics and control systems, covering various aspects from longitudinal to lateral and vertical dynamics, as well as aerodynamics and control systems. Students will learn theoretical concepts and apply and problem-solving techniques related to vehicle performance and stability.

Prerequisites

- Basic knowledge of Engineering Mathematics (e.g.,Calculus, differential equation, linear algebra, numerical methods).
- Basic knowledge of Automotive engineering and vehicle dynamics.
- Proficiency in classical mechanics and control systems theory. with a high-level programming (e.g., C or C++).

UNIT I INTRODUCTION **9**

History of road and off-road vehicle system dynamics - dynamics of the motor vehicle, coordinate systems, details of vehicle systems, wheel angles, typical data of vehicles. Fundamental approaches to vehicle dynamics modelling, lumped mass, vehicle fixed coordinate system, motion variables, earth fixed coordinate system. Definitions- modeling and simulation of dynamic behavior of vehicle., motion analysis, force analysis, and energy analysis.

UNIT II LONGITUDINAL DYNAMICS **9**

Introduction to longitudinal dynamics - Performance of road vehicles: forces and moments on vehicle, equation of motion, tire forces, rolling resistance, weight distribution, tractive effort/tractive resistance and power available from the engine/ power required for propulsion, road performance curves- acceleration, grade ability, drawbar pull and the problems related to these terms. Calculation of maximum acceleration braking torque, braking force, brake proportioning, braking efficiency, stopping distance, load distribution (three wheeled and four wheeled vehicles), calculation of acceleration, tractive effort and reactions for different drives, Stability of a vehicle on slope, (Problems related to these). Steer-By-Wire Systems.

UNIT III LATERAL DYNAMICS **9**

Introduction to lateral dynamics - Steering geometry, types of steering systems, fundamental condition for true rolling, development of lateral forces. slip angle, cornering force, cornering stiffness, pneumatic trail, self-aligning torque, power consumed by tire, tire stiffness, hysteresis effect in tires, steady state handling

characteristics. yaw velocity, lateral acceleration, curvature response & directional stability. Stability of a vehicle on a curved track and a banked road. Gyroscopic effects, weight transfer during acceleration, cornering and braking, stability of a rigid vehicle and equations of motion of a rigid vehicle, cross wind handling, the problems related to these terms.

UNIT IV VERTICAL DYNAMICS 9

Introduction to vertical dynamics - Human response to vibrations, classification of vibration, specification and vibration, sources of vibration, suspension systems, Modal Analysis, One DOF, two DOF, free and forced vibration, damped vibration, magnification and transmissibility, vibration absorber, functions of suspension system. body vibrations: bouncing and pitching. Doubly conjugate points (only basic idea). body rolling. roll center and roll axis, roll axis and the vehicle under the action of side forces, stability against body rolling. Vehicle dynamics and suspension design for stability, choice of suspension spring rate, chassis springs and theory of chassis springs, gas & hydraulic dampers and choice of damper, damper characteristics, mechanics of an independent suspension system. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car mode- Hydraulic Actuators for Active Suspensions.

UNIT V VEHICLE AERODYNAMIC AND DYNAMIC CONTROL SYSTEM 9

Road Loads: Air resistance-Mechanics of air flow around a vehicle, pressure distribution on a vehicle, factors affecting rolling resistance, aerodynamic forces – aerodynamic drag, drag components, dynamic Control, modelling of actuators, sensors for automobile control, sensors for detecting vehicle environment, central tyre inflation system. Prediction of vehicle performance. ABS, stability control, traction control. Dynamic Model for Simulation of a Parallel Gas-Electric Hybrid Vehicle Dynamic Model for Simulation of a Power-Split Hybrid Vehicle Background on Control Design Techniques for Energy Management – steer by wire controller Design.

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

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

CO1: Recognize the vehicle system dynamics.
CO2: Evaluate the driving/ braking resistances and their influences on vehicle dynamics.
CO3: Identify and analyze the dynamics systems such as suspension systems, body vibrations, steering mechanisms.
CO4: Analyze and solve engineering problems related to vehicle dynamics.
CO5: Comparing and identifying the different types of control systems in automobiles.

TEXT BOOKS:

1. Rajesh Rajamani, “Vehicle Dynamics and Control”, 2nd edition, Springer, 2021.
2. Singiresu S. Rao, “Mechanical Vibrations”, 8th Edition, Prentice Hall, 2018.
3. Thomas D. Gillespie, “Fundamentals of Vehicle Dynamics”, Society of Automotive Engineers

Inc., 2021.
4. Wong. J. Y., "Theory of Ground Vehicles", 5th Edition, Wiley-Interscience, 2022.
5. N.K. Giri, "Automotive Mechanics", Kanna Publishers, 2007.

REFERENCES:

1. J.Y. Woung - John Willey & Sons "Theory of Ground Vehicles ", NY,5th Edition,2022.
2. J. G. Giles," Steering, Suspension &Tyres", Ilete Books Ltd., London,1968.
3. W. Steed "Mechanics of Road Vehicles ", Ilete Books Ltd. London,1960.
4. P. M. Heldt, "Automotive Chassis", Chilton Co. NK.
5. Gillespie.T.D., "Fundamental of vehicle dynamic society of Automotive Engineers ", USA, 2021 Revised Edition.
6. Rajesh Rajamani, "Vehicle dynamics and control", Springer publication,2014.
7. Reza NJazar, "Vehicle Dynamics: Theory and Application", Springer publication, 3rd Edition,2018

YouTube Resources:

1. https://www.youtube.com/watch?v=I8Zx7cMVG08
2. https://www.youtube.com/watch?v=3XcVwKOmqJQ
3. https://www.youtube.com/watch?v=hOYwzfnQinI
4. https://www.youtube.com/watch?v=JS9ej7T5kFc
5. https://www.youtube.com/watch?v=I2HYa9DfXg8
6. https://www.youtube.com/watch?v=W9Nn1d83l2s
7. https://www.youtube.com/watch?v=KYbV6kVwTRI
8. https://www.youtube.com/watch?v=yhSt6NHxeKo
9. https://www.youtube.com/watch?v=8uevWw2uZd0
10. https://www.youtube.com/watch?v=ZrqwvXALCs4
11. https://www.youtube.com/watch?v=YkNlfzRAjHs
12. https://www.youtube.com/watch?v=UYA9YU2ZZkA
13. https://www.youtube.com/watch?v=9xXS7yl15wY
14. https://www.youtube.com/watch?v=9PTy98AaAok
15. https://www.youtube.com/watch?v=muwJbPzLz0I

Course Code	ADVANCED DRIVER ASSISTANCE SYSTEM	L	T	P	C
MT4V46		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- introduce students with various fundamentals related to advanced driver assistance technologies.
- impart knowledge on sensors, control and actuation methodologies and create impact of automating vehicles
- acquire skills on vehicle prognostics and impaired driver technology.
- learn about various commonly available Advanced Driver Assistance Systems.
- study about Center Console Technology and other display technology.

Course Description

This course provides a comprehensive overview of automotive fundamentals, sensors, and advanced driver assistance systems (ADAS). Additionally, the course covers a wide range of automotive sensors, their operations, types, characteristics, and applications, including radar, ultrasonic, sonar, lidar, and camera sensors.

Prerequisites

- Basic understanding of automotive fundamentals including power systems, running systems, comfort systems, engine components, drive train, suspension systems, ABS, and steering systems.
- Familiarity with automotive sensors such as knock sensors, oxygen sensors, crankshaft angular position sensor, temperature sensor, speed sensor, pressure sensor, Mass air flow sensor, etc.
- Awareness of advanced driver assistance systems (ADAS) such as lane departure warning, active cruise control, blind spot detection, parking assist, autonomous emergency braking, night vision, traffic sign recognition, etc.

UNIT – I AUTOMOTIVE FUNDAMENTALS **9**

Power System-Running System-Comfort System–Engine Components Drive train suspension system, ABS, Steering System.

UNIT – II AUTOMOTIVE SENSORS **9**

Knock sensors, oxygen sensors, crankshaft angular position sensor, temperature sensor, speed sensor, Pressure sensor, Mass air flow sensor, Manifold Absolute Pressure Sensors, crash sensor, Coolant level sensors, Brake fluid level sensors – operation, types, characteristics, advantage and their applications. Radar, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera.

UNIT – III OVERVIEW OF DRIVER ASSISTANCE TECHNOLOGY **9**

Basics of Theory of Operation, Applications, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion. Vehicle Prognostics Technology.

UNIT – IV ADVANCED DRIVER ASSISTANCE SYSTEMS **9**

Advanced Driver Assistance Systems - Lane Departure (LDW), Active Cruise Control (ACC), Blind Spot Detection, Parking Assist, Autonomous Emergency Braking (AEB), Night Vision, Traffic Sign Recognition (TSR), Intelligent High beam Assistant (IHC), Tire Pressure Monitoring (TPMS), Front Collision Warning System (FCWS), Front Vehicle Departure Warning (FVDW), Adaptive Lighting, Driver Drowsiness Detection, Hill Decent Control, Rear Cross Traffic.

UNIT – V ADAS DISPLAY & IMPAIRED DRIVER TECHNOLOGY 9

Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, and Warning Technology – Driver Notification. Impaired Driver Technology -Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Recognize the rational for and evolution of automotive electronics
CO2: Know about the various automotive functions, sensors and
CO3: Familiar with the theory and operation of legacy, new, and emerging ADAS systems and proposed autonomous vehicle systems
CO4: Fundamentals of sensor data fusion as it relates to ADAS
CO5: Apply possible evolution of vehicle prognostics and impaired driver technology

TEXT BOOKS:

1. Tom Denton, “Automobile Electrical and Electronic systems, Roultedge”, Taylor & Francis Group, 5th Edition,2018.
2. William B Ribbens, “Understanding Automotive Electronic: An Engineering Perspective”, Elsevier Science,8th Edition,2017.

REFERENCES:

1. “Intelligent Transportation Systems and Connected and Automated Vehicles”, Transportation Research Board, 2016.
2. Radovan Miucic, “Connected Vehicles: Intelligent Transportation Systems”, Springer, 2019.

YouTube Resources:

1. https://www.youtube.com/watch?v=WTNX1KU0YTs
2. https://www.youtube.com/watch?v=v6Kq5dF3WgQ
3. https://www.youtube.com/watch?v=0o2GK_yPnIc
4. https://www.youtube.com/watch?v=J-Cv6-12NcU
5. https://www.youtube.com/watch?v=8cniOCz2t4E
6. https://www.youtube.com/watch?v=74OFl2SmyQA

7. https://www.youtube.com/watch?v=mkdHyCU5J48
8. https://www.youtube.com/watch?v=3Gk0pTdzZ9s
9. https://www.youtube.com/watch?v=qrrk8m4Pl7w

Course Code	BATTERY MANAGEMENT SYSTEM	L	T	P	C
MT4V47		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management.

COURSE DESCRIPTION

This course equips students with the necessary knowledge and skills to understand, analyze, and manage advanced battery systems, preparing them for roles in industries ranging from automotive to renewable energy.

PREREQUISITES

- Fundamental understanding of electrical circuits and systems.
- Basic knowledge of chemistry, especially in relation to battery chemistry.
- Familiarity with mathematical modeling and simulation techniques.
- Previous experience with battery testing equipment and methodologies will be added advantage.
- Basic understanding of communication protocols like CAN Open and Flex Ray.

UNIT – I ADVANCED BATTERIES **9**

Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics- SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT – II BATTERY PACK **9**

Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT – III BATTERY MODELLING **9**

Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks.

UNIT – IV BATTERY STATE ESTIMATION **9**

SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods- Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.

UNIT – V BMS ARCHITECTURE AND REAL TIME COMPONENTS **9**

Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray- CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, online resources and tutorials.

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Acquire knowledge of different Li-ion Batteries performance.
CO2. Design a Battery Pack and make related calculations.
CO3. Demonstrate a Battery Model or Simulation.
CO4. Estimate State-of-Charges in a Battery Pack.
CO5. Approach different BMS architectures during real world usage

TEXT BOOKS:

1. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles'', Wiley, 2015.
2. Davide Andrea ,"Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010

REFERENCES:

1. Developing Battery Management Systems with Simulink and Model-Based Designwhitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

YouTube Resources:

1. https://www.youtube.com/watch?v=pxP0Cu00sZs
2. https://www.youtube.com/watch?v=6p5CP6O1WyE
3. https://www.youtube.com/watch?v=5u7gJHbE2zg
4. https://www.youtube.com/watch?v=exS1kSm9qAs
5. https://www.youtube.com/watch?v=3Da-MbXpJdM
6. https://www.youtube.com/watch?v=oIrgWnhMk9I
7. https://www.youtube.com/watch?v=8zmFoX6Fr2Q
8. https://www.youtube.com/watch?v=ZY2AaM4Q8z8
9. https://www.youtube.com/watch?v=mvFJ9KehRmc

10. https://www.youtube.com/watch?v=6RQoH6ugW2M
11. https://www.youtube.com/watch?v=H6vPLWl1WV0

Course Code	UNMANNED AERIAL VEHICLE	L	T	P	C
MT4V48		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To expose students to concepts needed in modelling and analysing an unmanned system.
- To expose students to the design and development of UAV.
- To expose students to the type of payloads used in UAV.
- To study path planning.
- To understand the avionics hardware used in the UAV.

Course Description

Throughout the course, students will engage in discussions, case studies, and practical exercises to reinforce theoretical concepts and gain hands-on experience with UAV technology. The course aims to prepare students for roles in UAV development, operation, and management, as well as to address emerging challenges and opportunities in the field.

Prerequisites

- Fundamental concepts of aerodynamics, aircraft structures, and propulsion systems is essential for comprehending the principles underlying UAV design and operation.
- Proficiency in mathematics, including calculus, differential equations, and linear algebra, is necessary for analyzing aerodynamic performance, control systems, and sensor data.
- Familiarity with aviation regulations and standards, particularly those relevant to UAV operations in different regions such as the UK, USA, and Europe.
- Strong analytical and problem-solving skills are essential for troubleshooting and optimizing UAV systems during development and operation.

UNIT – I INTRODUCTION TO UAV **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications.

UNIT – II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK, USA and Europe Design for Stealth--control surfaces-specifications.

UNIT – III AVIONICS HARDWARE **9**

Autopilot–AGL-pressure sensors-servos-accelerometer–gyros-actuators-power supply processor, integration, installation, configuration, and testing.

UNIT – IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT – V THE DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Design UAV system.
CO2: Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3: Identify different hardware for UAV.
CO4: Perform system testing for unmanned aerial vehicles.
CO5: Design micro aerial vehicle systems by considering practical limitations.

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc, 1998.
2. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley, 2010.

REFERENCES:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001.
2. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

YouTube Resources:

1. https://www.youtube.com/watch?v=YI6E6hFq7vA
2. https://www.youtube.com/watch?v=YI6E6hFq7vA
3. https://www.youtube.com/watch?v=dywq0CF25gs
4. https://www.youtube.com/watch?v=DbryQbIxsko
5. https://www.youtube.com/watch?v=-6VSEeTibCw

Vertical 5: <Artificial Intelligence and Data Science>

Course Code	COGNITIVE COMPUTING	L	T	P	C
MT4V51		3	0	0	3

COURSE OBJECTIVES:

- To provide students with a thorough understanding of the principles, technologies, and architectures that underlie cognitive computing systems.
- To equip students with practical skills in cognitive computing technologies such as natural language processing, machine learning, and cognitive robotics
- To explore the design and implementation of user interfaces and interactions between humans and cognitive systems.
- To analyze and develop applications of cognitive computing in various domains such as healthcare, IoT, and autonomous systems.
- To foster an understanding of the ethical, social, and privacy issues related to cognitive computing and to promote responsible innovation in this field.

UNIT I INTRODUCTION TO COGNITIVE COMPUTING AND COGNITIVE ARCHITECTURES 9

Overview of Cognitive Computing, Definition and scope, Cognitive Architectures, Introduction to cognitive models, Key architectures: SOAR, ACT-R, Knowledge Representation and, Symbolic vs. Sub-symbolic representation, Ontologies and knowledge graphs,- Logical reasoning and inference engines.

UNIT II NATURAL LANGUAGE PROCESSING (NLP) AND COGNITIVE LEARNING 9

Fundamentals of Natural Language Processing, Basics of NLP, Tokenization, stemming, and lemmatization, Part-of-speech tagging and named entity recognition, Advanced NLP Techniques, Machine Translation, Sentiment Analysis, Text generation and summarization.

UNIT III COGNITIVE LEARNING ALGORITHMS 9

Overview of Machine Learning (supervised, unsupervised, reinforcement),- Deep Learning basics, Cognitive learning algorithms and their applications.

UNIT IV: COGNITIVE ROBOTICS 9

Human-Machine Interaction, Principles of Human-Computer Interaction, User interface design for cognitive systems, Speech recognition and synthesis, Cognitive Robotics, Autonomous robots and intelligent agents, Human-robot interaction and collaboration.

UNIT V CASE STUDIES 9

Real-world Applications in Robotics , Case studies in cognitive robotics, Robotics in healthcare, manufacturing, and service industries, Future trends in cognitive robotics, Emerging technologies in cognitive computing, Research challenges and opportunities.

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

CO1: Explain the foundational concepts and key technologies of cognitive computing.
CO2: Implement natural language processing techniques for tasks such as text analysis, machine translation, and sentiment analysis.
CO3: Design and develop cognitive applications using machine learning algorithms and cognitive computing frameworks.
CO4: Critically assess and design effective human-machine interfaces
CO5: Develop and evaluate cognitive robotics systems, understanding the principles of autonomous agents.

TEXT BOOKS

1. Cognitive Computing and Big Data Analytics" by Judith S. Hurwitz, Marcia Kaufman, and Adrian Bowles.
2. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
3. Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy

REFERENCES

1. Speech and Language Processing" by Daniel Jurafsky and James H. Martin
2. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
3. Human-Computer Interaction: An Empirical Research Perspective" by I. Scott MacKenzie
4.Cognitive Computing: Theory and Applications" edited by Vijay V.Raghavan and Venu Govindaraju
5. The Quest for Artificial Intelligence" by Nils J. Nilsson

YOUTUBE RESOURCES

Coursera

Coursera offers a variety of courses and specializations in cognitive computing and related fields. Here are some highly recommended courses and specializations that can provide valuable knowledge and skills in cognitive computing:

edX

edX offers a variety of courses and programs related to cognitive computing, artificial intelligence, and related fields. Here are some recommended courses and programs available on edX that can help you gain a comprehensive understanding of cognitive computing:

MIT OpenCourseWare

MIT OpenCourseWare (OCW) offers a wealth of courses that cover various aspects of cognitive computing, artificial intelligence, machine learning, and related fields. Here are some highly recommended MIT OCW courses that can help you gain a comprehensive understanding of cognitive computing:

Course Code	DEEP LEARNING	L	T	P	C
MT4V52		2	0	2	3

COURSE OBJECTIVES:

1. To understand the basic ideas and principles of neural networks and concepts of deep learning.
2. To study Convolutional Neural Networks with image processing facilities like TensorFlow and Keras.
3. To study Recurrent Neural Networks with speech processing models
4. To study Deep Reinforcement Learning and the use of real-time applications.
5. To understand and implement deep learning architectures.

UNIT I FUNDAMENTALS OF DEEP LEARNING **6**

Introduction to Neural Network – Feed Forward Neural Nets – Tensorflow - Deep Learning Fundamentals: Fundamental deep learning concepts, deep learning algorithms, and their types

UNIT II CONVOLUTIONAL NEURAL NETWORK **6**

Convolutional Neural Networks – Filters – Strides and Padding – The structure of a convolutional network – Improving the performance of CNNs - Multilevel Convolution – Computer Vision with Convolutional Networks – Advanced Computer Vision

UNIT III RECURRENT NEURAL NETWORK **6**

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks - Complete Autoencoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders – Language Modelling – Sequence to sequence learning – Speech Recognition

UNIT IV DEEP REINFORCEMENT LEARNING **6**

Reinforcement Learning Theory – Markov Decision process – Monte Carlo methods – Temporal Difference methods – Value functions – Q learning – Deep Q-learning – Policy gradient methods – Model-based methods -Actor-Critic Methods

UNIT V DEEP LEARNING IN AUTONOMOUS VEHICLES **6**

Autonomous Vehicles Introduction – Imitation driving policy – Driving policy with ChaufferNet – DL in Cloud

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

LIST OF EXPERIMENTS NUMBER OF PRACTICAL PERIODS: 30

1. Implement a feedforward neural network using TensorFlow to classify handwritten digits from the MNIST dataset.
2. Design a convolutional neural network with appropriate filters and padding to classify images from the CIFAR-10 dataset.
3. Compare the performance of different stride values in convolutional layers on a given image recognition task.
4. Explore the impact of multilevel convolutions on improving the accuracy of a CNN for object detection in computer vision.
5. Build a recurrent neural network model to generate text sequences and analyze its performance in language modeling.

6. Develop a bidirectional RNN architecture for sentiment analysis on movie reviews dataset and compare it with a unidirectional RNN.
7. Implement a deep reinforcement learning agent using Q-learning to solve a simple grid world problem.
8. Evaluate the performance of Deep Q-learning algorithm on the CartPole environment in OpenAI Gym.
9. Design an autonomous driving policy using imitation learning and assess its performance in a simulated environment.
10. Investigate the feasibility of deploying a deep learning model for autonomous driving on cloud infrastructure, considering latency and scalability aspects.

COURSE OUTCOMES:

On completion of this course, the students will be able to:
CO1 Understanding the basic concepts of deep learning.
CO2 Emphasizing knowledge of Convolutional Neural Networks and applying CNN to its variants for suitable applications.
CO3 Understanding Recurrent Neural Networks to apply autoencoders and generative models for suitable applications.
CO4 Understanding deep reinforcement learning
CO5 Analyzing the key computations underlying deep learning and using them to build and train deep neural networks for various tasks.

TEXTBOOKS:

1. Eugene Charniak, “Introduction to Deep Learning," MIT Press, 2018.
2. Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, “Python Deep Learning," Packt Publishing Ltd, 2019.

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “ Deep Learning," MIT Press, 2017.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach" O'Reilly Media, 2017.
3. Umberto Michelucci “Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" The MIT Press, 2012.
5. Ethem Alpaydin,"Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition 2014.
6. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore Neural Networks with Python" Packt Publisher, 2017.
7. Antonio Gulli, Sujit Pal, "Deep Learning with Keras" Packt Publishers, 2017.
8. Francois Chollet, "Deep Learning with Python," Manning Publications, 2017

Course Code	NATURAL LANGUAGE PROCESSING	L	T	P	C
MT4V53		2	0	2	3

COURSE OBJECTIVES:

1. To learn the mathematical foundations and basics of Natural Language Processing.
2. To understand the text data processing technologies for processing textdata.
3. To understand the role of Information Retrieval and Information Extraction in Text Analytics.
4. To acquire knowledge of text data analytics using language models.
5. To learn about NLP Tools and real-time examples of NLP.

UNIT I INTRODUCTION TO NATURAL LANGUAGE PROCESSING 6

Natural Language Processing – Linguistic Background – Mathematical Foundations – Morphological Analysis – Tokenization – Stemming – Lemmatization – Boundary Determination.

UNIT II TEXT DATA ANALYSIS 6

Reading unstructured data – Representing text data – Part of speech tagging – Syntactic representation – Text similarity – WordNet-based similarity – Shallow parsing – Semantic representation.

UNIT III INFORMATION RETRIEVAL AND EXTRACTION 6

Information Retrieval: Design features of Information Retrieval Systems-Classical, Nonclassical, Alternative Models of Information Retrieval – Information extraction – Named Entity Recognition – Relation Identification - Template filling.

UNIT IV LANGUAGE MODELLING 6

Language model – Probabilistic Models – n-gram language models- Hidden Markov Model- Topic Modelling - Graph Models -Feature Selection and classifiers -Rule-based Classifiers - Maximum entropy classifier – Clustering-Word and Phrase-based Clustering.

UNIT V NLP TOOLS AND APPLICATIONS 6

Tools: Natural Language Toolkit, Apache Open NLP. Applications of Text Analytics – Applications in social media - Life science - Legal Text – Visualization - Case studies.

Theory:30 Periods

LIST OF EXPERIMENTS

1. Implement tokenization and compare the effectiveness of stemming versus lemmatization in improving text preprocessing for sentiment analysis.
2. Develop a part-of-speech tagging system using NLTK and evaluate its accuracy on a corpus of news articles.
3. Explore various text similarity metrics, including WordNet-based similarity, for clustering news headlines into topics.
4. Build an information retrieval system using classical and nonclassical models and compare their performance on a dataset of scientific papers.
5. Implement a named entity recognition model using Apache OpenNLP and assess its accuracy on legal text documents.
6. Investigate different approaches for relation identification in biomedical texts and evaluate their precision and recall.

7. Construct a language model using n-gram models and compare its performance with a hidden Markov model on a corpus of tweets.
8. Apply topic modeling techniques to extract themes from a collection of customer reviews and visualize the results using t-SNE.
9. Develop a rule-based classifier to categorize legal documents into different types and measure its accuracy against a maximum entropy classifier.
10. Utilize word and phrase-based clustering algorithms to identify patterns in social media conversations and analyze their implications for marketing strategies.

COURSE OUTCOMES:

On completion of this course, the students will be able to:
CO1 Understand the mathematical foundations and basics of Natural Language Processing.
CO2 Process text data at the syntactic and semantic level.
CO3 Extract key information from text data.
CO4 Analyze text content to provide predictions related to a specific domain using language processing.
CO5 Design an innovative application using NLP components.

TEXTBOOKS:

1. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing," MIT Press, 1999;
2. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015.
3. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, 1st Edition, O'Reilly Media, 2009.

REFERENCES:

1. Matthew A. Russell, “Mining the Social Web," O'Reilly Media, 2013;
2. Daniel Jurafsky and James H. Martin “Speech and Language Processing," 3rd edition, Prentice Hall, 2009.
3. Nitin Indurkhya, Fred J. Damerau “Handbook of Natural Language Processing," Second Edition, CRC Press, 2010.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

Course Code	COMPUTER VISION AND IMAGE PROCESSING	L	T	P	C
MT4V54		2	0	2	3

COURSEOBJECTIVES:

1. Tounderstandthebasicsofimageprocessingtechniquesforcomputervision.
2. To learn the techniques used for image pre-processing.
3. To Discuss the Various Object Detection Techniques.
4. To understand the various Object recognition mechanisms.
5. To Elaborate on The Video Analytics Techniques.

UNIT I INTRODUCTION **6**

Computer Vision–Image Representation and Image Analysis Tasks-Image Representations–digitization–properties–color images–Data Structures for Image Analysis-Levels Of image data representation - Traditional and Hierarchical image data structures.

UNIT II IMAGEPRE-PROCESSING **6**

Local Pre-processing-Image Smoothing-Edge Detectors-Zero-crossings the second derivative-Scale in image processing- Canny Edge Detection -Parametric edge models - Edgesinmulti-speralctimages-Localpre-processinginthefrequencydomain-Line
Detection by local pre-processing operators-Image restoration.

UNIT III OBJECT DETECTION USING MACHINE LEARNING **6**

Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union (IoU)–Deep Learning
Architectures-R-CNN-Faster R-CNN-You Only Look Once (YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV FACE RECOGNITION AND GESTURE RECOGNITION **6**

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- Deep Face solution by Facebook-Face Net for Face Recognition-Implementation using Face Net-Gesture Recognition.

UNIT V VIDEO ANALYTICS **6**

VideoProcessing–usecasesofvideoanalytics-VanishingGradientandexplodinggradient problem-RestNetarchitecture-RestNetandskipconnections-InceptionNetwork-GoogleNetarchitecture-ImprovementinInceptionv2-Videoanalytics-RestNetandInceptionv3.

Theory:30 Periods

SAMPLE LIST OF EXPERIMENTS **NUMBER OF PRACTICAL PERIODS: 30**

1. Write program that computes the-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop Programs for The Following Geometric Transforms:(a) Rotation(b) Change of scale
4. Skewing(d)Affine Transform Calculated from Three Pairs of Corresponding Points(e) Bilinear transform calculated from four pairs of corresponding points.

a. Develop a program to implement Object Detection and Recognition

b. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
5. Develop a program for Facial Detection and Recognition
6. Write a program for event detection in video surveillance system

PRACTICAL: 30 PERIODS

COURSE OUTCOMES:

On completion Of This course, the students will be able to:
CO1 Understandthebasicsofimageprocessingtechniquesforcomputervisionand video analysis.
CO2 Explain the Techniques Used for Image Pre-processing.
CO3 Develop Various Object Detection Techniques.
CO4 Understand the Various Face Recognition Mechanisms.
CO5 Elaborate on deep learning-based video analytics.

TEXTBOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and MachineVision",4th edition, Thomson Learning,2013.
2. Vaibhav Verdhan, (2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, A press2021(UNIT-III,IVandV)

REFERENCES:

1.Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
2.Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer,2012.
3. D.A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", PearsonEducation,2003.
4. E.R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

Course Code	REINFORCEMENT LEARNING	L	T	P	C
MT4V55		2	0	2	3

COURSEOBJECTIVES:

1. Explore the historical development and interdisciplinary connections of Reinforcement Learning.
2. Gain a deep understanding of Markov Decision Processes (MDPs)
3. Focusing on iterative policy evaluation and iteration, and understanding the convergence properties.
4. Understand Monte Carlo methods for model-free prediction and control. application in reinforcement learning tasks.
5. Familiarize with function approximation methods and their applications in reinforcement learning.

UNIT I INTRODUCTION **6**

Introduction- Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning.

Probability Primer - Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.

UNIT II MARKOV DECISION PROCESS **6**

Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

UNIT III PREDICTION AND CONTROL BY DYNAMIC PROGRAMING **6**

Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions.

UNIT IV MONTE CARLO METHODS FOR MODEL FREE PREDICTION AND CONTROL **6**

Overview of Monte Carlo methods for model-free RL, First visit and every visit Monte Carlo, Monte Carlo control, On-policy and off-policy learning, Importance sampling. TD Methods

Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC, and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.

UNIT V FUNCTION APPROXIMATION METHODS **6**

Getting started with the function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, Eligibility trace for function approximation, Afterstates, Control with function approximation, Least squares, Experience replay in deep Q-Networks.

Policy Gradients - Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.

Theory: 30 Periods

LIST OF EXPERIMENTS

1. Simulation of a Markov Chain: Simulate a simple Markov chain to demonstrate its properties and transitions between states.
2. Bellman Equation Implementation: Implement the Bellman equation for a Markov reward process in a simple environment to understand its application in reinforcement learning.
3. Policy Evaluation with Dynamic Programming: Implement policy evaluation using iterative methods like policy iteration or value iteration for a simple Markov decision process.
4. Monte Carlo Prediction: Implement first-visit Monte Carlo prediction to estimate state values in a grid world environment without a model.
5. Q-Learning Implementation: Implement the Q-learning algorithm for solving a simple grid world problem, demonstrating the exploration-exploitation trade-off.
6. Function Approximation with Linear Regression: Implement linear regression as a function approximation method in reinforcement learning to approximate state-action values.
7. Actor-Critic Method Implementation: Implement an actor-critic algorithm to learn policies and value functions concurrently, demonstrating the advantage of bootstrapping.
8. Gradient Descent in Function Approximation: Implement gradient descent for updating parameters in a function approximation method like neural networks for Q-value estimation.
9. Experience Replay in Deep Q-Networks: Implement experience replay in a deep Q-network (DQN) to improve learning efficiency and stability.
10. Policy Gradient Method Implementation: Implement a policy gradient method like REINFORCE to learn a policy in a simple environment, analyzing bias and variance in the estimates.

Practicals:30 Periods

COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO1 Attain comprehensive understanding of RL's historical evolution and interdisciplinary connections, alongside fundamental Probability concepts.

CO2 Achieve deep comprehension of MDPs, emphasizing terminology, properties, and Bellman equations for optimal decision-making.

CO3 Master Dynamic Programming techniques for MDP prediction and control tasks, understanding convergence properties.

CO4 Gain thorough understanding of Monte Carlo methods for model-free RL, proficiently implementing First visit and every visit technique.

CO5 Familiarize with function approximation methods, gradient descent, eligibility traces, experience replay, policy gradient methods, and actor-critic architectures in RL applications.

TEXTBOOKS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", , 2nd Edition.
2. Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press.

REFERENCES:

1. Leon-Garcia, A. (2008). Probability, statistics, and random processes for electrical engineering. Prentice Hall.
2. Murphy, K. P. (2012). Machine learning: A probabilistic perspective. MIT Press.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

Course Code	BIG DATA ANALYTICS	L	T	P	C
MT4V56		2	0	2	3

COURSE OBJECTIVES:

1. To understand big data.
2. To learn and use NoSQL big data management.
3. To learn Map, reduce analytics using Had oop and related tools.
4. To work with map-reduce applications
5. To understand the usage of Hadoop-related tools for Big Data Analytics

UNIT I UNDERSTANDING BIG DATA **6**

Introduction to big data–convergence key trends–unstructured data–industry examples of big data–web analytics–big data applications–big data technologies–introduction to Hadoop – open-source technologies – cloud and big data – mobile business intelligence –Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II NOSQL DATA MANAGEMENT **6**

Introduction to No SQL –aggregate data models –key-value and document data models – relationships – graph databases – schemaless databases – materialized views –distribution models–master-slave replication – consistency -Cassandra– Cassandra's Data model– Cassandra Examples–Cass and raclients

UNIT III MAPREDUCE APPLICATIONS **6**

MapReduceworkflows–unittestswithMRUnit–testdataandlocaltests–anatomy of MapReducejobrun–classicMap-reduce–YARN–failuresinclassicMap-reduceandYARN– job scheduling –shuffle and sort –task execution –Map Reduce types– input formats– output formats.

UNIT IV BASICS OF HADOOP **6**

Data format–analyzing data with Hadoop–scaling out–Hadoop Streaming–Hadoop Pipes –design of Had oop distributed file system (HDFS)–HDFS concepts–Java interface–data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT V HADOOP RELATED TOOLS **6**

H base–data model and implementations –H base Client–H base Examples–praxis. Pig– Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive –data types and file formats–HiveQL data definition–Hive QL data manipulation–Hive QL queries.

THEORY:30 PERIODS

SAMPLE LIST OF EXPERIMENTS

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count MapReduceprogramtounderstandMapReduce Paradigm.
5.Installation of Hive along with practice examples.

7.Installation of HBase, Installing thrift along with Practice examples
8.Practice importing and exporting data from various databases.

COURSE OUTCOMES:

On completion Of This course, the students will be able to:
CO1 Describe big data and use cases from selected business domains.
CO2 Explain No SQL big data management.
CO3 Install, configure, and run Had oop and HDFS.
CO4 Perform map-reduce analytics using Had oop.
CO5 Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for bigdata analytics.

TEXTBOOKS:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer,"Had oop Operations”, O’Reilley,2012.
3. Sadalage, PramodJ. “NoSQLdistilled”,2013

REFERENCES:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide”, O’Reilley,2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide”, O’Reilley,2010.
4. Alan Gates, "Programming Pig”, O’Reilley,2011.

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

Course Code	ROBOTIC PROCESS AUTOMATION	L	T	P	C
MT4V57		3	0	0	3

COURSE OBJECTIVES

- To introduce to the process of Robotic process of Automation.
- To learn about RPA tools.
- To introduce to advanced automation concepts and techniques.
- To make students understand exception handling and assistant bots.
- To deploy and maintain a bot.

Pre-requisites: Basic Programming Concepts

UNIT-I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document - Industriesbest suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

UNIT-II RPA TOOL INTRODUCTION AND BASICS 9

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation - Introduction - Scalar variables, collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data

UNIT-III ADVANCED AUTOMATION CONCEPTS & TECHNIQUES 9

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel DataTables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel – Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

UNIT-IV HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING 9

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event andblocking it - Launching an assistant bot on a keyboard event.

EXCEPTION HANDLING:
Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

UNIT-V DEPLOYING AND MAINTAINING THE BOT 9

Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robotfrom the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages

COURSE OUTCOMES

At the end of the course, the student will be able to,
CO 1: Describe RPA, where it can be applied and how it's implemented.
CO 2: Describe the different types of variables, Control Flow and data manipulation techniques.
CO 3: Identify and understand Image, Text and Data Tables Automation.
CO 4: Describe how to handle the User Events and various types of Exceptions and strategies.
CO 5: Understand the Deployment of the Robot and to maintain the connection.

TOTAL 45 PERIODS

TEXT BOOKS:

1. Alok Mani Tripathi, "*Learning Robotic Process Automation*", Packt Publishing, 2018.

REFERENCES:

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, "Introduction to Robotic Process Automation:a Primer", Institute of Robotic Process Automation,1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, 1st Edition 2018.
3. Srikanth Merianda,"Robotic Process Automation Tools, Process Automation and their b enefits:Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots andautomate business processes", Packt Publishing, 1st Edition 2018.

YOUTUBE REFERENCES:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

Course Code	OPTIMIZATION TECHNIQUES	L	T	P	C
MT4V58		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to Linear Programming
- To make students to understand various methods of Linear Programming
- To make students practice single variable optimization problems
- To practice multivariable and constrained optimization techniques
- To introduce students to intelligent optimization techniques

Prerequisites: Calculus, Linear Algebra

UNIT-I INTRODUCTION TO OPTIMIZATION 9

Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

UNIT-II LINEAR PROGRAMMING PROBLEM 9

Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

UNIT-III SINGLE VARIABLE OPTIMIZATION PROBLEMS 9

Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

UNIT-IV MULTIVARIABLE AND CONSTRAINED OPTIMIZATION TECHNIQUES 9

Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

UNIT-V INTELLIGENT OPTIMIZATION TECHNIQUES 9

Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO),Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations usingGP.

COURSE OUTCOMES: At the end of this course, the student will be able to
CO1: Comprehend the techniques and applications of Engineering optimization.
CO2: Analyze characteristics of a general linear programming problem
CO3: Apply basic concepts of mathematics to formulate an optimization problem CO4:

Analyze various methods of solving the unconstrained minimization problem

CO5: Analyze and appreciate variety of performance measures for various optimization problems

TEXTBOOKS

1. S. S. Rao, Engineering Optimization: Theory and Practice, Wiley, 2008.

2. K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall, 2nd edition 2012.

REFERENCES

1. C.J. Ray, Optimum Design of Mechanical Elements, Wiley, 2007.

2. R. Saravanan, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.

3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

Vertical 6: <Management Courses>

Course Code	PRINCIPLES OF MANAGEMENT	L	T	P	C
MT4V61		3	0	0	3

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management — Science or Art — Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority –Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership — Communication — Process of communication — Barrier in communication — Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Controland performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10thEdition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management"Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

Course Code	TOTAL QUALITY MANAGEMENT	L	T	P	C
MT4V62		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

Prerequisites

- Understanding of basic business concepts and principles.
- Knowledge of quality control and assurance fundamentals.
- Familiarity with statistical analysis and data interpretation.
- Awareness of customer satisfaction metrics and feedback mechanisms.
- Experience with process improvement methodologies such as Lean Six Sigma is beneficial.

Course Description

This course introduces principles and practices of Total Quality Management (TQM) in organizations. Topics include quality philosophies, customer focus, continuous improvement, quality tools and techniques, leadership for quality, employee involvement, supplier relationships, and measurement systems. Students will learn strategies for implementing TQM principles to enhance organizational performance and competitiveness.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES **9**

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning-Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - new management tools - Six-sigma Process Capability-
Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, learning from the data, Using
the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages:
Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM –
Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.
CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply
QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, RevisedThird Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.

2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth –Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006

YouTube Resources:

1. ASQTV- https://www.youtube.com/user/ASQdotorg: The official YouTube channel of the American Society for Quality (ASQ) covers a wide range of quality management topics, including TQM.
2.Lean Strategies -https://www.youtube.com/channel/UCjMxmyKO_YfXyoCLV0P7TPQ: This channel focuses on Lean Six Sigma and TQM methodologies, providing practical insights and case studies.
3. Quality Gurus- https://www.youtube.com/channel/UCq9HwqXc1TYvkkH5tEtOhGQ: Quality Gurus offers videos on various quality management concepts, including TQM, explained in a clear and concise manner.
4.Edspira- https://www.youtube.com/channel/UCbEBs-tkLNOkLoQu_OkbQ5A: While not exclusively focused on TQM, Edspira covers business and management topics, including quality management principles that are relevant to TQM.
5. The Quality Coach- https://www.youtube.com/user/QualityCoach1: This channel provides insights into quality management practices, including TQM, with practical examples and tutorials.

Course Code	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
MT4V63		3	0	0	3

COURSE OBJECTIVES

- Understanding the concept of Engineering Economics.
- Implement various micro economics concept in real life.
- Gaining knowledge in the field of macro economics to enable the students to have better
- Understanding of various components of macro economics.
- Understanding the different procedures of pricing.
- Learn the various cost related concepts in micro economics.

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function — Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization - Least cost input - Isoquant- Managerial uses of production function.Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures -Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9

Investments - Risks and return evaluation of investment decision - Average rate of return- Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

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

CO1: Upon successful completion of this course, students will acquire the skills to apply thebasics of economics and cost analysis to engineering and take economically sound decisions
CO2: Evaluate the economic theories, cost concepts and pricing policies
CO3: Understand the market structures and integration concepts
CO4: Understand the measures of national income, the functions of banks and concepts ofglobalization
CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCES

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, NewYork, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

Course Code	HUMAN RESOURCE MANAGAEMENT	L	T	P	C
MT4V64		3	0	0	3

OBJECTIVE

- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources — Objective of Human Resource Management - Humanresource policies - Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 9

Compensation plan — Reward — Motivation — Career Development - Mentor — Protege relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation – Feedback - The control process – Importance – Methods – grievances –Causes – Redressal methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learnedin the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. John Bernardin. H., "Human Resource Management — An Experimental Approach", 5th Edition,Tata McGraw Hill, 2013, New Delhi.

REFERENCES

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

Course Code	KNOWLEDGE MANAGEMENT	L	T	P	C
MT4V65		3	0	0	3

COURSE OBJECTIVES: The student should be made to:

- Listen to experts on Knowledge Management
- Learn the Evolution of Knowledge management.
- Be familiar with tools.
- Be exposed to Applications.
- Be familiar with some case studies.

UNIT I INTRODUCTION **9**

Introduction: An Introduction to Knowledge Management - he foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING **9**

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists — Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS **9**

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION **9**

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES **9**

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

CO1: Understand the process of acquiring knowledge from experts.
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

TEXT BOOK

1. Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional"Information Today, Inc., 2000.

REFERENCE:

1. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How JapaneseCompanies Create the Dynamics of Innovation", Oxford University Press, 1995.

Course Code	INDUSTRIAL MANAGEMENT	L	T	P	C
MT4V66		3	0	0	3

COURSE OBJECTIVES

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision-making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative.

UNIT – II FUNCTIONS OF MANAGEMENT – I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility — Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT – II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) - Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management — Maslow's hierarchy of needs theory; Herzberg's motivation- hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve — Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions functionin professional organizations.

CO2 Discuss the planning; organizing and staffing functions of management in professional organization.
CO3 Apply the leading; controlling and decision making functions of management in professional organization.
CO4 Discuss the organizational theory in professional organization.
CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, NewDelhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.

APPENDIX B: OPEN ELECTIVES

OPEN ELECTIVES- I

S.No	Course code	Course Title
1	MT26O1	Product Design and Development
2	MT2602	Fundamentals of Aeronautical Engineering
3	MT2603	Introduction to Aerial Robotics
4	MT2604	Wearable Devices
5	MT2605	Medical Mechatronics
6	MT2606	Industrial Internet of Things
7	CY4101	Engineering Chemistry

OPEN ELECTIVES - II

S.No	Course code	Course Title
1	MT2701	Avionics
2	MT2702	Design of UAV Systems
3	MT2703	Machine Learning for Intelligent Systems
4	MT2704	Aircraft Mechatronics
5	MT2705	Agricultural Robotics and Automation
6	MT2706	Underwater Robotics

Open Elective – I:

Course Code	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
MT46O1		3	0	0	3

COURSE OBJECTIVES:

The following are the objectives of the course:

- To know about the process management and improvement of the product
- To acquire knowledge about the conceptualisation and selection of the product.
- To create the architecture of the product.
- To integrate the process design and assess the quality of the product.
- To develop the prototype of the product

UNIT I INTRODUCTION 9

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN 9

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Plan and establish product specifications.
CO2: Develop concept and select the process for the product
CO3: Create a detailed architecture for the product
CO4: Integrate and design the process for manufacturing the product
CO5: Develop the prototype of the product.

TEXT BOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal,"Effective Product Design and Development", Business OneOrwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

Course Code	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	L	T	P	C
MT46O2		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I History of Flight **9**

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II Aircraft Configurations and Its Controls **9**

Different types of flight vehicles, classifications-Components of an airplane and their functions Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III Basics of Aerodynamics **9**

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV Basics of Aircraft Structures **9**

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

UNIT V Basics of Propulsion **9**

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

- Illustrate the history of aircraft & developments over the year
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket.

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw Hill; 8th edition , 2015
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021

3. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCES

1. Sadhu Singh, “Internal Combustion Engines and Gas Turbine”-, SS Kataraia & Sons, 2015
2. Kermode, “Flight without Formulae”, -, Pitman; 4th revised edition 1989

Course Code	INTRODUCTION TO AERIAL ROBOTICS	L	T	P	C
MT4603		3	0	0	3

COURSE OBJECTIVES: The objective of this subject is to

1. Introduce to the concept of Aerial Robotics
2. Apply various rules for Aerial Robotics.
3. Understand the concept of flight control.
4. Understand motion planning of aerial robots.
5. Understand and apply knowledge to develop Aerial Robots.

UNIT I INTRODUCTION TO AERIAL ROBOTICS 9

History of Aerial Robotics, current challenges in Aerial Robotics, possible applications, basic flight concepts, Loop control.

UNIT II STATE ESTIMATION 9

Frame Rotations and Representations - Euler Angles , Euler to-and-from Quaternions, Python implementation and MATLAB Implementation, Dynamics of a Multirotor Micro Aerial Vehicle, Dynamics of a Fixed-Wing Unmanned Aerial Vehicle, Inertial Sensors, Accelerometers, Gyroscopes, The Kalman Filter – Python Implementation, Inertial Navigation Systems of aerial robots.

UNIT III FLIGHT CONTROLS 9

PID Control using MATLAB implementation, using Labview implementation and with embedded processors, LQR Control, Linear Model Predictive Control, An Autopilot Solution.

UNIT IV MOTION PLANNING 9

Holonomic Vehicle Boundary Value Solver, Dubins Airplane model Boundary Value Solver, Collision-free Navigation, Structural Inspection Path Planning.

UNIT V SIMULATION TOOLS AND CASE STUDY 9

Vehicle Dynamics Simulations with SimPy, Simulation of quadrotor aerial robot, The RotorS Integrated Simulation Solution -RotorS-ready Ubuntu VM, modeling and control of a multirotor Micro Aerial Vehicle (MAV).

TOTAL: 45 PERIODS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Understand the concept of Aerial Robotics
CO2: Apply various rules for Aerial Robotics.
CO3: Understand the concept of flight control.
CO4: Understand motion planning of aerial robots.
CO5: Understand and apply knowledge to develop Aerial Robots.

TEXT BOOKS

6. Aerial Robotics: With STM32F100RB Microcontroller, Sheikh Muhammad Ibraheem, 2021 edition , Kindle edition.
7. A First Course in Aerial Robots and Drones , Bestaoui Sebbane Yasmina, ISBN: 9780367631383, CRC Press, 2017.

REFERENCES

1. Aerial Robotic Manipulation: Research, Development and Applications , springer Tracts in Advanced Robotics Book 129) 1st ed. 2019 Edition, Kindle Edition, Anibal Ollero,Bruno Siciliano.
2. Aerial Robotics in Agriculture Parafoils, Blimps, Aerostats, and Kites, K. R. Krishna, Copyright 2021, 2023 by Apple Academic Press.

ONLINE RESOURCES

5. https://www.autonomousrobotslab.com/online-textbook.html.

Course Code	WEARABLE DEVICES	L	T	P	C
MT4604		3	0	0	3

COURSE OBJECTIVES:

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine
- Understand smart textile concept.
- Compare the wearable devices in healthcare systems.

UNIT I INTRODUCTION 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertiamovement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II WEARABLE SENSORS 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WEARABLE NETWORKS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture — Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE WEARABLES 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT V HEALTHCARE WEARABLES 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile.
CO5: Compare the various wearable devices in healthcare system.

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer,2011.
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013.
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals,Implementation and Applications, Elsevier, 2014.
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012.

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian,Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

Course Code	MEDICAL MECHATRONICS	L	T	P	C
MT4605		3	0	0	3

COURSE OBJECTIVES:

1. To understand how to measure biochemical parameters and various physiologicalinformation.
2. To study the need and technique of electrical safety in Hospitals.
3. To study the use of radiation for diagnostic and therapy.
4. To study about recorders and advanced equipment in medicine
5. Understand about various Bio Medical Diagnostics

UNIT I INTRODUCTION 9

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG – machine description – methods ofmeasurement – three equipment failures and trouble shooting

UNIT II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application.

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier, and differential amplifier — feedback, op-Amp-Electrometer amplifier, carrier Amplifier – instrument power supply. Oscillographic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems –Telemetry principles – Bio telemetry.

UNIT IV MEDICAL SUPPORT 9

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – Plethysmography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC– defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIT V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION 9

Introduction – computers in medicine – basis of signal conversion and digital filtering data Reduction technique – time and frequency domain technique – ECG Analysis.

TOTAL: 45 PERIODS

OUTCOMES: On successful completion of this course, the student will be able to

CO 1: Explain different measurement techniques used in physiological parametersmeasurement.
CO2: Describe the sensors and signal conditioning circuits used in biomedical engineering.
CO3: Understand about various amplifiers, recording and display devices.
CO4: Differentiate the working of recorders and explain the advanced systems used inmedicine

CO5: Understand about various Bio- medical diagnostics instrumentation.

TEXT BOOKS

1. Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2003
2. Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", 2ndEdition, Printice Hall of india , 2014.
3. Siamak Najarian" Mechatronics in Medicine – A Bio medical engg approach" , McGraw – Hill Education , 2011.

REFERENCE BOOKS

1. Geddes L.A., and Baker, L.E., "Principles of Applied Bio-medical Instrumentation", 3rd Edition, John Wiley and Sons, 2010
2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 2009.
3. Tompkins W.J., "Biomedical Digital Signal Processing", Prentice Hall of India, 1998

Course Code	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
MT4606		3	0	0	3

COURSE OBJECTIVES:

To give an introduction to various industrial revolutions
To introduce them to various sensors and actuators used in industries.
To acquaint them with cloud computing and data analysis for industries.
To give them insights on Product Lifecycle Management and AR and VR.
To teach them to apply the concepts of IIoT to various industries.

UNIT I INRODUCTION TO INDUSTRIAL REVOLUTION 5

The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.

UNIT II INDUSTRIAL SENSORS AND ACTUATORS 10

Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

UNIT III INDUSTRIAL DATA ANALYTICS 10

IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT IV BIG DATA ANALYTICS 10

Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

UNIT V CASE STUDIES 10

Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Milk Processing and packaging industries, Manufacturing industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Understand various industrial revolutions.
CO2: Work with various sensors and actuators used in industries for different applications
CO3: Use cloud computing and data analysis for industries.
C)4: Understand the process of Product Lifecycle Management and AR and VR.
CO5: Apply the concepts of IIoT to various industries.

TEXT BOOKS

1. Introduction to Industrial Internet of Things and Industry 4.0, Anandarup Misra, Sudip, Roy, Chandana Mukherjee , 2020,CRC Press.

2. The Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance, R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman, © 2022 Scrivener Publishing LLC.

REFERENCES:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress .

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
CY4101		3	0	2	4

COURSE OBJECTIVES

- To inculcate sound understanding of water quality and water treatment techniques.
- To impart knowledge on the preparatory methods of nanomaterial's. To introduce the properties and applications of composites
- To facilitate the understanding of fuel classification, preparation, combustion, and environmental
- impact.
- To be conversant with the principle electrochemistry, cell reactions, and corrosion protection techniques.
- To acquire a deep understanding of renewable energy sources along with energy storage technologie and innovation in sustainable energy systems.

UNIT I WATER AND ITS TREATMENT **9**

Water: Sources and impurities, Requisites of portable water- hardness (Calculation of hardness in terms of calcium carbonate equivalents) and alkalinity. - Municipal water treatment (screening, sedimentation, coagulation, filtration and disinfection - ozonolysis, UV treatment, chlorination), Desalination of brackish water: Reverse Osmosis.

Boiler troubles: Scale and sludge, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate, and calgon conditioning) and External treatment - Ion exchange demineralization and zeolite process.

UNIT II NANO MATERIALS & COMPOSITES **9**

Basics: Distinction between molecules, Nanomaterials, and bulk materials; Types of nanomaterials: Definition, properties, and uses of nanoparticles and nanotubes. Preparation of nano materials: laser ablation, and electro spinning. Application of nano materials in medicine, agriculture, energy, electronics, and catalysis.

Composites: Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. FRP-Hybrid composites- definition and examples. Basic concept of biomaterials.

UNIT III FUELS AND COMBUSTION **9**

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value (Dulong's Formula only); Flue gas analysis - ORSAT Method. CO_2 emission and carbon footprint.

UNIT IV ELECTRO CHEMISTRY AND CORROSION CONTROL **9**

Electrochemistry - Introduction, Electrochemical cell - electrolytic cell - reversible and irreversible cells. Electrode potential-Oxidation and reduction Potentials-emf, Nernst equation and applications. Reference electrodes-Calomel electrode-Electrochemical series and its applications.

Corrosion protection - cathodic protection - sacrificial anodic and impressed current protection methods; advanced protective coatings: electroplating and electroless plating.

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Solar energy conversion: Principle, working and applications of solar cells; recent developments in solar cell (DSSC) materials - Wind energy; Geothermal energy. Hydrogen as fuel: Sources of hydrogen - Hydrogen production methods - electrolysis, limitations and applications.

Storage Devices: Batteries - Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion battery; Electric vehicles-working principles; Fuel cells: H_2-O_2 fuel cell.

THEORY: 45 PERIODS

COURSE OUTCOMES.

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

- To infer the quality of water and propose suitable treatment methodologies for hard water.
- To identify and apply basic concepts of nanomaterial's preparation for engineering applications.
- To gain knowledge of fuel properties, manufacturing processes, combustion characteristics, and environmental considerations.
- To attain expertise in electrochemical principles, cell reactions and corrosion protection techniques.
- To attain proficiency in different forms of energy resources and fuel cell utilization, fostering the lead advancements in renewable energy and energy storage solutions.

List of Experiments (Any five Experiments)

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Estimation of chloride content in water by Argentometric method [Mohr's Method].
4. pH-metry determination strength of HCl by NaOH.
5. Determination of $BaCl_2$ by conductometric precipitation titration.
6. Conductometric titration of mixture of acids (HCl &CH_3COOH).
7. Estimation of iron content of the given solution by using potentiometer.

PRACTICAL: 30 PERIODS

TOTAL: 75 PERIODS

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", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3. K. Klabunde, G. Sergeev, Nanochemistry, 2nd Edition, Springer Publisher, 2013.
4. S.A. Sherif, D. Yogi Goswami, E.K. (Lee) Stefanakos, Aldo Steinfeld "Handbook of Hydrogen Energy", 1st Edition, CRC Press, 2014.

REFERENCE BOOKS:

1. Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2. Lefrou.,Christine., Fabry., Pierre., Poignet., Jean-claude., "Electrochemistry - The Basics, with examples" Springer. 2012.
3. Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier

Science, 2nd Edition, 2012.
4. Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
5. Kazunari Sasaki, Hai-Wen Li, Akari Hayashi, Junichiro Yamabe, Teppei Ogura, Stephen M. Lyth, Hydrogen Energy Engineering A Japanese Perspective, Springer, 2016

WEB REFERENCES:

1. https://www.who.int/
2. www.corrosionsource.com/
3. https://ocw.mit.edu/courses/chemistry
4. https://nptel.ac.in/courses/113108051
5. https://onlinecourses.nptel.ac.in/noc20_me29/preview
6. https://www.coursera.org/search?query=electrochemistry
7. https://www.udemy.com/course/renewable/
8. https://www.nationalgrid.com/stories/energy-explained/what - is- hydrogen.

Open Elective – II:

Course Code	AVIONICS	L	T	P	C
MT4701		3	0	0	3

COURSE OBJECTIVES:

CO1: To introduce the basic of avionics and its need for civil and military aircrafts.
CO2: To impart knowledge about the avionic architecture and various avionics data buses
CO3: To gain more knowledge on various avionics subsystems
CO4: To understand the concepts of navigation systems.
CO5: To gain knowledge on auto pilot system

UNIT I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT III DATA BUS FOR INTEGRATION 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Directvoice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV RADIO NAVIGATION 9

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial NavigationSystems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT V DESIGN OF AUTOPILOTS 9

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

45 PERIODS

COURSE OUTCOMES:

CO1: Built Digital avionics architecture.
CO2: Design Navigation system
CO3: Integrate avionics systems using data buses.
CO4: Analyze the performance of various cockpit display technologies.
CO5: Design autopilot for small aircrafts using MATLAB.

TEXT BOOKS

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.

REFERENCES

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman GroupUK Ltd., England, 1989.
2. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
4. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000

Course Code	DESIGN OF UAV SYSTEMS	L	T	P	C
MT47O2		3	0	0	3

COURSE OBJECTIVES:

- To expose students to concepts needed in modelling and analysing an unmanned system.
- To expose students to the design and development of UAV.
- To expose students to the type of payloads used in UAV.
- To study path planning of the UAV.
- To understand the avionics hardware used in the UAV

UNIT I INTRODUCTION **9**

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT II AERODYNAMICS OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations**-** Characteristics of Aircraft Types**-** Design Standards and Regulatory Aspects**-**UK,USA and Europe- Design for Stealth--control surfaces-specifications.

UNIT III SENSORS FOR UAV SYSTEMS **9**

Autopilot — AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply- processor, integration, installation, configuration, and testing.

UNIT IV UAV CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT V UAV NAVIGATION **9**

Waypoints navigation-ground control software- System Ground Testing**-** System In-flight Testing**-** Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

45 PERIODS

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Design UAV system
CO2: Prepare preliminary design requirements for an unmanned aerial vehicle.
CO3: Identify different hardware for UAV.
CO4: Perform system testing for unmanned aerial vehicles.
CO5: Design micro aerial vehicle systems by considering practical limitations.

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998.
2. Reg Austin “Unmanned Aircraft Systems UAV design, development and deployment”, Wiley,2010.

REFERENCES:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed MartinAeronautics Company, 2001.
2. Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road toAutonomy”, Springer, 2007.
3. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

Course Code	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
MTOE4703		3	0	0	3

COURSE OBJECTIVES:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearestneighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application.

UNIT IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics.

UNIT V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand basic machine learning techniques such as regression, classification.

CO2: Understand about clustering and segmentation

CO3: Model a fuzzy logic system with fuzzification and defuzzification
CO4: Understand the concepts of neural networks and neuro fuzzy networks.
CO5: Gain knowledge on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rdEdition, Addision Wesley, England, 2011.

REFERENCES:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer
2. Simon Haykin, "Neural Networks and Learning Machines: A ComprehensiveFoundation", Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.

Course Code	AIRCRAFT MECHATRONICS	L	T	P	C
MT4704		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data bases
- To gain more knowledge on various avionics subsystems
- To impart knowledge on aircraft materials.
- To analyse the application of Mechatronics in aircraft.

UNIT I AIRCRAFT AERODYNAMICS 9

Nomenclature used in Aerodynamics, different parts of airplane- Wing as lifting surface, Types of wing plan forms, Aerodynamic features like Aerofoil pressure distribution- Aerodynamic forces and moments Lift and Drag- Drag polar, L/D ratio, high lift devices, Airplane performancelike Thrust/Power available, climb and glide - maximum range and endurance, take off and landings.

UNIT II AIRCRAFT PROPULSION 9

Requirement of power- various means of producing power - Brief description of thermo dynamics of engines - Piston engines, Jet engines - Airplane Structure, Materials and Production - Structural arrangement of earlier airplane- developments leading to all metal aircraft - Strength to weight ratio choice of aircraft materials for different parts.

UNIT III AIRCRAFT MATERIALS 9

Detailed description of wing - tail and fuselage joints - Stress-Strain diagrams, Plane and Space, Mechanical properties of materials - Materials for different components - use of composites - Aircraft production methods and equipment.

UNIT IV PRIMARY FLIGHT CONTROLS 9

Ailerons - Aileron Control System of a Commercial Aircraft - Elevators - Elevator control system of a commercial aircraft – Rudders- Rudder Control System

UNIT V APPLICATIONS OF MECHATRONICS IN AVIATION 9

Aileron-Flaps and Actuator drive unit-Pilot Static system-Fly by wire control system-Yaw damper-Primary flight control system-Internal navigation system-Under carriage-Measurement of motor rpm-Measurement of air flow velocity-Altitude measurement sensor-Air speed.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO 1: Recognize the Basics in aerodynamics, aircraft propulsion, materials and controls

CO 2: Know about the various concepts used in aerodynamics

CO 3: Apply the techniques to develop the aero system
CO 4: Design the aircraft with the use of concepts in aerodynamics, aircraft propulsion,materials and controls
CO 5: Apply this aircraft system in various applications

TEXT BOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2 Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.

Course Code	AGRICULTURAL ROBOTICS AND AUTOMATION	L	T	P	C
MT47O5		3	0	0	3

COURSE OBJECTIVES:

1. To learn about Farming related Machines.
2. To understand the global position and information system in machines.
3. To know about traction and testing.
4. To familiarize the concept on weed management.
5. To learn about machinery selection.

UNIT I INTRODUCTION **9**

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

UNIT II PRECISION AGRICULTURE **9**

Sensors — types and agricultural applications, Global Positioning System (GPS) - GPS for civilian use, Differential GPS, Carrier-phase GPS, Real-time kinematic GPS, Military GPS, Geographic Information System, Variable Rate Applications and Controller Area Networks

UNIT III TRACTION AND TESTING **9**

Hitching- Principles of hitching, Types of hitches, Hitching and weight transfer, Control of hitches, Tires and Traction models, Traction predictor spread sheet, Soil Compaction, Traction Aids, Tractor Testing.

UNIT IV SOIL TILLAGE AND WEED MANAGEMENT **9**

Tillage Methods and Equipment, Mechanics of Tillage Tools, Performance of Tillage Implements, Hitching of Tillage Implements, Weed Management - Conventional Cropping Systems, Tools, Crop Rotation, Mechanical Cultivation

UNIT V MACHINERY SELECTION **9**

Screw Conveyors, Pneumatic Conveyors, Bucket Elevators, Forage Blowers andMiscellaneous Conveyors, Machinery Selection - Field Capacity and Efficiency, Draft and Power Requirements, Machinery Costs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO 1: Recognize the areas in agricultural process where robotics can be applied.
CO 2: Integrate sensor and system for a required specific process in agricultural applications.
CO 3: Apply Mechanics to the design various robot parameters
CO 4: Convert various mechanisms into robot by providing actuation at specific links and jointsof the mechanism.

CO 5: Develop suitable robotic system for specific agricultural tasks.

TEXT BOOKS

1. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster,"Engineering Principles of Agricultural Machines", ASABE Publication, 2012.
2. Myer Kutz, "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2019.

REFERENCES

1. Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices",CRC Press, 2016.
2. Stephen L Young, Francis J. Pierce, "Automation: The Future of Weed Control inCropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.
3. R.A. Kepner, Roy Bainer, E.L. Barger, "Principles of Farm Machinery", 3rd Edition,CBS Publishers, New Delhi, 2005.
4. Guangnan Chen, "Advances in Agricultural Machinery and Technologies", 1st Edition,CRC Press, 2021.

Course Code	UNDERWATER ROBOTICS	L	T	P	C
MT47O6		3	0	0	3

COURSE OBJECTIVES:

- To study the principle of locomotion and describe different types of mobile robots.
- To associate the degree of freedom to manoeuvrability of various robots.
- To understand the use of various sensors deployed in autonomous robots.
- To calculate motion path planning and its control for an autonomous robot.
- To understand and implement the robust feedback control methods.

UNIT I FUNDAMENTALS OF MOBILE ROBOT 9

Introduction to mobile robots - principle of locomotion - types of mobile robots: ground robot, aerial robot, underwater robot and water-surface robot - principles of underwater vehicle construction.

UNIT II KINEMATICS OF UNDERWATER VEHICLE 9

Equations for moving frame - rigid motion in a plane - representation of a rotated frame - holonomic and non-holonomic systems - kinematic modelling with respect to global coordinates.

UNIT III SENSORS FOR ROBOT NAVIGATION 9

Types of sensors - magnetic and optical position sensor - gyroscope - accelerometer - magnetic compass inclinometer - tactile and proximity sensor - ultrasound range finder - laser scanner, infrared range finder - visual and motion sensing systems.

UNIT IV MOTION PATH PLANNING, CONTROL AND STABILITY 9

Path planning algorithms - collision-free path planning - sensor-based obstacle avoidance - motion control methods: kinematic control, dynamic control, controllability and stability about a point and trajectory.

UNIT V ROBUST FEEDBACK CONTROL DESIGN 9

Based on kinematic model: input uncertain control model - robust control by the Lyapunov Redesign method - Based on dynamic model: robust backstepping: unmatched uncertainty - robust control: matched uncertainty - both matched and unmatched uncertainty

TOTAL: 45 PERIODS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: explain the principle of locomotion and describe different types of mobile robots.
CO2: associate the degree of freedom to manoeuvrability of various robots.
CO3: categorize the use of various sensors deployed in autonomous robots.
CO4: calculate motion path planning and its control for an autonomous robot.
CO5: explain the robust feedback control methods.

TEXT BOOKS

6. Sabiha Wadoo, Pushkin Kachroo, Autonomous Underwater Vehicles, 1st Edition, CRC Press, 2011.
7. Yu Junzhi, Visual Perception and Control of Underwater Robots, 1st Edition, CRC Press, 2018.

REFERENCES:

1. Wheeled Mobile Robots, IITM IIT Palakkad, NPTEL.
2. Nikolaus Correll, Introduction to Autonomous Robots, 1st edition, April 23, 2016.
3. Robotics and Control: Theory and Practice, IIT Roorkee, NPTEL.
4. Gerald Cook, Feitian Zhang, Mobile Robots: Navigation, Control and Sensing, Surface Robots and AUVs, 2nd Edition, Wiley Publication, 2020.

APPENDIX C: MANDATORY COURSES

Course Code	Course Title	Semester	L-T-P-C
MC4301	Introduction to Women and Gender Studies	III	2-0-0-0
MC4302	Elements of Literature	III	2-0-0-0
MC4303	Film Appreciation	III	2-0-0-0
MC4304	Disaster Management	III	2-0-0-0
MC4305	Design Thinking	III	2-0-0-0
MC4401	Well, Being with traditional practices (Yoga, Ayurveda and Siddha)	IV	2-0-0-0
MC4402	History of Science and Technology in India	IV	2-0-0-0
MC4403	Political and Economic Thought for a Humane Society	IV	2-0-0-0
MC4404	State, Nation Building and Politics in India	IV	2-0-0-0
MC4405	Industrial safety	IV	2-0-0-0
MC4406	Environmental Science and Sustainability	IV	2-0-0-0

MC4301	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY **9**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **9**

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE **9**

Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media.

Gender and Representation in Alternative Media. Gender and social media.

TOTAL: 45 PERIODS

MC4302	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

I COURSE CONTENTS

Introduction to Elements of Literature

1. Relevance of literature
   - ✓ Enhances Reading, thinking, discussing and writing skills.
   - ✓ Develops finer sensibility for better human relationship.
   - ✓ Increases understanding of the problem of humanity without bias.
   - ✓ Providing space to reconcile and get a cathartic effect.
2. Elements of fiction
   - ✓ Fiction, fact and literary truth.
   - ✓ Fictional modes and patterns.
   - ✓ Plot character and perspective.
3. Elements of poetry
   - ✓ Emotions and imaginations.
   - ✓ Figurative language.
   - ✓ (Simile, metaphor, conceit, symbol, pun and irony).
   - ✓ Personification and animation.
   - ✓ Rhetoric and trend.
4. Elements of drama
   - ✓ Drama as representational art.
   - ✓ Content mode and elements.
   - ✓ Theatrical performance.
   - ✓ Drama as narration, mediation and persuasion.

- ✓ Features of tragedy, comedy and satire.

II READINGS:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

3.1 Textbook:

Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

III OTHER SESSION:

4.1. *Tutorials:
4.2. *Laboratory:
4.3. *Project: The students will write a term paper to show their understanding of a particular piece of literature

IV *ASSESSMENT:

5.1. HA:
5.2. Quizzes-HA:
5.3. Periodical Examination: one
5.4. Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
5.5. Final Exam:

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

MC4303	FILM APPRECIATION	L	T	P	C
		3	0	0	0

OBJECTIVES:

- In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

Theme - A: The Component of Films

- ✓ A-1: The material and equipment
- ✓ A-2: The story, screenplay and script
- ✓ A-3: The actors, crew members, and the director
- ✓ A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

- ✓ B-1: Film language, form, movement etc.
- ✓ B-2: Early cinema… silent film (Particularly French)
- ✓ B-3: The emergence of feature films: Birth of a Nation
- ✓ B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

- ✓ C-1: Realist theory; Auteurists
- ✓ C-2: Psychoanalytic, Ideological, Feminists
- ✓ C-3: How to read films?
- ✓ C-4: Film Criticism / Appreciation

Theme – D: Development of Films

- ✓ D-1: Representative Soviet films
- ✓ D-2: Representative Japanese films
- ✓ D-3: Representative Italian films
- ✓ D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

- ✓ E-1: The early era
- ✓ E-2: The important films made by the directors
- ✓ E-3: The regional films
- ✓ E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

TOTAL: 45 PERIODS

MC4304	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
- To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

- To develop disaster response skills by adopting relevant tools and technology
- Enhance awareness of institutional processes for Disaster response in the country and
- Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3 Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
4 Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

Course Code	DESIGN THINKING	L	T	P	C
MC4305		2	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- Introduce students to the fundamental concepts and principles of design thinking.
- Develop students' ability to empathize with users and identify their needs.
- Equip students with skills for problem-solving and generating innovative solutions.
- Foster collaboration and interdisciplinary teamwork among students.
- Apply design thinking methodologies to real-world engineering challenges.

Course Description

This course offers an exploration of the principles and methodologies behind design thinking, emphasizing on a human-centered approach to innovation and problem-solving. Through a blend of lectures, hands-on exercises, and interactive workshops, participants learn to empathize with users, define problems, generate creative solutions, and iterate on prototypes.

UNIT I Introduction to Design Thinking 2

Definition and principles of design thinking – Importance and applications in engineering – Case studies of successful design thinking projects

UNIT II Empathize and Define 2

Understanding user needs and motivations – Techniques for empathetic research (interviews, observations, etc.) – Defining problem statements based on user insights

UNIT III Ideate and Prototype 2

Techniques for generating ideas (brainstorming, mind mapping, etc.) – Prototyping methods and tools – Iterative design process and feedback loops

UNIT IV Test and Iterate **2**

User testing and feedback collection – Analyzing and interpreting feedback – Iterating on prototypes based on feedback

UNIT V Application and Workshop **2**

Applying design thinking to engineering challenges – Workshop sessions for hands-on practice – Presentation (Posters / PPT / Demonstration) of final projects and reflection on the design process

Workshop Ideas:

1. Design Sprints: Conduct short, intensive workshops where students work collaboratively to solve a specific problem within a constrained timeframe.
2. Design Challenges: Pose open-ended design challenges to students and facilitate group work sessions where they brainstorm and prototype solutions.
3. User Persona Creation: Have students create user personas based on research findings and use them to guide the design process.
4. Prototyping Sessions: Provide materials and tools for students to create rapid prototypes of their ideas, encouraging experimentation and creativity.
5. Design Critiques: Organize sessions where students present their prototypes to peers for feedback and constructive criticism, fostering a culture of iteration and improvement.

Course Format

Lectures and discussions, Workshops, Group discussions and presentations,

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the principles and process of design thinking.
CO2: Identify user needs through empathetic research.
CO3: Generate creative ideas and solutions through brainstorming and prototyping.
CO4: Apply design thinking methodologies to solve engineering problems effectively.
CO5: Work collaboratively in multidisciplinary teams to address complex challenges.

TEXT BOOKS:

4. Tim Brown, "Change by Design", Revised and Updated, Harper, 2019.
5. Christian Müller-Roterberg, “Handbook of Design Thinking: Tips & Tools for How to Design Thinking”, Independently Published, 2018.
6. Jeanne Liedtka, and Tim Ogilvie, “Designing for Growth: A Design Thinking Tool Kit for Managers”, Columbia University Press, 2011.

REFERENCES:

2. Don Norman, “The Design of Everyday Things”, Basic Books, 2015.
3. Hasso Plattner, Christoph Meinel, and Larry Leife (editors), “Design Thinking: Understand – Improve – Apply”, Springer-Verlag, 2013.
4. Richard Banfield, C. Todd Lombardo and Trace Wax, “Design Sprint: A Practical Guidebook for Building Great Digital Products”, O'Reilly Media, 2015.

TOTAL: 10 PERIODS

MC4401	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA SIDDHA	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 6

Health: Definition - Importance of maintaining health - More importance on prevention than Treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 10

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 8

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH – AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) – Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 7

Emotional health - Definition and types - Three key elements: the subjective experience – the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 14

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA

2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts

2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/

2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. **Read more:** https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. **Benefits of healthy eating** https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html
6. Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditi
7. **BMI** https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle-whorecommendatIon
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
https://yogamedicine.com/guide-types-yoga-styles/
Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-inayurveda
9**. Siddha :** http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. **CAM :** https://www.hindawi.com/journals/ecam/2013/376327/
11. **Preventive herbs** : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

MC4402	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

UNIT I CONCEPTS AND PERSPECTIVES **9**

Meaning of History

Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA **9**

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S.Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA **9**

Technology in pre-historic period

Beginning of agriculture and its impact on technology

Science and Technology during Vedic and Later Vedic times

Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA **6**

Legacy of technology in Medieval India, Interactions with Arabs

Development in medical knowledge, interaction between Unani and Ayurveda and alchemy

Astronomy and Mathematics: interaction with Arabic Sciences

Science and Technology on the eve of British conquest

UNIT V GENDER AND REPRESENTATION **6**

Science and the Empire

Indian response to Western Science

Growth of techno-scientific institutions

UNIT VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA **6**

Science, Technology and Development discourse
Shaping of the Science and Technology Policy
Developments in the field of Science and Technology
Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL: 45 PERIODS

MC4403	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	L	T	P	C
		3	0	0	0

Pre-Requisite: None. (Desirable: Universal Human Values 1, Universal Human Values 2)

OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. **(9 lectures, 1 hour each)**
(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(5 lectures)**
(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. **(2 lectures)**

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.
(Refs: Marx, Lenin, Mao, M N Roy) **(5 lectures)**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. **(3 lectures)**

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. **(6 lectures)**
(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. **(3 lectures)**
(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. **(4 lectures)** (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)
Total lectures: 39
Preferred Textbooks: See Reference Books
Reference Books: Authors mentioned along with topics above. Detailed reading list will be provided.

GRADING:

Mid sems	30
End sem	20
Home Assign	10
Term paper	40

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

MC4404	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
		3	0	0	0

OBJECTIVES:

- The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

COURSE TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary - federal, Presidential-Parliamentary,

The idea of India.
1857 and the national awakening.
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy.

Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)
New social movements.
The changing nature of Indian Political System, the future scenario. What can we do?

TOTAL: 45 PERIODS

OUTCOMES:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

SUGGESTED READING:

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

MC4405	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects-Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998-Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety-Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

ONLINE RESOURCES:

1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html
2. Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf
3. Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

MC4406	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 9

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, students should be able to:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.