GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN
JODHPUR

SEMESTER SCHEME-2020-21

(SESSION 2021-2022 & ONWARDS)

TEACHING AND EXAMINATION SCHEME AND SYLLABUS

ELECTRONICS (ROBOTICS) ENGINEERING

(ER)

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Curriculum Development Cell
Board of Technical Education, Rajasthan
W-6 Residency Road,
Jodhpur

GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR

TEACHING AND EXAMINATION SCHEME

(SEMESTER SCHEME-2020-21)

FOR DIPLOMA **III SEMESTER ELECTRONICS (ROBOTICS) (ER)**

SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assign	PR(S)		
PC	**ER 3001	An Introduction to Robotics	4	0	0	4	60	3	–	–	20	20	–	100	4
PC	*ER 3002	Electronic Devices and Circuits	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	$ER 3003	Digital Electronics	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	**ER 3004	Sensors and Instrumentation	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	***ER 3005	Electric circuits and Network	2	1	0	3	60	3	–		20	20	–	100	3
PC	**ER 3006	An Introduction to Robotics Lab	0	0	2	2	–	–	40	–	–	–	60	100	1
PC	*ER 3007	Electronic Devices and Circuits Lab	0	0	2	2	–	–	40	–	–	–	60	100	1
PC	*ER 3008	Digital Electronics Lab	0	0	2	2	–	–	40	–	–	–	60	100	1
PC	**ER 3009	Sensors and Instrumentation Lab	0	0	2	2	–	–	40	–	–	–	60	100	1
SI	ER 3010	Summer Internship-I(4 weeks after II Sem)	–	–	–	–	–	–	100	–	–	–	–	100	2
VS	+ER 3333	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**15**	**1**	**12**	**28**	**300**		**260**		**100**	**100**	**340**	**1100**	**24**
							Grand Total :							**1100**	**24**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +ER 3333 is same in all branches of Engineering

2. *ER 3002, *ER3007 and *ER 3008 are same as EF/EL/RA 3002, EF/EL/RA 3007 and EF/EL/RA 3008

3. $ER 3003 is same as EF/EL/RA/MT 3003

4. **ER 3001, **ER 3004, **ER 3006 and **ER 3009 are same as RA3001,RA 3004,RA 3006 and RA 3009 respectively

5. ***ER 3005 is same as EF/EL 3005

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR

TEACHING AND EXAMINATION SCHEME

(SEMESTER SCHEME-2020-21)

FOR DIPLOMA **IV ELECTRONICS (ROBOTICS) (ER)**

SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs	PR	Hrs	CT	TU/Assi	PR(S)		
PC	***ER 4001	Microcontroller and Applications	3	0	0	3	60	3	–	-	20	20	–	100	3
PC	**ER 4002	Subsystems of Robots	3	0	0	3	60	3	–	-	20	20	–	100	3
PC	**ER 4003	Special Machines and Controllers	3	0	0	3	60	3	–	-	20	20	–	100	3
PE	ER 4004	**Programme Elective- I** ****ER40041**- Kinematics and Dynamics of Machines *****ER40042**- Simulation Software	3	0	0	3	60	3	–	-	20	20	–	100	3
PE	ER 4005	**Programme Elective II** *****ER40051**- Linear Integrated Circuits *__ER40052__- Power Electronics	3	0	0	3	60	3	–	-	20	20	–	100	3
PC	***ER 4006	Microcontroller and Applications Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	**ER 4007	Special Machines and Controllers Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	ER 4008	**Programme Elective- I Lab** ****ER40081**- Kinematics and Dynamics of Machines Lab *****ER40082**- Simulation Software Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	ER4009	**Programme Elective II Lab** *****ER40091**- Linear Integrated Circuits Lab *__ER40092__- Power Electronics Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PR	ER 4010	Minor Project	0	0	4	4	--	--	40	--	--	--	60	100	2
AU	+ER 4222	Essence of Indian Knowledge and Tradition	2	0	0	2		--	--	--	--	--	--	--	**0**
VS	+ER 4444	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**17**	**0**	**16**	**33**	**300**		**200**		**100**	**100**	**400**	**1100**	**23**
													Grand Total :	**1100**	**23**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +ER 4222 and +ER 4444 are same in all branches of Engg.

2. *ER40052 and *ER40092 are same as EF/EL/RA 40052and EF/EL/RA 40092 respectively

3 **ER4002 **ER4003 **ER4041, **ER4007 and **ER 4081 are same as RA 4002 , RA 4003 , RA 40041 RA 4007 and RA 40081 respectively

4. ***ER 4001, ***ER 40042, ***ER 40051, ***ER 4006, ***ER 40082 and ***ER 40091 are same as are same as EF/EL 4001, EF/EL 4042, EF/EL 4051, EF/EL 4006, EF/EL 40082 and EF/ER 40091 respectively

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning

Note:Students will go for 6 Weeks Summer Internship in the Summer Vacations after Fourth Semester. The assessment of the Summer Internship will be done in Fifth Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA **V SEMESTER ELECTRONICS (ROBOTICS) (ER)**
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
PC	***ER 5001	Embedded Systems	4	0	0	4	60	3	–	-	20	20	–	100	4
PC	ER 5002	Robot Kinematics and Robot Programming	3	0	0	3	60	3	–	-	20	20	–	100	3
OE	+ER 5100	**Open Elective-I** +**ER 51001**- Economic Policies in India +**ER 51002**- Engineering Economics & Accountancy	3	0	0	3	60	3	–	-	20	20	–	100	3
PE	ER 5003	**Programme Elective III** *ER50031- Industrial Automation *ER50032- Control System And PLC	3	0	0	3	60	3	–	-	20	20	–	100	3
PE	ER 5004	**Programme Elective IV** **ER50041- Object Oriented Programming & Data Structure (c++) **ER50042- Python Programming	3	0	0	3	60	3	–	-	20	20	–	100	3
PC	***ER 5005	Embedded Systems Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	ER 5006	Robot Kinematics and Robot Programming	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	ER 5007	**Programme Elective III Lab** *ER50071- Industrial AutomationLab *ER50072- Control System And PLC Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	ER 5008	**Programme Elective IV Lab** **ER50081- Object Oriented Programming & Data Structure (c++) Lab **ER50082- Python Programming Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
SI	ER 5009	Summer Internship-II(6 weeks after IV S Labem)	0	0	0	0	–	–	100	–	–	–	–	100	3
PR	ER 5010	Major Project	0	0	2	2	–	–	–	–	–	–	–	–	--
VS	+ER 5555	**Anandam (Joy of Giving)**	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	**0**	**0**	**3**	**3**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
		Total	**16**	**0**	**14**	**30**	**300**		**260**		**100**	**100**	**340**	**1100**	**25**
													Grand Total :	**1100**	**25**

1. L : Lecture
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5. PR : Marks for End Semester Exam for Practical
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7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +ER 51001, +ER 51002 and +ER5555 are same in all branches of Engineering
2. *ER 50031, *ER50032, *ER 50071, *ER 50072, and are same as EF/ EL/RA 50031, EF/ EL/RA 50032, , EF/ EL/RA 50071, and EF/ EL/RA 50072, respectively
3. **ER 50041, **ER 50042**ER 50081 and **ER 50082 are same as RA50041,RA50042,RA 50081 and RA 50082 respectively
4.***ER 5001 and ***ER 5005 are same as EF/EL 5001 and EF/EL 5005 respectively
Note:Major Project will be continued and Assesed in VI Semester

GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR

TEACHING AND EXAMINATION SCHEME

(SEMESTER SCHEME-2020-21)

FOR DIPLOMA **VI SEMESTER ELECTRONICS (ROBOTICS) (ER)**

SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs	PR	Hrs	CT	TU/Assi	PR(S)		
HS	+ER 6111	Entrepreneurship and Startups	3	1	0	4	60	3	–	-	20	20	–	100	4
OE	+ER 6200	**Open Elective-II** +**EL 62001**- Project Management +**EL 62002**- Renewable Energy Technologies	3	0	0	3	60	3	–	-	20	20	–	100	3
OE	+ER 6300	**Open Elective-III** +**EL 63001**- Product Design +**EL 63002**- Disaster Management	3	0	0	3	60	3	–	-	20	20	–	100	3
AU	+ER 6333	Indian Constitution	2	0	0	2	–	–	–	–	–	–	–	–	0
PC	*ER 6001	Modeling and Simulation using MATLAB	4	0	0	4	60	3	–	-	20	20	–	100	4
PC	*ER 6002	Modeling and Simulation using MATLAB Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PR	ER 6003	Major Project	0	0	6	6	--	--	40	--	--	--	60	100	4
SE	ER 6004	Seminar	1	0	0	1	–	–	–	–	–	–	100	100	1
VS	+ER 6666	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**16**	**1**	**12**	**29**	**240**		**80**		**80**	**80**	**320**	**800**	**22**
													Grand Total :	**800**	**22**

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7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1.+ ER 6111, +ER 62001, +ER 62002, +ER 63001, +ER 63002, +ER 6333 and +ER 6666 are same in all branches of Engineering

2. *ER 6001 and *ER 6002 are same as RA 6001 and RA 6002 respectively

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

III SEMESTER

(SESSION 2021-2022 & ONWARDS)

AN INTRODUCTION TO ROBOTICS

Course Code	ER-3001(Same as RA 3001)
Course Title	**AN INTRODUCTION TO ROBOTICS**
Number of Credits	4 (L-4,T-0, P-0)
Prerequisites	NIL
Course Category	PC

UNIT-1 INTRODUCTION:

1.1 What is Robotics Engineering ?
1.2 Brief History of Robotics
1.3 Working Definition of Robot
1.4 Basic Principles in Robotics
1.5 Advantages & Disadvantages of Robots
1.6 Robot Applications
1.7 Growth of the Industry
1.8 Social Issues & Safety

UNIT-2 ROBOTS COMPONENTS

2.1 Power source
2.2 Actuation
- 2.2.1 Electric motors
- 2.2.2 Linear actuators
- 2.2.3 Series elastic actuators
- 2.2.4 Air muscles
- 2.2.5 Muscle wire
- 2.2.6 Electroactive polymers
- 2.2.7 Piezo motors
- 2.2.8 Elastic nanotubes

2.3 Sensors in Robotics
- 2.3.1 Light Sensors i.e. Photo resistor, Photovoltaic cell
- 2.3.2 Sound Sensor
- 2.3.3 Proximity Sensor
  - a) Infrared (IR) transceiver
  - b) Ultrasound Sensor
  - c) Photo resistor
- 2.3.4 Tactile Sensors
  - a) Touch Sensor or Contact Sensor
  - b) Force Sensor
- 2.3.5 Temperature Sensor
- 2.3.6 Navigation and Positioning Sensors
- 2.3.7 Acceleration Sensor

2.4 Manipulation
- 2.4.1 Mechanical grippers
- 2.4.2 Suction end-effectors
- 2.4.3 General purpose effectors

2.5 Locomotion
- 2.5.1 Rolling robots
  - 2.5.1.1 Two-wheeled balancing robots
  - 2.5.1.2 One-wheeled balancing robots
  - 2.5.1.3 Spherical orb robots
  - 2.5.1.4 Six-wheeled robots
  - 2.5.1.5 Tracked robots
- 2.5.2 Walking applied to robots
  - 2.5.2.1 ZMP technique

2.5.2.2 Hopping
2.5.2.3 Dynamic balancing (controlled falling)
2.5.2.4 Passive dynamics
2.5.3 Other methods of locomotion
2.5.3.1 Flying
2.5.3.2 Snaking
2.5.3.3 Skating
2.5.3.4 Climbing
2.5.3.5 Swimming (Piscine)
2.5.3.6 Sailing
2.7 Human-robot interaction
2.7.1 Speech recognition
2.7.2 Robotic voice
2.7.3 Gestures
2.7.4 Facial expression
2.7.5 Artificial emotions
2.7.6 Personality
2.7.7 Social intelligence
2.8 Robot Control Methods
2.8.1 Lead-Through Programming
2.8.1 Teach Programming
2.8.1 Off-Line Programming
2.8.1 Autonomous
2.8.1 Teleoperation
2.8.1 Telerobotic
2.8.1 Lead-Through Programming
2.8.1 Lead-Through Programming

UNIT-3 TYPES OF ROBOTS

(Based on Drive Technologies, Work Envelope Geometries, Motion Control Methods)
3.1 Classification by Degrees of Freedom
3.2 Classification by Robot Motion
3.3 Classification by Platform
3.4 Classification by Power Source
3.5 Classification by Intelligence
3.6 Classification by Application Area

UNIT-4ROBOT SPECIFICATIONS (TECHNICAL ROBOTICS TERMS)

4.1 Number of Axes, Capacity & speed, Reach & Stroke, Tool Orientation
4.2 Repeatability, Precision and Accuracy, Operating Environment
4.3 Degrees of Freedom, Joints, Coordinates, Reference Frames, Programming Modes
4.4 Workspace, Characteristics

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. **ROBOTICS: FUNDAMENTAL CONCEPTS AND ANALYSIS , By AshitavaGhosal, Publisher-OUP India, 2006**
2. **Introduction to Robotics, By S K Saha,Publisher- Tata McGraw-Hill Education**
3. **Introduction To Robotics: Analysis,Control,Applications, 2nd EditionBy Saeed Benjamin Niku · 2011, Publisher:Wiley India Pvt. Limited**
4. **Fundamentals of Robotics Engineering, By Harry H. Poole, Publisher:Springer Science & Business Media, 2012**

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ELECTRONICS DEVICES AND CIRCUITS

Course Code	ER3002(Same as EF/EL/RA 3002)
Course Title	Electronic Devices And Circuits
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 – SEMICONDUCTOR AND DIODES

1.1 Definition, Extrinsic/Intrinsic, N-type & p-type
1.2 PN Junction Diode – Forward and Reverse Bias Characteristics
1.3 Zener Diode – Principle, characteristics, construction, working
1.4 Diode Rectifiers – Half Wave and Full Wave
1.5 Filters – C, LC and PI Filters

UNIT 2 – BIPOLAR JUNCTION TRANSISTOR (BJT)

2.1 NPN and PNP Transistor – Operation and characteristics
2.2 Common Base Configuration – characteristics and working
2.3 Common Emitter Configuration – characteristics and working
2.4 Common Collector Configuration – characteristics and working
2.5 High frequency model of BJT
2.6 Classification of amplifiers
2.7 negative feedback

UNIT 3 – FIELD EFFECT TRANSISTORS

3.1 FET – Working Principle, Classification
3.2 MOSFET Small Signal model
3.3 N-Channel/ P-Channel MOSFETs – characteristics
3.4 Enhancement and depletion mode
3.5 MOS- FET as a Switch
3.6 Common Source Amplifiers
3.7 Uni-Junction Transistor – equivalent circuit and operation

UNIT 4 – SCR DIAC & TRIAC

4.1 SCR – Construction, operation, working, characteristics
4.2 DIAC - Construction, operation, working, characteristics
4.3 TRIAC - Construction, operation, working
4.4 characteristics SCR and MOSFET as a Switch
4.5 DIAC as bidirectional switch
4.6 Comparison of SCR, DIAC, TRIAC, MOSFET

UNIT 5 – AMPLIFIERS AND OSCILLATORS

5.1 Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different parameters
5.2 Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt
5.3 Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Analog Circuits By AK MainiKhanna Publishing House Ed. 2018 (ISBN: 978-93-86173-584)
1. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
2. Electronics Devices and circuit theory Boyestad&Nashelsky Pearson Education India; 11 edition (2015) ISBN: 978-9332542600
3. Electronic Principles Albert Malvino& David Bates Tata McGraw Hill Publication 2010 ISBN: 978-0070634244
4. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition (2015)ISBN: 978-9339219543

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://www.electronics-tutorials.ws/
2. https://www.youtube.com/watch?v=Rx43l-QpeWQ
3. https://electronicsforu.com/resources/electronic-devices-and-circuit-theory

DIGITAL ELECTRONICS

Course Code	ER3003(Same as EF/EL/RA/MT 3003)
Course Title	Digital Electronics
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT 1 – NUMBER SYSTEMS & BOOLEAN ALGEBRA

1.1 Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal
1.2 Conversion from one number system to another.
1.3 Boolean variables – Rules and laws of Boolean algebra
1.4 De-Morgan's Theorem
1.5 Karnaugh Maps and their use for simplification of Boolean expressions

UNIT 2 – LOGIC GATES

2.1 Logic Gates – AND, OR, NOT, NAND, NOR, XOR, XNOR: Symbolic representation and truth table
2.2 Implementation of Boolean expressions and Logic Functions using gates
2.3 Simplification of expressions

UNIT 3 – COMBINATIONAL LOGIC CIRCUITS

3.1 Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders
3.2 Encoder, Decoder
3.3 Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications
3.4 Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX

UNIT 4 – SEQUENTIAL LOGIC CIRCUITS

4.1 Flip Flops – SR, JK, T, D, FF, JK-MS, Triggering
4.2 Counters – 4 bit Up – Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter
4.3 Registers – 4bit Shift Register: Serial in Serial Out, Serial in Parallel Out, Parallel in Serial Out, and Parallel inParallel Out

UNIT 5 – MEMORY DEVICES

5.1 Classification of Memories – RAM Organization, Address Lines and Memory Sixe,
5.2 Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM
5.3 Read only memory – ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash memory
5.4 Data Converters – Digital to Analog converters, Analog to Digital Converters

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Digital principles & Applications Albert Paul Malvino& Donald P. Leach McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2. Digital Electronics Roger L. TokheimMacmillian McGraw-Hill Education (ISE Editions); International 2 Revised edition ISBN: 978-0071167963
3. Digital Electronics – an introduction to theory and practice William H. Gothmann Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition ISBN: 978-8172247744
5. Digital Electronics R. AnandKhanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445

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SENSORS AND INSTRUMENTATION

Course Code	ER-3004 (Same as RA 3004)
Course Title	SENSORS AND INSTRUMENTATION
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE OUTCOMES:

Upon Completion of the course the students will be able to
CO1: Familiar with various calibration techniques and signal types for sensors.
CO2: Apply the various sensors in the Automotive and Robotics applications
CO3: Describe the working principle and characteristics of force, magnetic and heading sensors.
CO4: Understand the basic principles of various pressure and temperature, smart sensors.
CO5: Ability to implement the DAQ systems with different sensors for real time applications.

COURSE CONTENTS:

UNIT I INTRODUCTION

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

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive,
LVDT, RVDT , Synchro , Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages:
Magneto resistive , Hall Effect ,Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, 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 - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi
channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances,Manufacturing, Environmental monitoring.

REFRENCES/SUGGESTED LEARNING RESOURSES:

1.Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009
2.Sawney A K and PuneetSawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, DhanpatRai& Co, New Delhi, 2013.
3.C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley &Sons,Canada, 2001
4.Hans Kurt Tönshoff (Editor), Ichiro , “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
5.John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
6.Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
7.RichardZurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press,2015

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ELECTRIC CIRCUITS & NETWORK

Course Code	ER3005(Same as EF/EL 3005)
Course Title	Electric Circuits & Network
Number of Credits	3 (L-2,T-1, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT – 1 BASIC OF NETWORK AND NETWORK THEOREM

1.1 Node and Mesh
1.2 Analysis Superposition Theorem
1.3 Thevenin Theorem
1.4 Norton Theorem
1.5 Maximum Power transfer theorem
1.6 Reciprocity Theorem

UNIT– 2 GRAPH THEORY

2.1 Graph of network, tree, and incidence matrix
2.2 F- Tie Set Analysis
2.3 F-Cut Set Analysis
2.4 Analysis of resistive network using cut-set and tie-set Duality

UNIT– 3 TIME DOMAIN AND FREQUENCY DOMAIN ANALYSIS

3.1 Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-Ccircuits
3.2 Initial and Final conditions in network elements
3.3 Forced and Free response, time constants Steady State and Transient State Response
3.4 Analysis of electrical circuits using Laplace Transform for standard inputs (unit, Ramp, Step)

UNIT– 4 TRIGONOMETRIC AND EXPONENTIAL FOURIER SERIES

4.1 Discrete spectra and symmetry of waveform
4.2 Steady state response of a network to non-sinusoidal periodic inputs
4.3 power factor, effective values
4.4 Fourier transform and continuous spectra

UNIT- 5 TWO PORT NETWORK

5.1 Two Port Network
5.2 Open Circuit Impedance Parameters
5.3 Short Circuit Admittance Parameters
5.4 Transmission Parameters
5.5 Hybrid Parameters
5.6 Interrelationship of Two Port Network
5.7 Inter Connection of Two Port Network

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Networks and Systems Ashfaq Husain Khanna Publishing House
2. Network Analysis M. E. Van Valkenburg Prentice Hall of India
3. Engineering Circuit Analysis W. H. Hayt, J. E. Kemmerly and S. M. Durbin McGraw Hill
4. Electrical Circuits Joseph EdministerSchaum's Outline, Tata McGraw Hill
5. Basic Circuit Theory Lawrence P. Huelsma Prentice Hall of India
6. Network & Systems D. Roy Choudhury Wiley Eastern Ltd
7. Linear Circuit Analysis De Carlo and Lin Oxford Press

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AN INTRODUCTION TO ROBOTICS LAB

Course Code	ER-3006 (Same as RA 3006)
Course Title	AN INTRODUCTION TO ROBOTICS LAB
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

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PRACTICALS:

1. Study of Robo-Analyzer(a 3D model based software) user manual.(http://www.roboanalyzer.com)
2. Study of different types of robots based on configuration and application.
3. Study of robotic actuators.
4. Study of different sensing element used in robots.
5. Study of robotic manipulator.
6. Study of robotic locomotion technique used in robots.
7. Study of different Human-robot interactions.
8. Study of robot specifications.
9. Study of different type of links and joints used in robots.
10. Study the basic terminology and notation used in robot geometry and kinematics. (robots with planar geometry)

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ELECTRONIC DEVICES AND CIRCUITS LAB

Course Code	ER3007(Same as EF/EL/RA 3007)
Course Title	Electronic Devices and Circuits Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICAL OUTCOMES (PROs)

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

PRACTICALS:

1. Construct the circuit and plot the VI characteristics of the PN Junction Diode ,find the cut in voltage
2. Construct the circuit and plot the characteristics of a Zener Diode. Find thebreakdown voltage
3. Construct a Half Wave Rectifier and obtain regulation characteristics –WithoutFilters and with Filters Compare the results
4. Construct a Full Wave Rectifier and obtain regulation characteristics –WithoutFilters and with Filters Compare theresults
5. Construct a Bridge Rectifier and obtain regulation characteristics – Without Filters and with Filters
6. Obtain the characteristics of DIAC and TRIAC
7. Simulate half wave, full wave and bridge rectifier using simulation tool likePSpice/ Orcad/ Multisim.
8. Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers
9. Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers andObtain output plots. Compare the results with the simulation model.
10. Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers
11. Develop circuits for Current Series and Current Shunt Feedback Amplifiers andObtain output plots. Compare the results with the simulation model

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Analog Circuits By AK MainiKhanna Publishing House Ed. 2018 (ISBN: 978-93-86173-584)
2. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
3. Electronics Devices and circuit theory Boyestad&Nashelsky Pearson Education India; 11 edition (2015)ISBN: 978-9332542600
4. Electronic Principles Albert Malvino& David Bates Tata McGraw Hill Publication 2010 ISBN: 978-0070634244
5. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition (2015)ISBN: 978-9339219543

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DIGITAL ELECTRONICS LAB

Course Code	ER 3008(Same as EF/EL/RA 3008)
Course Title	Digital Electronics Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICAL OUTCOMES (PROs)

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

PRACTICALS:

1. To verify the truth tables for all logic fates – NOT OR AND NAND NORXOR XNOR using CMOS Logic gates and TTL Logic Gates
2. Implement and realize Boolean Expressions with Logic Gates
3. Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using ICs
4. Implement parallel and serial full-adder using ICs
5. Design and development of Multiplexer and De-multiplexer using multiplexer ICs
6. Verification of the function of SR,D, JK and T Flip Flops
7. Design controlled shift registers
8. Construct a Single digit Decade Counter (0-9) with 7 segment display
9. To design a programmable Up-Down Counter with a 7 segment display
10. Study of different memory ICs
11. Study Digital- to – Analog and Analog to Digital Converters
12. Simulate in Software (such as PSpice) an Analog to Digital Converter
13. Simulate in Software (such as PSpice) an Analog to Digital Converter

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Digital principles & Applications Albert Paul Malvino& Donald P. Leach McGraw Hill Education; Eighth edition ISBN: 978-9339203405
2. Digital Electronics Roger L. TokheimMacmillian McGraw-Hill Education (ISE Editions); International 2 Revised edition ISBN: 978-0071167963
3. Digital Electronics – an introduction to theory and practice William H. Gothmann Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485
4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition ISBN: 978-8172247744
5. Digital Electronics R. AnandKhanna Publications, New Delhi (Edition 2018) ISBN: 978-93-82609445

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SENSORS AND INSTRUMENTATION LAB

Course Code	ER-3009(Same as RA 3009)
Course Title	**SENSORS AND INSTRUMENTATION LAB**
Number of Credits	2 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS OUTCOMES (PROs):

The practical in this section are PrOs (i.e. sub-components of the Cos) to be developed and assessed in the student for the attainment of the competency.

PRACTICALS:

1. Measurement of displacement using following transducers :
    - 1.1 Potentiometer
    - 1.2 L.V.D.T.
    - 1.3 Capacitive
2. To draw the resistance temperature characteristics of
    - 2.1 RTD
    - 2.2 Thermistor
3. To draw the temperature characteristics of Thermocouple
4. Measurement of flow by differential pressure flow meter
5. Measurement of flow by magnetic flow meter
6. Study of various pressure elements
7. Measurement of stress / pressure / weight by strain gauge.
8. Velocity and speed measurement by suitable transducer
9. To draw the input/ output characteristics of P V Cell
10. To draw the input/ output characteristics of Photo diode
11. To draw the input/ output characteristics of Photo conductive (LDR)
12. Measurement of light intensity by lux meter.

REFRENCES/SUGGESTED LEARNING RESOURSES:

1.Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009
2.Sawney A K and PuneetSawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, DhanpatRai& Co, New Delhi, 2013.
3.C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley &Sons,Canada, 2001
4.Hans Kurt Tönshoff (Editor), Ichiro , “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
5.John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
6.Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
7.RichardZurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press,2015

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

IV SEMESTER

(SESSION 2021-2022 & ONWARDS)

MICROCONTROLLER AND APPLICATIONS

Course Code	ER 4001(Same as EF/EL 4001)
Course Title	Microcontroller and Applications
Number of Credits	3(L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT I INTRODUCTION

1.1 Introduction to Microprocessors and Microcontrollers
1.2 Architectures [8085,8086]
1.3 Intel MCS- 51 family features
1.4 8051 -organization and architecture

UNIT II PROGRAMMING WITH 8051

2.1 8051 instruction set
2.2 addressing modes
2.3 conditional instructions
2.4 I/O Programming
2.5 Arithmetic logic instructions
2.6 single bit instructions
2.7 interrupt handling
2.8 programming counters, timers and Stack

UNIT III

3.1 MCS51 and external Interfaces
3.2 User interface – keyboard, LCD, LED
3.3 Real world interface -ADC, DAC
3.4 SENSORS Communication interface

UNIT IV C PROGRAMMING WITH 8051

4.1 I/O Programming
4.2 Timers/counters
4.3 Serial Communication
4.4 Interrupt
4.5 User Interfaces- LCD, Keypad, LED and communication interfaces [RS232]

UNIT V ARM PROCESSOR CORE BASED MICROCONTROLLERS

5.1 Need for RISC Processor-ARM processor fundamentals
5.2 ARM core based controller [LPC214X]
5.3 IO ports, ADC/DAC, Timers

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely PHI Pearson Education, 5th Indian reprint
2. Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of India, New Delhi
3. Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051Soumitra Kumar Mandal McGraw Hill Edu,
4. Microcontrollers: Architecture implementation and Programming Tabak Daniel, Hintz Kenneth j Tata McGraw Hill, 2007
5. ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4 Andrew N.Sloss,Dominic Symes, Chris Wright User manual – Rev.4
6. Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill, 2editon, 2000
7. "Microcontroller – Fundamentals and Applications with Pic Valder – Perez Yeesdee Publishers, Tayler& Francis

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SUBSYSTEMS OF ROBOTS

Course Code	ER-4002(Same as RA 4002)
Course Title	**SUBSYSTEMS OF ROBOTS**
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	BASIC KNOWLEDGE OF ROBOTICS
Course Category	PC

UNIT-1ACTUATING SYSTEMS:

1.1 Characteristics of Actuating Systems
- 1.1.1 Nominal Characteristics- Weight, Power to Weight Ratio, Operating Pressure, Voltage
- 1.1.2 Stiffness versus Compliance
- 1.1.3 Use of Reduction Gears

1.2 Comparison of Actuating Systems
1.3 Parameters for Selection of Actuators

UNIT-2 HYDRAULIC ACTUATORS & PNEUMATIC DEVICES

2.1 Cylinders- Types & Construction, Applications
2.2 Hydraulic Cushioning, Hydraulic Motors
2.3 Compressor – Filters, Regulator, Lubricator, Muffler
2.4 Air Control Valves, Quick Exhaust Valves

UNIT-3 GRIPPERS

5.1 Different Methods of Gripping
5.2 Mechanical Grippers-Slider Crank Mechanism, Screw Type, Cam Type Grippers
5.3 Magnetic Grippers, Vacuum Grippers, Air Operated Grippers.

UNIT-4 ROBOTIC VISION SYSTEMS

4.1 Human Vision Considerations
4.2 Machine Vision Approaches
4.3 Image Acquisition and Image Analysis
4.4 Applications and Available Systems
4.5 Ranging Techniques

UNIT-5 ROBOTIC CONTROL SYSTEMS

5.1 Linear Control
- 5.1.1 Control Techniques
- 5.1.2 Dynamic Systems
- 5.1.3 Transfer Function and State Space Representation

5.2 Nonlinear and Force Control
- 5.2.1 Control of a Moving Block
- 5.2.2 Force Control

UNIT-4 MOBILE ROBOTS

4.1 Approaches to Mobility
4.2 Design Considerations
4.3 Locomotion
4.4 Steering
4.5 Power and Stability
4.6 Intelligence
4.7 Error Considerations
4.8 Current Applications

UNIT-6 ROBOT STANDARDS

3.1 RIA Standards Program
3.2 Testing Standards

3.3 Device Communication Standards
3.4 Network Standards
3.5 Other Standards Activity
3.6 Japan Industrial Robot Safety Standards

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. **ROBOTICS: FUNDAMENTAL CONCEPTS AND ANALYSIS , By AshitavaGhosal, Publisher-OUP India, 2006**
2. **Introduction to Robotics, By S K Saha,Publisher- Tata McGraw-Hill Education**
3. **Introduction To Robotics: Analysis,Control,Applications, 2nd EditionBy Saeed Benjamin Niku · 2011, Publisher:Wiley India Pvt. Limited**
4. **Fundamentals of Robotics Engineering, By Harry H. Poole, Publisher:Springer Science & Business Media, 2012**

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SPECIAL MACHINES AND CONTROLLERS

Course Code	ER-4003 (Same as RA 4003)
Course Title	**SPECIAL MACHINES AND CONTROLLERS**
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES :
To know about stepper motors.
To know about switched reluctance motors
To know about permanent magnet brushless d.c. Motors
To know about permanent magnet synchronous motors
To know about linear motors

COURSE OUTCOMES
Understanding principles of operation, types and applications of stepper motors
Understanding principles of operation, types and applications of switched reluctance motors
Knowledge in evaluating the performance of dc motors
To evaluate knowledge in permanent magnet synchronous motors.
Ability to understand the working and applications linear motors and servo motors.

COURSE CONTENTS

UNIT 1 STEPPER MOTORS
1.1 Types
1.2 Constructional features and Principle of operation
1.3 Variable reluctance motor -single and Multi stack configurations
1.4 Permanent Magnet Stepper motor
1.5 Hybrid stepper motor
1.6 Different modes of Excitation
1.7 Theory of torque predictions
1.8 Drive systems and circuit for open loop and closed loop control of stepper motor.

UNIT 2 SWITCHED RELUCTANCE MOTORS
2.1 Constructional features and principle of operation
2.2 Torque Equation - Power Converters for SR Motor
2.3 Rotor Sensing Mechanism & Logic Controller
2.4 Sensorless Control of SR motor
2.5 Applications.

UNIT3 PERMANENT MAGNET BRUSHLESS D.C. MOTORS
3.1 Principle of operation
3.2 Types
3.3 Magnetic circuit analysis – EMF and torque equations
3.4 Power controllers
3.5 Motor characteristics and control
3.6 Applications.

UNIT 4 PERMANENT MAGNET SYNCHRONOUS MOTORS
4.1 Principle of operation
4.2 EMF, power input and torque expressions
4.3 Phasor diagram, Power Controllers,
4.4 Torque speed characteristics
4.5 Self control, Vector control, Current control Schemes
4.6 Applications.

UNIT 5 LINEAR MOTORS
5.1 Linear Induction motor (LIM)
5.2 Classification , construction , Principle of operation
5.3 Concept of current sheet , goodness factor
5.4 DC Linear motor (DCLM) types , circuit equation , DCLM control applications

5.5 Linear Synchronous motor(LSM) , Types,Applications
5.6 Servomotor Types , Constructional features, Principle of operation
5.7 Control applications of servo motors

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India,2009.
2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press,Oxford, 1989
3. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
4. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press,Oxford, 1989 .
5. Naser A and BoldeaL,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
6. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.
7. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC,2001

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KINEMATICS AND DYNAMICS OF MACHINCES

Course Code	ER-40041(Same as RA 40041)
Course Title	**KINEMATICS AND DYNAMICS OF MACHINCES**
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES

- To understand the basic knowledge about kinematics of machines.
- To understand the basic components and layout of linkages in the assembly of a system/machine.
- To understand the principles in analyzing the assembly with respect to the displacement,velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkagemechanisms and cam mechanisms for specified output motions.
- 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.

COURSE OUTCOMES

Upon completion of this course,

- The students will be able to understand the basic knowledge of kinematics of machines
- Students will able to apply fundamentals of mechanism for the design of new mechanisms
- Able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Ability to analyse them for optimum design

COURSE CONTENTS

UNIT 1 KINEMATIC OF MACHINES

1.1 Mechanisms
1.2 Terminology and definitions
1.3 Kinematics inversions of 4 bar and slide crank chain
1.4 Kinematics analysis in simple mechanisms
  1.4.1Velocity and acceleration polygons
  1.4.2Analytical methods
  1.4.3Computer approach
1.5 Cams
  1.5.1 Classifications
  1.5.2 Displacement diagrams
  1.5.3 Layout of plate cam profiles
  1.5.4 Derivatives of followers motion
  1.5.5 Circular arc and tangent cams.

UNIT 2 GEARS AND GEAR TRAINS

2.1 Spur gear
2.2 Law of toothed gearing
2.3 Involute gearing
2.4 Interchangeable gears
2.5 Gear tooth action
  2.5.1interference and undercutting
  2.5.2 Nonstandard teeth
2.6 Gear trains
  2.6.1 Parallel axis gears trains
  2.6.2 Epicyclic gear trains
  2.6.3 Automotive transmission gear trains.

UNIT 3 FRICTION

3.1 Sliding and Rolling Friction angle
3.2 friction in threads
3.3Friction Drives
3.3.1Belt and rope drives .

UNIT 4 FORCE ANALYSIS

4.1 Applied and Constrained Forces
4.2 Free body diagrams
4.3 static Equilibrium conditions
4.3.1Two, Three and four members
4.4 Static Force analysis in simple machine members
4.5 Dynamic Force Analysis
4.6 Inertia Forces and Inertia Torque
4.7 D"Alembert"s principle
4.8 Superposition principle
4.9 Dynamic Force Analysis in simple machine members.

UNIT 5 BALANCING AND VIBRATION

5.1 Static and Dynamic balancing
5.2 Balancing of revolving and reciprocating masses
5.3 Balancing machines
5.4 Free vibrations
5.5 Equations of motion
5.5.1 Natural Frequency
5.5.2 Damped Vibration
5.6 Bending critical speed of simple shaft .

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", OxfordUniversity Press, 2003
3. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
4.Ghosh. A, and A.K. Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi,1988.
5. Rao.J.S. andDukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.
6. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low Prices Student Edition,1999.
7. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
8. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

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SIMULATION SOFTWARE

Course Code	ER 40042(Same as EF/EL 40042)
Course Title	Simulation Software
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PE

Course Contents:

UNIT I

1.1 Introduction to PSpice software
1.2 General purpose circuit simulation using Schematic Editor,
1.3 Introduction to netlist command based SPICE simulation,
1.4 Basic netlist commands. Basic circuit analyses: DC, AC Transient

UNIT II

2.1 Introduction to PCB Design software Schematic Entry, Netlist Creation, Working with component libraries,
2.2 Design of Boards, Layout of Parts, Optimizing Parts Placements, Pads and Via, Manual and Auto Routing,
2.3 Handling Multiple Layers

UNIT III

3.1 Introduction to SCILAB,
3.2 use SCILAB functions.
3.3 Writing simple programs using SCILAB, handling arrays, files, plotting of functions etc.
3.4 Writing SCI files for Creation of analog& discrete signals, plotting of signals etc.
3.5 Simulation of electronic circuits using SCILAB

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. NGspice, LTSpice, MULTISIM, Orcad, Proteus or other open source PCB design tools, SCILAB
2. Website: http://www.scilab.org/ (To download SCILAB open source software)
3. http://www.linear.com/,
4. http://www.expresspcb.com/
5. http://ngspice.sourceforge.net/

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LINEAR INTEGRATED CIRCUITS

Course Code	ER 40051(Same as EF/EL 40051)
Course Title	Linear Integrated Circuits
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT I - IC FABRICATION AND CIRCUIT CONFIGURATION FOR LINEAR IC

1.1 Advantages of ICs over discrete components –
1.2 Manufacturing process of monolithic Ics
1.3 Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors Monolithic Capacitors, Inductors. Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS

2.1 Sign Changer
2.2 Scale Changer
2.3 Phase Shift Circuits
2.4 Voltage Follower,
2.5 V-to-I and I-to-V converters
2.6 Adder, subtractor
2.7 Instrumentation amplifier
2.8 Integrator, Differentiator
2.9 Logarithmic amplifier, Antilogarithmic amplifier
2.10 Comparators, Schmitt trigger
2.11 Precision rectifier, peak detector
2.12 Clipper and clamper
2.13 Low-pass, high-pass and band-pass Butterworth filters

UNIT III ANALOG MULTIPLIER AND PLL

3.1 Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique,
3.2 analog multiplier ICs and their applications,
3.3 Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator,
3.4 Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

4.1 Analog and Digital Data Conversions,
4.2 D/A converter – specifications –
4.3 weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R2R Ladder types switches for D/A converters, high speed sample-and-hold circuits
4.4 A/D Converters specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type – A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS

5.1 Sine-wave generators, Multi-vibrators and Triangular wave generator, Saw-tooth wave generator,
5.2 ICL8038 function generator,
5.3 Timer IC 555,
5.4 IC Voltage regulators – Three terminals fixed and adjust- able voltage regulators - IC 723 general purpose regulator Monolithic switching regulator,
5.5 Switched capacitor filter IC MF10,
5.6 Frequency to Voltage and Voltage to Frequency converters,
5.7 Audio Power amplifier, Video Amplifier, Isolation Amplifier,
5.8 Opto-couplers and fibre optic IC.

REFERENCES /SUGGESTED LEARNING RESOURCES

1. Design with operational amplifiers and analog integrated circuits, 3rd Edition Sergio Franco Tata McGraw-Hill, 2007
2. Linear Integrated Circuits, D.RoyChoudhry, Shail Jain New Age International Pvt. Ltd
3. System design using Integrated Circuits B.S.Sonde New Age Pub, 2nd Edition, 2001
4. Analysis and Design of Ana- log Integrated Circuits Gray and Meyer Wiley International, 2005.
5. OP-AMP and Linear IcsRamakantA.Gayakwad Prentice Hall / Pearson Education, 4th Edition, 2001
6. Operational Amplifier and Linear Integrated Circuits K Lal Kishore Pearson Education, 2006

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POWER ELECTRONICS

Course Code	ER 40052(Same as EF/EL/RA 40052)
Course Title	POWER ELECTRONICS
Number of Credits	3 (L-3T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT I POWER SEMI CONDUCTOR DEVICES AND CONTROLLED RECTIFIER

1.1 Classification of Thyristor family
1.2 Working, of SCR, IGBT, GTO, DIAC and TRIAC

UNIT II SCR PROTECTION AND COMMUTATING CIRCUITS

2.1 Need of SCR protections: Over voltage and over current protection
2.2 Snubber circuit, freewheeling diode, Thermistor, heat sink
2.3 Turn off (commutation) method and types-Natural commutation, Forced commutation, Series resonance/ current commutation, Voltage commutation

UNIT III CHOPPERS

3.1 Function and working of choppers
3.2 Types of chopper circuits: A type to E-type
3.3 Jone's chopper circuit

UNIT IV INVERTERS AND CYCLOCONVERTER

4.1 Working principle of inverter
4.2 Classification of inverter-
- 1-Phase and 3-phase inverters
- Line commutated and forced commutated inverters
- Series, Parallel and bridge inverter

4.3 Operating principle of cyclo converter.
4.4 Types of cyclo-converters:
Single phase to single phase cyclo converter
Single phase to bridge cyclo converter

UNIT V OTHER INDUSTRIAL APPLICATIONS OF POWER ELECTRONIC DEVICES

5.1 Speed control of D.C. Motor using armature voltage control.
5.2 Speed control of D.C. Motor using SCR chopper circuit.
5.3 Speed control of D.C. drive using PLL method.

REFERENCES /SUGGESTED LEARNING RESOURCES

1. Power Electronics Rashid, Muhammad H. PHI Learning, and New Delhi latest edition
2. Power Electronics Gupta, B. R., Singhal V. S.K. Kataria and sons, New Delhi

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MICROCONTROLLER AND APPLICATIONS LAB

Course Code	ER 4006(Same as EL/EF 4006)
Course Title	Microcontroller and Applications Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS:

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051microcontroller.
2. Programming with Arithmetic logic instructions [Assembly]
3. Program using constructs (Sorting an array) [Assembly]
4. Programming using Ports [Assembly and C]
5. Delay generation using Timer [Assembly and C]
6. Programming Interrupts [Assembly and C]
7. Implementation of standard UART communication (using hyper terminal) [Assembly and C].
8. Interfacing LCD Display. [Assembly and C]
9. Interfacing with Keypad [Assembly and C]
10. Programming ADC/DAC [Assembly and C]
11. Interfacing with stepper motor. [Assembly and C]
12. Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASM and C using simulator.
13. Programming with Arithmetic logic instructions [Assembly]
14. GPIO programming in ARM microcontroller. [C Programming].
15. Timers programming in ARM Microcontroller. [C Programming].

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely PHI Pearson Education, 5th Indian reprint
2. Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of India, New Delhi
3. Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051Soumitra Kumar Mandal McGraw Hill Edu,
4. Microcontrollers: Architecture implementation and Programming Tabak Daniel, Hintz Kenneth j Tata McGraw Hill, 2007
5. ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4 Andrew N.Sloss,Dominic Symes, Chris Wright User manual – Rev.4
6. Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill, 2editon, 2000
7. "Microcontroller – Fundamentals and Applications with Pic Valder – Perez Yeesdee Publishers, Tayler& Francis

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SPECIAL MACHINES AND CONTROLLERS LAB

Course Code	ER-4007 (Same as RA 4007)
Course Title	**SPECIAL MACHINES AND CONTROLLERS LAB**
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVE

- To impart hands on experience in verification of circuit laws and theorems
- To measure the circuit parameters, study of circuit characteristics and simulation of time response.
- To expose the students to the basic operation of electrical machines and help them to develop experimental skills.

COURSE OUTCOME

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

1. Differentiate between various motors.
2. Obtain the equivalent circuit parameters of dc motor, induction motor and stepper motor.
3. Test a dc and induction motor to estimate its efficiency at different load condition.
4. Select ac and dc motors and drives for industrial application

PRACTICALS:

1. Draw the torque speed characterstic of permanent magnet brushless D.C Motor
2. Perform an experiment for circuit equation of D.C.LinearMotor control.
3. Perform an experiment for EMF and Torque equation for permanent magnet synchronous motor
4. Draw load characterstics of D.C.LinearMotor,Linear Induction Motor.
5. Starting of synchronous motor and plotting V-curves.
6. Determination of transfer function of AC servomotor and study of synchros.
7. To fully characterize a small permanent magnet stepper motor
8. To drive stepper motor with full half and micro steps
9. Perform an experiment for EMF and Torque equation for permanent magnet stepper motor
10. Determination of transfer function of DC servomotor
11. Speed control of Switched Reluctance Motor.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India,2009.
2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press,Oxford, 1989
3. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
4. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press,Oxford, 1989 .
5. Naser A and BoldeaL,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
6. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.
7. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC,2001

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KINEMATICS AND DYNAMICS OF MACHINCES LAB

Course Code	ER-40081(Same as RA 40081)
Course Title	**KINEMATICS AND DYNAMICS OF MACHINCES LAB**
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

COURSE OBJECTIVES

To supplement the principles learnt in kinematics and Dynamics of Machinery.
To understand how certain measuring devices are used for dynamic testing.

COURSE OUTCOMES

Ability to demonstrate the principles of kinematics and dynamics of machinery
Ability to use the measuring devices for dynamic testing.

PRACTICALS:

1. Study of gear parameters.
2. Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
3. Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
4. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
8. Vibration of Equivalent Spring mass system – undamped and damped vibration.
9. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
10. Balancing of rotating masses.
11. Balancing of reciprocating masses.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", OxfordUniversity Press, 2003
3. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
4.Ghosh. A, and A.K. Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi,1988.
5. Rao.J.S. andDukkipatti R.V, "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.
6. John Hannah and Stephens R.C, "Mechanics of Machines", Viva Low Prices Student Edition,1999.
7. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
8. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

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SIMULATION SOFTWARE LAB

Course Code	ER 40082(Same as EF/EL 40082)
Course Title	Simulation Software Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PE

Course Outcomes: After successful completion of the course students should be able to:

1. Design the electronics circuits using software tools like NGspice/LTSpice/Multisim.
2. Simulate various analog and digital circuits using NGspice/LTSpice/Multisim
3. Able to design PCB for given circuit using PCB Software like EAGLE, ExpressPCB, and OrCAD.
4. Use open source SCILAB tool and write simple programs
5. Plot various waveforms using SCILAB.
6. Simulate basic electronic system blocks using SCILAB

PRACTICALS:-

1. Simulation of one rectifier circuit and one clipper/clamper circuit.
2. Simulation of any one transistor biasing circuit.
3. Simulation of CE single/double stage amplifier circuit.
4. Simulation of any one power amplifier circuit.
5. Simulation of any one JFET/MOSFET amplifier circuit.
6. Simulation of any one negative feedback circuit.
7. Simulation of encoder/multiplexer circuit.
8. Simulation of decoder/de multiplexer circuit.
9. Simulation of any one flip-flop circuit using gates.
10. Simulation of any one register/counter circuit.
11. Design of PCB for any one circuit from experiment 1 to 6.
12. Design of PCB for any one circuit from experiment 7 to 10.
13. Plot the sine, cosine, triangle and exponential waveform using SCILAB.
14. Plot sampled sine, cosine, triangle and exponential waveform using SCILAB.
15. Study of Simulink. (Only source and sink available in Simulink library).

REFERENCES /SUGGESTED LEARNING RESOURCES:

NGspice, LTSpice,MULTISIM, Orcad, Proteus or other open source PCB design tools, SCILAB
Website: http://www.scilab.org/ (To download SCILAB open source software)
http://www.linear.com/,
http://www.expresspcb.com/
http://ngspice.sourceforge.net/

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LINEAR INTEGRATED CIRCUITS LAB

Course Code	ER 40091(Same as EF/EL 40091)
Course Title	Linear Integrated Circuits Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PE

PRACTICAL OUTCOMES (PROs)

PRACTICALS:

1. Operational Amplifiers (IC741)-Characteristics and Application.
2. Waveform Generation using Op-Amp (IC741).
3. Applications of Timer IC555.
4. Design of Active filters.
5. Study and application of PLL IC's
6. Design of binary adder and subtractor.
7. Design of counters.
8. Study of multiplexer and Demultiplexer /decoders.
9. Implementation of combinational logic circuits.
10. Study of DAC and ADC
11. Op-Amp voltage Regulator- IC 723

REFERENCES /SUGGESTED LEARNING RESOURCES

1. Design with operational amplifiers and analog integrated circuits, 3rd Edition Sergio Franco Tata McGraw-Hill, 2007
2. Linear Integrated Circuits, D.RoyChoudhry, Shail Jain New Age International Pvt. Ltd
3. System design using Integrated Circuits B.S.Sonde New Age Pub, 2nd Edition, 2001
4. Analysis and Design of Ana- log Integrated Circuits Gray and Meyer Wiley International, 2005.
5. OP-AMP and Linear IcsRamakantA.Gayakwad Prentice Hall / Pearson Education, 4th Edition, 2001
6. Operational Amplifier and Linear Integrated Circuits K Lal Kishore Pearson Education, 2006

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POWER ELECTRONICS LAB

Course Code	ER 40092(Same as EF/EL/RA 40092)
Course Title	Power Electronics Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PE

PRACTICAL OUTCOMES (PROs)

PRACTICALS:

1. Test the performance of IGBT
2. Test the performance of GTO
3. Test the performance of TRIAC for AC load control
4. Troubleshoot Snubber circuits
5. Troubleshoot SCR commutating circuits.
6. Simulate chopper circuit, observe and print the various wave forms.
7. Test the Speed control of DC motor using chopper circuits
8. Test the Speed control of motor using PLL method.

REFERENCES /SUGGESTED LEARNING RESOURCES

1. Power Electronics Rashid, Muhammad H. PHI Learning, and New Delhi latest edition
2. Power Electronics Gupta, B. R., Singhal V. S.K. Kataria and sons, New Delhi

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ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	ER 4222(Common in all branches of Engg.)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0(L-2,T-0, P-0)
Prerequisites	None
Course Category	AU

COURSE CONTENTS:

Basic Structure of Indian Knowledge System:

(i)वेद,

(ii)उनवेद (आयुवेद,धनुवेद,गन्धवेद,स्थानत्यआदद)

(iii)वेदथाथांग (शिक्था, कलन, ननरुत, व्थाकरण, ज्योनतषछथांद),

(iv)उनथाइग (धर्मशथास्न, र्ीथर्थांसथा, नुरथाण, तकशरथास्न)

- •Modern Science and Indian Knowledge System
- •Yoga and Holistic Health care
- •Case Studies.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. V. Sivarama Krishna, " Cultural Heritage of India- Course Material", BhartiyaVidyaBhavan, Mumbai, fifth Edition, 2014.
2. Swami Jitatmanand, " Modern Physics and Vedant", BhartiyaVidyaBhavan.
3. Fritz of Capra, " The wave of Life".
4. Fritz of Capra, " Tao of Physics".
5. V N Jha, " Tarkasangraha of Annam Bhatta, International" Cinmay Foundation, Velliarnad, Amakuam.
6. R N Jha, " Science of Consciousness Psychotheraphy and Yoga Practices" VidyanidhiPrakasham, Delhi, 2016.

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

V SEMESTER

(SESSION 2021-2022 & ONWARDS)

EMBEDDED SYSTEMS

Course Code	ER 5001(Same as EF/EL5001)
Course Title	Embedded Systems
Number of Credits	4 (L-4,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE CONTENTS:

UNIT I –

1.1 Embedded C basics operators for Arduino
1.2 Familiarizing with the Arduino IDE
1.3 Sketch designing for Arduino Communication interfaces using serial port
1.4 Basic understanding of the code with Boolean operations, pointer access operations, bitwise operations, compounded operations.

UNIT II –

2.1 Embedded C control structure blocks
2.2 looping mechanism – for, do and while
2.3 The branching operations based on conditions expression

UNIT III

3.1 Introduction to Arduino Mega
3.2 Arduino Mega specifications including power ratings, digital and analog peripherals.
3.3 Difference between the C language and Embedded C language
3.4 Arduino Mega Ports, Pins, Digital and Analog Peripherals

UNIT IV

4.1 Communication with Arduino
4.2 Different communication modules available with their real-life application Communication interface

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Arduino Projects For Dummies (For Dummies Series) Kennedy George; Davis Bernard; Prasanna SRM Wiley (5 July 2013) ISBN: 978-1118551479

2. Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh Shroff/Maker Media; Third edition (27 December 2014)ISBN : 978-9351109075

SUGGESTED SOFTWARE/LEARNING WEBSITES:

https://www.arduino.cc/reference/en/
https://learn.adafruit.com/category/learn-arduino

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ROBOT KINEMATICS AND ROBOT PROGRAMMING

Course Code	ER-5002
Course Title	ROBOT KINEMATICS AND ROBOT PROGRAMMING
Number of Credits	3(L-3, T-0, P-0)
Prerequisites	BASIC KNOWLEDGE OF ROBOTICS AND PROGRAMMMING
Course Category	PC

UNIT-1 DIRECT AND INVERSE KINEMATICS

1.1 Introduction
1.2 Mathematical representation of Robots
1.2.1 Position and orientation
1.2.2 Homogeneous transformation
1.3 Various joints: Rotary, Screw, Cylindrical
1.4 Representation of Links using the Denavit-Hartenberg parameters
1.5 Degrees of freedom
1.6 Direct kinematics-Inverse kinematics of Robots
1.7 SCARA robots
1.8 PUMA Robots

UNIT-2 PATH PLANNING(basic knowledge)

2.1 Definition
2.2 Joint space technique
2.3 Use of p-degree polynomial
2.4 Cubic polynomial
2.5 Cartesianspace technique
2.6 Parametric descriptions
2.7 Straight line and circular paths
2.8 Position and orientation planning.

UNIT-3 Robot TeachingMethods

3.1 Online Methods
3.1.1 Manual teaching (point to point task)
- Control handle / Joystick
- Push buttons
- Teach-pendant

3.1.2 Lead-through Teaching (continuous path task)
- Robot simulator

3.2 Off-line Methods
(Programming language)

UNIT-4PROGRAMMING LANGUAGES FOR ROBOTICS AND ROBOT PROGRAMMING(HARRY H POOLE)

4.1 Early Languages
4.2 Current Languages
4.3 Language Approaches and Limitations
4.4 Language Command Review (robot language structure – basic commands)
4.5 Robot Programming Methods
4.6Simple Program Example

UNIT-5 NEW TRENDS, TECHNOLOGY AND APPLICATION AREAS (HARRY H POOLE)

5.1 Technological Trends and Predictions
5.2 Natural Language Processing
5.3 Walking Vehicles (Legged Locomotion)
5.4 Future Robotics Applications

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. MikkelP.Groover, Mite chellweiss, RogernNegal and NicholesG.Odress, Industrial Robotics Technology- Programming and Applications
2. R.K.Mittal, I.J.Nagrath, Robotics and controls, Tata Mcgraw Hill Education Pvt.
Reference Books:
1. Doughlaes –R. HAlcoojr, An Introduction to robotics.
2. Robotics – An Introduction – Doughales – R. Halconnjr.An Introduction to Robotics
3. Latombe, J. C. (2012). Robot motion planning (Vol. 124).Springer Science & Business Media.
4. Hegde, G.S. (2009). Industrial Robotics, University Science Press.

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ECONOMIC POLICIES IN INDIA

Course Code	ER 51001(Common in all branches of Engg.)
Course Title	Economic Policies in India
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

CO1	Understand Indian economics policy, planning strategies
CO2	It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes
CO3	Development Economics as a discipline encompasses different approach estotheproblemsofunemployment,poverty,incomegeneration,industrializationfromdifferentperspec-tives
CO4	Abletoidentifytheproblemsandcapabletodecidetheapplicationforfuturedevelopment
CO5	Analyzeeconomicissuesandfindsolutionstocomplexeconomicproblemsandtakecor-recteconomicjudgment

COURSE CONTENTS:

1. BASIC FEATURES AND PROBLEMS OF INDIAN ECONOMY:
- 1.1. Economic History of India;
- 1.2. Nature of Indian Economy
- 1.3. Demographic features and Human Development Index,
- 1.4. Problems of Poverty, Unemploy-ment, Inflation, income inequality, Blackmoney in India.

2. SECTORAL COMPOSITION OF INDIAN ECONOMY:
- 2.1. Issues in Agriculture sector in India,
- 2.2. land reforms
- 2.3. Green Revolution
- 2.4. agriculture policies of India,
- 2.5.

3. INDUSTRIAL DEVELOPMENT,
- 3.1. Small scale and cottage industries,
- 3.2. Industrial Policy,
- 3.3. Public sector in India,
- 3.4. Service sector in India.

4. ECONOMIC POLICIES:
- 4.1. Economic Planning in India,
- 4.2. Planning commission v/s NITI Aayog,
- 4.3. Five Year Plans,
- 4.4. Monetary policy in India,
- 4.5. Fiscal Policy in India,
- 4.6. Centre state Finance Relations,
- 4.7. Finance commission in India
- 4.8. LPG policy in India

5. EXTERNAL SECTOR IN INDIA
- 5.1. India's foreign trade value composition and direction,
- 5.2. India Balance of payment since 1991,
- 5.3. FDI in India,

5.4. Impact of Globalization on Indian Economy,
5.5. WTO and India.

REFERENCE BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy .S Chand &Co.Ltd. New Delhi.
2. Mishra S. K &V. K Puri (2017). Indian Economy and Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, NewDelhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India ,Oxford University Press.

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ENGINEERING ECONOMICS & ACCOUNTANCY

Course Code	ER 51002(Common in all branches of Engg.)
Course Title	Engineering Economics & Accountancy
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

COURSE OBJECTIVES

•To acquire knowledge of basic economicst of a cilitate the process of economic decision making.
•To acquire knowledge on basic financial management aspects.
•To develop the basic skills to analyze financial statements.

COURSE OUTCOMES:

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

CO1	Understand the macro-economic environment of the business and its impact on enterprise
CO2	Understand cost elements of the product and its effect on decision making
CO3	Prepare accounting records and summarize and interpret the accounting datafor managerial decisions
CO4	Understand accounting systems and analyze financial statements using ratio analysis
CO5	Understand the concepts of financial management and investment

COURSE CONTENTS

1. INTRODUCTION:
- 1.1. Managerial Economics;
- 1.2. Relationship with other disciplines;
- 1.3. Firms: Types, objectives and goals;
- 1.4. Managerial decisions;
- 1.5. Decision analysis.

2. DEMAND & SUPPLY ANALYSIS:
- 2.1. Demand;
  - 2.1.1. Types of demand;
  - 2.1.2. Determinants of demand;
  - 2.1.3. Demand function;
  - 2.1.4. Demand elasticity;
  - 2.1.5. Demand forecasting;
- 2.2. Supply;
  - 2.2.1. Determinants of supply;
  - 2.2.2. Supply function;
  - 2.2.3. Supply elasticity.

3. PRODUCTION AND COST ANALYSIS:
- 3.1. Production function;
- 3.2. Returns to scale;
- 3.3. Production optimization;
- 3.4. Least cost input; Iso quants;
- 3.5. Managerial uses of production function;
- 3.6. Cost Concepts;
  - 3.6.1. Cost function;
  - 3.6.2. Types of Cost;
  - 3.6.3. Determinants of cost;
  - 3.6.4. Short run and Long run cost curves;
  - 3.6.5. Cost Output Decision;
  - 3.6.6. Estimation of Cost.

4. PRICING:

4.1. Determinants of Price;
4.2. Pricing under different objectives and different market structures;
4.3. Price discrimination;
4.4. Pricing methods in practice;
4.5. Role of Government in pricing control.

5. FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT):

5.1. Balance sheet and related concepts;
5.2. Profit & Loss Statement and related concepts;
5.3. Financial Ratio Analysis;
5.4. Cash flow analysis;
5.5. Funds flow analysis;
5.6. Comparative financial statements;
5.7. Analysis & Interpretation of financial statements;
5.8. Investments;
5.9. Risks and return evaluation of investment decision;
5.10. Average rate of return;
5.11. Payback Period;
5.12. Net Present Value;
5.13. Internal rate of return,

REFERENCE BOOKS:

1.McGuigan, Moyer and Harris,' Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
2.Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition,2005.
3.Samuelson. Paul A and Nordhaus W. D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
4.Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, NewDelhi, 2007.
5.Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson SouthWestern, 4th Edition, 2001.

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INDUSTRIAL AUTOMATION

Course Code	ER 50031(Same as EF/EL/RA 50031)
Course Title	Industrial Automation
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT I -

1.1 Industrial automation overview and data acquisition
1.2 Architecture of Industrial Automation Systems.
1.3 Measurement Systems Characteristics
1.4 Data Acquisition Systems

UNIT II -

2.1 Control Generation
2.2 Introduction to Automatic Control
2.3 P-I-D Control
2.4 Feed-forward Control Ratio Control
2.5 The branching operations based on conditions expression

UNIT III

3.1 Sequential control and PLC
3.2 Introduction to Sequence Control, PLC, RLL
3.3 PLC Hardware Environment

UNIT IV

4.1 Industrial control application
4.2 Hydraulic Control Systems
4.3 Pneumatic Control Systems
4.4 Energy Savings with Variable Speed Drives
4.5 Introduction to CNC Machines

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Industrial Instrumentation, Control and Automation S.Mukhopadhyay, S. Sen and A. K. Deb Jaico Publishing House, 2013 ISBN: 978-8184954098
2. Electric Motor Drives, Modelling, Analysis and Control R. Krishnan Prentice Hall India, 2002 ISBN: 978-0130910141

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CONTROL SYSTEM AND PLC

Course Code	ER 50032(Same as EF/EL/RA 50032)
Course Title	Control System And PLC
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PE

COURSE CONTENTS:

UNIT I BASICS OF CONTROL SYSTEM

1.1 Basics of control system diagram and practical examples
1.2 Classification of control systems:-
Open loop and closed loop systems
Linear and non-linear systems
1.3 transfer function

UNIT II TIME DOMAIN STABILITY ANALYSIS

2.1 Transient and steady state response
2.2 standard test inputs: Step, Ramp, Parabolic, Impulse and their corresponding Laplace transform
2.3 analysis of second order control system: analysis for unit step input, concept, definition, effect of damping.
2.4 steady state analysis: type 0, 1, 2 systems, steady state error and error constants, numerical problems

UNIT III PROCESS CONTROLLERS

3.1 Process control system: block diagram, functions of each block
3.2 control actions: discontinuous mode, continuous mode
3.3 composite controllers: PI, PD, PID controllers- output equation, response

UNIT IV FUNDAMENTALS OF PLC

4.1 PLC: block diagram, classification, needs and benefits of PLCs in automation
4.2 descriptions of different parts of PLC: CPU function, scanning cycle, speed of execution, memory, i/o modules
4.3 PLC installation

UNIT V PLC HARDWARE AND PROGRAMMING

5.1 Discrete input modules: block diagram, specifications of AC input modules and DC input module. Sinking and Sourcing concept in DC input modules
5.2 discrete output modules: block diagram, description, specifications of AC output module and DC output modules
5.3 analog input and output modules: block diagram and specifications
5.4 I/O addressing of PLC: addressing data files, format of logical address, different addressing types
5.5 PLC programs using Ladder programming language.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Modern control engineering Ogata K. PHI 5th edition New Delhi
2. Programmable Logic Controllers Petruzella F.D. TMH 3rd edition New Delhi

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OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES (C^{++})

Course Code	ER-50041(Same as RA 50041)
Course Title	**OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES (C^{++})**
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

OBJECTIVES:
To comprehend the fundamentals of object oriented programming, particularly in C++.
To use object oriented programming to implement data structures.
To introduce linear data structures.
To study about the non-linear data structures
To understand about the different algorithms

UNIT I
DATA ABSTRACTION & OVERLOADING

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – ProxyClasses – Overloading: Function overloading and Operator Overloading.

UNIT II
INHERITANCE & POLYMORPHISM

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – CompositionVs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

UNIT III
LINEAR DATA STRUCTURES

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists – Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions

UNIT IV
NON-LINEAR DATA STRUCTURES

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components.

UNIT V
SORTING AND SEARCHING
Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

OUTCOMES:
Upon completion of the course, students will be able to:
• To know about data abstraction
• Explain the concepts of Object oriented programming.

• Write simple applications using C++.
• To demonstrate different linearity in data structures.
• Discuss the different methods of organizing large amount of data.

TEXT BOOKS:

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education
3. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, Addison- Wesley, 2007.

REFERENCES:

1. BhushanTrivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
4. BjarneStroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, SartajSahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007
6. Big C++ - Wiley India
7. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
8. C++ and Object Oriented Programming – Jana, PHI Learning.
9. Object Oriented Programming with C++ - Rajiv Sahay, Oxford
10. Mastering C++ - Venugopal, McGraw-Hill Education (India)

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PYTHON PROGRAMMING

Course Code	ER-50042(Same as RA 50042)
Course Title	**PYTHON PROGRAMMING**
Number of Credits	3 (L-3,T-0, P-0)
Prerequisites	NIL
Course Category	PC

COURSE OUTCOMES:
Upon completion of the course, students will be able to
Develop algorithmic solutions to simple computational problems
Read, write, execute by hand simple Python programs.
Structure simple Python programs for solving problems.
Decompose a Python program into functions.
Represent compound data using Python lists, tuples, dictionaries.
Read and write data from/to files in Python Programs.

UNIT I ALGORITHMIC PROBLEM SOLVING

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, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES

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; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES

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.

REFRENCES/SUGGESTED LEARNING RESOURSES:
Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

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EMBEDDED SYSTEMS LAB

Course Code	ER 5005(Same as EF/EL 5005)
Course Title	Embedded Systems Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS:-

1. Built-in LED state control by push button sketch implementation
2. Built-in LED blinking sketch implementation
3. Built-in LED blinking by toggling states based on binary operation
4. Built-in LED state control by user interface through serial port
5. User interface for Boolean operation and bit wise operation through serial port
6. User interface for compounded operation through serial port
7. Looping mechanism to check the state of pin and if change print its status on serial port
8. Controlling multiple LEDs with a loop and an array
9. Use a potentiometer to control the blinking of an LED
10. Uses an analog output (PWM pin) to fade an LED.
11. Servo Motor Control using PWM
12. Temperature sensor interfacing and sending its reading over serial port
13. I2C light sensor interfacing and sending its reading over serial port

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Arduino Projects for Dummies (For Dummies Series) Kennedy George; Davis Bernard; Prasanna SRM Wiley (5 July 2013) ISBN: 978-1118551479
2. Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh Shroff/Maker Media; Third edition (27 December 2014)ISBN : 978-9351109075

SUGGESTED SOFTWARE/LEARNING WEBSITES:

https://www.arduino.cc/reference/en/
https://learn.adafruit.com/category/learn-arduino

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ROBOT KINEMATICS AND ROBOT PROGRAMMING LAB

Course Code	ER-5006
Course Title	ROBOT KINEMATICS AND ROBOT PROGRAMMING LAB
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	BASIC KNOWLEDGE OF ROBOTICS AND PROGRAMMMING
Course Category	PC

LIST OF PRACTICALS

1. Demonstration of Cartesian/ cylindrical/ spherical robot
2. Study of Robot Teach-Pendant functions and its use in moving robot wrist in joint space and Cartesian space.
3. Use of Teach-Pendant for recording wrist positions and speed control.
4. Use of Teach-Pendant for making simple robot programs for pick and Place operations.
5. Demonstration of Articulated robot.
6. Demonstration of SCARA robot.
7. Validate Forward kinematics of robots using a software (Robo Analyser or any other free software tool).
8. Validate Inverse kinematics of robots using a software (Robo Analyser or any other free software tool).
9. Forward kinematics of Programmable Universal Machine for Assembly (PUMA 560) (VIRTUAL LAB)
10. Inverse kinematics of Programmable Universal Machine for Assembly (PUMA 560) (VIRTUAL LAB)
11. Robot Teaching Using VAL Programming (VIRTUAL LAB)
12. Use of open source computer vision programming tool openCV.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. MikkelP.Groover, Mite chellweiss, RogerrNegal and NicholesG.Odress, “Industrial Robotics Technology-Programming and Applications”.
2. R.K.Mittal, I.J.Nagrath, “Robotics and controls”, Tata Mcgraw Hill Education Pvt.
3. Doughlaes –R. HAlcoojr, “An Introduction to robotics”.
4. Latombe, J. C. (2012). Robot motion planning (Vol. 124). Springer Science & Business Media.
5. Hegde, G.S. (2009). Industrial Robotics, University Science Press.

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INDUSTRIAL AUTOMATION LAB

Course Code	ER 50071(Same as EF/EL/RA 50071)
Course Title	Industrial Automation Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PE

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

PRACTICALS:-

1. Develop a data acquisition system using Arduino
2. Temperature control system using PID
3. Level control system based on error feedback
4. PLC programming using Relay ladder Logic for AND , OR XOR and NOR gate
5. PLC, RLL programming using CASCADE method
6. PLC timer, counter, registers and analog input/output functions
7. Variable Speed drive of an induction motor
8. PLC/ microcontroller based computer numerical control machine job completion

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Industrial Instrumentation, Control and Automation S.Mukhopadhyay,S, S. Sen and A. K. Deb Jaico Publishing House, 2013 ISBN: 978-8184954098
2. Electric Motor Drives, Modelling, Analysis and Control R. Krishnan Prentice Hall India, 2002 ISBN: 978-0130910141

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CONTROL SYSTEM AND PLC LAB

Course Code	ER 50072(Same as EF/EL/RA 50072)
Course Title	Control System And PLC Lab
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PE

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

PRACTICALS:-

1. Different Toolboxes in MATLAB, Introduction to Control Systems Toolbox or its equivalent open source freeware Software like Scilab using Spoken Tutorial MOOCs.
2. Determine the transfer function for given closed loop system in block diagram representation.
3. Plot unit step response of given transfer function and find delay time, rise time, peak time and peak overshoot
4. Using MATLAB/SCILAB
   a) Simulation of a typical second order system and determination of step response and evaluation of time domain specifications
   b) Evaluation of the effect of additional poles and zeroes on time response of second order system
   c) Evaluation of effect of pole location on stability d) Effect of loop gain of a negative feedback . . system on stability
5. To study the effect of P, PI, PD and PID controller on step response of a feedback control system (Using control engineering trainer/process control simulator).Verify the same by simulation
6. Components/sub-components of a PLC, Learning functions of different modules of a PLC system
7. Practical steps in programming a PLC (a) using a Hand held programmer (b) using computer interface
8. Introduction to step 5 programming language, ladder diagram concepts, instruction list syntax
9. Basic logic operations, AND, OR, NOT functions
10. Logic control systems with time response as applied to clamping operation

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Modern control engineering Ogata K. PHI 5th edition New Delhi
2. Programmable Logic Controllers Petruzella F.D. TMH 3rd edition New Delhi

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OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES (C^{++}) LAB

Course Code	ER-50081(Same as RA 50081)
Course Title	**OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES(C^{++}) LAB**
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

OBJECTIVES:
To comprehend the fundamentals of object oriented programming, particularly in C++.
To use object oriented programming to implement data structures.
To introduce linear data structures.
To study about the non-linear data structures
To understand about the different algorithms

C ++ PRACTICALS: (LIST OF PROGRAMS)

1. Programs related to basic input/ouput.
2. Programs related to variables, strings, numbers
3. Programs related to conditions
4. Programs related to switch statement
5. Programs related to While Loops and For loop
6. Programs related to Break/Continue statement
7. Programs related to create references and pointers
8. Programs related to Functions
9. Programs related to Classes
10. Case study of application areas of C++.

OUTCOMES:
Upon completion of the course, students will be able to:
• To know about data abstraction
• Explain the concepts of Object oriented programming.
• Write simple applications using C++.
• To demonstrate different linearity in data structures.
• Discuss the different methods of organizing large amount of data.TEXT BOOKS:
1. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, Addison- Wesley, 2007.
REFERENCES:
1. BhushanTrivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
4. BjarneStroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, SartajSahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007

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PYTHON PROGRAMMING LAB

Course Code	ER-50082(Same as RA 50082)
Course Title	**PYTHON PROGRAMMING LAB**
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	NIL
Course Category	PC

PRACTICALS: (LIST OF PROGRAMS)

1. Programs related to basic input/ouput.
2. Programs related to variables,strings,numbers
3. Programs related to Lists and Tuples
4. Programs related to Functions
5. Programs related to If Statements
6. Programs related to While Loops and Input
7. Programs related to Basic Terminal Apps
8. Programs related to Dictionaries
9. Programs related to Classes
10. Programs related to Exceptions
11. Case study of application areas of python.

REFRENCES/SUGGESTED LEARNING RESOURSES:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
6. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
7. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem- Solving Focus, Wiley India Edition, 2013.
8. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

VI SEMESTER

(SESSION 2021-2022 & ONWARDS)

ENTREPRENEURSHIP AND START-UPS

Course Code	ER 6111(Common in all branches of Engg.)
Course Title	Entrepreneurship and Start-ups
Number of Credits	4 (L-3,T-1, P-0)
Prerequisites (Course code)	None
Course Category	HS

COURSE LEARNING OBJECTIVES:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with varioususesofhuman resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship-its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

LEARNING OUTCOME:

Upon completion of the course, these student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. StrategicMarketing Planning
6. New Productor Service Development
7. Business Plan Creation

COURSE CONTENTS:

1. INTRODUCTION TO ENTREPRENEURSHIP AND START–UPS
- 1.1. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- 1.2. Types of Business Structures,
- 1.3. Similarities / differences between entrepreneurs and managers.

2. BUSINESS IDEAS AND THEIR IMPLEMENTATION
- 2.1. Discovering ideas and visualizing the business
- 2.2. Activity map
- 2.3. Business Plan

3. IDEA TO START-UP
- 3.1. Market Analysis– Identifying the target market,
- 3.2. Competition evaluation and Strategy Development,
- 3.3. Marketing and accounting,
- 3.4. Risk analysis

4. MANAGEMENT
- 4.1. Company's Organization Structure,
- 4.2. Recruitment and management of talent.
- 4.3. Financial organization and management

5. FINANCING AND PROTECTION OF IDEAS
- 5.1. Financing methods available for start-ups in India
- 5.2. Communication of Ideas to potential investors– Investor Pitch
- 5.3. Patenting and Licenses

6. EXIT STRATEGIES FOR ENTREPRENEURS ,BANKRUPTCY, AND SUCCESSION ANDHARVESTING STRATEGY

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN–978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN–978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN–978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Chris Tensen	Harvard business ISBN:978-142219602

SUGGESTEDSOFTWARE/LEARNINGWEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatestructure/
c .https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

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PROJECT MANAGEMENT

CourseCode	ER 62001(Common in all branches of Engg.)
CourseTitle	Project Management
NumberofCredits	3(L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

•To develop an understanding of key project management skills and strategies.

COURSE OUTCOMES

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

CO1	Understand the importance of projects and its phases.
CO2	Analyze projects from marketing, operational and financial perspectives.
CO3	Evaluate projects based on discount and non-discount methods.
CO4	Develop network diagrams for planning and execution of a given project.
CO5	Apply crashing procedures for time and cost optimization.

COURSE CONTENTS

1. CONCEPT OF A PROJECT:
- 1.1. Classification of projects
- 1.2. Importance of project management
- 1.3. The project Life cycle
- 1.4. Establishing project priorities (scope-cost-time)
- 1.5. Project priority matrix
- 1.6. Work break down structure.

2. CAPITAL BUDGETING PROCESS:
- 2.1. Planning -Analysis-Selection-Financing-Implementation-Review.
- 2.2. Generation and screening of project ideas
- 2.3. Market and demand analysis
- 2.4. Demand forecasting techniques.
- 2.5. Market planning and marketing research process
- 2.6. Technical analysis

3. FINANCIAL ESTIMATES AND PROJECTIONS:
- 3.1. Cost of projects
- 3.2. Means of financing
- 3.3. Estimates of sales and production-cost of production
- 3.4. Working capital requirement and its financing
- 3.5. Profitability project , cash flow statement and balance sheet.
- 3.6. Breakeven analysis.

4. BASIC TECHNIQUES IN CAPITAL BUDGETING:

4.1. Non discounting and discounting methods
4.2. pay-back period
4.3. Accounting rate of return
4.4. Net present value
4.5. Benefit cost ratio
4.6. Internal rate of return.
4.7. Project risk.
4.8. Social cost benefit analysis andeconomic rate of return.
4.9. Non-financial justification of projects.

5. PROJECT ADMINISTRATION:

5.1. Progress payments,
5.2. Expenditure planning,
5.3. Project scheduling and network planning,
5.4. Use of Critical Path Method(CPM),
5.5. Schedule of payments and physical progress,
5.6. time-cost trade off.
5.7. Concepts and uses of PERT
5.8. Cost as a function of time,
5.9. Project Evaluation and Review Techniques
5.10. Cost mechanisms.
5.11. Determination of least cost duration.
5.12. Post project evaluation.
5.13. Introduction to various Project management softwares.

REFERENCE BOOKS

1.Project planning, analysis, selection, implementation and review –Prasannachandra–Tata McGraw Hill
2.Project Management – the Managerial Process– Clifford F. Gray& Erik W. Larson-McGrawHill
3.Project management- David I Cleland- Mcgraw Hill International Edition, 1999
4.Project Management– Gopalakrishnan– Mcmillan India Ltd.
5.Project Management- Harry – Maylor – Peason Publication

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RENEWABLE ENERGY TECHNOLOGIES

CourseCode	ER 62002(Common in all branches of Engg.)
CourseTitle	Renewable Energy Technologies
NumberofCredits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To understand present and future scenario of world energy use.
•To understand fundamentals of solar energy systems.
•To understand basics of wind energy.
•To understand bio energy and its usage in different ways.
•To identify different available non-conventional energy sources.

COURSE OUTCOMES

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

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods of solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio energy generations from various Bio wastes.
CO5	Identify suitable energy sources for a location.

COURSE CONTENTS

1. INTRODUCTION:
- 1.1. World Energy Use;
- 1.2. Reserves of Energy Resources;
- 1.3. Environmental Aspects OF Energy Utilisation;
- 1.4. Renewable Energy Scenario in India and around the World;
- 1.5. Potentials; Achievements/ Applications;
- 1.6. Economics of renewable energy systems.

2. SOLAR ENERGY:
- 2.1. Solar Radiation;
- 2.2. Measurements of Solar Radiation;
- 2.3. Flat Plate and Concentrating Collectors;
- 2.4. Solar direct Thermal Applications;
- 2.5. Solar thermal Power Generation
- 2.6. Fundamentals of Solar Photo Voltaic Conversion;
- 2.7. Solar Cells;
- 2.8. Solar PV Power Generation;
- 2.9. Solar PV Applications.

3. WIND ENERGY:
- 3.1. Wind Data and Energy Estimation;
- 3.2. Types of Wind Energy Systems;
- 3.3. Performance; Site Selection;

3.4. Details of Wind Turbine Generator;
3.5. Safety and Environmental Aspects.

4. BIO-ENERGY:

4.1. Bio mass direct combustion;
4.2. Bio mass gasifiers;
4.3. Bio gas plants;
4.4. Digesters;
4.5. Ethanol production;
4.6. Bio diesel;
4.7. Cogeneration;
4.8. Bio mass Applications.

5. OTHER RENEWABLE ENERGY SOURCES:

5.1. Tidal energy;
5.2. Wave Energy;
5.3. Open and Closed OTEC Cycles;
5.4. Small Hydro Geothermal Energy;
5.5. Hydrogen and Storage;
5.6. Fuel Cell Systems;
5.7. Hybrid Systems.

REFERENCE BOOKS

1. Non-Conventional Energy Sources, Rai. G. D., Khanna Publishers, New Delhi, 2011.
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN SponLtd.,UK,2 006.
3. Solar Energy, Sukhatme. S. P., Tata McGraw Hill Publishing CompanyLtd. ,New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, G N Tiwari and M K Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment A Policy Analysis for India ,NHRavindranath, U K Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, R A Ristinen and J JKraushaar, second edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, J W T widell and A D Weir, ELBS, 2006.

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PRODUCT DESIGN

CourseCode	ER 63001(Common in all branches of Engg.)
CourseTitle	Product Design
NumberofCredits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To acquire the basic concepts of product design and development process

•To understand the engineering and scientific process in executing a design from concept to finished product

•To study the key reasons for design or redesign.

COURSE OUTCOMES

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

CO1	Understand the basic concepts of product design and development process.
CO2	Illustrate the methods to define thecustomer needs.
CO3	Describe an engineering design and development process.
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5	Apply modelling and embodiment principles in product design and development process.

COURSE CONTENTS

1. DEFINITION OF A PRODUCT

1.1. Types of product;
1.2. Levels of product;
1.3. Product-market mix;
1.4. New prod-uct development (NPD) process;
1.5. Idea generation methods;
1.6. Creativity;
1.6.1. Creative attitude;
1.6.2. Creative design process;
1.7. Morpho logical analysis;
1.8. Analysis of inter-connected decision areas;
1.9. Brain storming.

2. PRODUCT LIFECYCLE;

2.1. The challenges of Product development;
2.2. Product analysis;
2.3. Product characteristics;
2.4. Economic considerations;
2.5. Production and Marketing aspects;
2.6. Characteristics of successful Product development;
2.7. Phases of a generic product development process;
2.8. Customer need identification;
2.9. Product development practices and industry-product strategies.

3. PRODUCT DESIGN

3.1. Design by evolution;
3.2. Design by innovation;
3.3. Design by imitation;
3.4. Factors affecting product design;
3.5. Standards of performance and environmental factors;
3.6. Decision making and iteration;
3.7. Morphology of design (different phases);
3.8. Role of aesthetics in design.

4. INTRODUCTION TO OPTIMIZATION IN DESIGN

4.1. Economic factors in design;
4.2. Design for safety and reliability;
4.3. Role of computers in design;
4.4. Modeling and Simulation;
4.5. The role of models in engineering design;
4.6. Mathematical modeling;
4.7. Similitude and scale models;
4.8. Concurrent design;
4.9. Six sigma and design for six sigma;
4.10. Introduction to optimization in design;
4.11. Economic factors and financial feasibility in design;
4.12. Design for manufacturing;
4.13. Rapid Proto typing (RP);
4.14. Application of RP in product design;
4.15. Product Development versus Design.

5. DESIGN OF SIMPLE PRODUCTS DEALING WITH VARIOUS ASPECTS OF PRODUCT DEVELOPMENT;

5.1. Design Starting from need till the manufacture of the product

REFERENCE BOOKS

1.Product Design and Development, Karl T.Ulrichand Steven D.Eppinger, TataMcGraw–Hill edition.
2.Engineering Design– George E. Dieter.
3.An Introduction to Engineering Design methods Vijay Gupta.
4.Merie Crawford: New Product management, McGraw-Hill Irwin.
5.Chitale A K and Gupta R C," Product Design and Manufacturing", Prentice Hall of India, 2005.
6.Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New Product Development, Pears on education.

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DISASTER MANAGEMENT

Course Code	ER 63002(Common in all branches of Engg.)
Course Title	Disaster Management
Number of Credits	3 (L: 3, T: 0 ,P :0)
Prerequisites	NIL
Course Category	OE

COURSE LEARNING OBJECTIVES

Following are the objectives of this course:

•To learn about various types of natural and man-made disasters.

•To know pre and post-disaster management for some of the disasters.

•To know about various information and organizations in disaster management in India.

•To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES:

1.1. After competing this course, student will be:
1.2. Acquainted with basic information on various types of disasters
1.3. Knowing the precautions and awareness regarding various disasters
1.4. Decide first action to be taken under various disasters
1.5. Familiarised with organization in India which are dealing with disasters
1.6. Able to select IT tools to help in disaster management

COURSE CONTENTS

1. UNDERSTANDING DISASTER

1.1. Understanding the Concepts and definitions of Disaster,
1.2. Hazard,
1.3. Vulnerability,
1.4. Risk,
1.5. Capacity–Disaster and Development,
1.6. Disaster management.

2. TYPES, TRENDS, CAUSES, CONSEQUENCES AND CONTROL OF DISASTERS

2.1. Geological Disasters (earth quakes, land slides,tsunami, mining);
2.2. Hydro-Meteorological Di-sasters (floods, cyclones, lightning, thunder-storms, hailstorms, avalanches, droughts, cold and heat waves)
2.3. Biological Disasters (epidemics, pestattacks, forestfire);
2.4. Technological Disasters (chemical, industrial, radiological, nuclear)
2.5. Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
2.6. Global Disaster Trends
2.7. Emerging Risks of Disasters
2.8. Climate Change and Urban Disasters.

3. DISASTER MANAGEMENT CYCLE AND FRAME WORK

3.1. Disaster Management Cycle
3.2. Paradigm Shift in Disaster Management.
3.3. Pre-Disaster
3.4. Risk Assessment and Analysis,
3.5. Risk Mapping,
3.6. Zonation and Microzonation,
3.7. Prevention and Mitigation of Disasters,
3.8. Early Warning System
3.8.1. Preparedness,
3.8.2. Capacity Development;
3.8.3. Awareness.

3.9. During Disaster
- 3.9.1. Evacuation
- 3.9.2. Disaster Communication
- 3.9.3. Search and Rescue
- 3.9.4. Emergency Operation Centre
- 3.9.5. Incident Comm and System
- 3.9.6. Relief and Rehabilitation

3.10. Post-disaster
- 3.10.1. Damage and Needs Assessment,
- 3.10.2. Restoration of Critical Infra structure
- 3.10.3. Early Recovery Reconstruction and Redevelopment;
- 3.10.4. IDNDR, Yokohama Stretegy, Hyogo Frame-work of Action.

4. DISASTER MANAGEMENT IN INDIA

4.1. Disaster Profile of India
4.2. Mega Disasters of India and Lessons Learnt.
4.3. Disaster Management Act 2005
4.4. Institutional and Financial Mechanism,
4.5. National Policy on Disaster Management,
4.6. National Guidelines and Plans on Disaster Management;
4.7. Role of Government (local, state and national),
4.8. Non-Government and Inter Governmental Agencies

5. APPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DISASTER MANAGEMENT

5.1. Geo informatics in Disaster Management (RS, GIS, GPS and RS).
5.2. Disaster Communication System (Early Warning and Its Dissemination).
5.3. Land Use Planning and Development Regulations,
5.4. Disaster Safe Designs and Constructions,
5.5. Structural and Non Structural Mitigation of Disasters
5.6. S & T Institutions for Disaster Management in India

REFERENCES

1.Publications of National Disaster Management Authority (NDMA) on Various Templates and Guide lines for Disaster Management
2.Bhandani, R. K., An over view on natural & man-made disasters and their reduction, CSIR, New Delhi
3.Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4.Alexander, David, Natural Disasters, Kluwer Academic London
5.Ghosh, G .K. ,Disaster Management, APH Publishing Corporation
6.Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

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INDIAN CONSTITUTION

CourseCode	ER 6333(Common in all branches of Engg.)
CourseTitle	Indian Constitution
NumberofCredits	0 (L:2,T:0;P:0)
Prerequisites(Coursecode)	None
CourseCategory	AU

COURSE CONTENT

1. **THE CONSTITUTION –**
   - 1.1. Introduction
   - 1.2. The History of the Making of the Indian Constitution
   - 1.3. Preamble and the Basic Structure, and its interpretation
   - 1.4. Fundamental Rights and Duties and their interpretation
   - 1.5. State Policy Principles

2. **UNION GOVERNMENT**
   - 2.1. Structure of the Indian Union
   - 2.2. President– Role and Power
   - 2.3. Prime Minister and Council of Ministers
   - 2.4. LokSabha and RajyaSabha

3. **STATE GOVERNMENT**
   - 3.1. Governor– Role and Power
   - 3.2. Chief Minister and Council of Ministers
   - 3.3. State Secretariat

4. **LOCAL ADMINISTRATION**
   - 4.1. District Administration
   - 4.2. Municipal Corporation
   - 4.3. ZilaPanchayat

5. **ELECTION COMMISSION**
   - 5.1. Role and Functioning
   - 5.2. Chief Election Commissioner
   - 5.3. State Election Commission

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L.Fadia	SahityaBhawan; New edition(2017)
3.	Introduction to the Constitution of India	D DBasu	Lexis Nexis; Twenty-Third 2018 edition

SUGGESTED SOFTWARE / LEARNING WEBSITES:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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MODELLING AND SIMULATION USING MATLAB

Course Code	ER-6001(Same as RA 6001)
Course Title	**MODELLING AND SIMULATION USING MATLAB**
Number of Credits	4 (L-4,T-0, P-0)
Prerequisites	Basic Engineering Mathematics
Course Category	PC

COURSE OUTCOMES:

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

- Learn basics of MATLAB programming
- Understand the main features of the MATLAB program development environment to enable their usage in the higher learning.
- Interpret and visualize simple mathematical functions and operations thereon using plots/display.

PART – A

1. Computer Programming

1.1 Introduction to Computer Programming
1.2 Algorithm and Pseudo-code
1.3 Compilers and Interpreters
1.4 Overview of High Level Programming Languages

2. Introduction to MATLAB

2.1 MATLAB Environment
2.2 Scalar and Vector Data types
2.3 Matrix manipulation
2.4 Saving and Retrieving Data using MAT-Files
2.5 Cell Arrays and Structures
2.6 Character Strings
2.7 Relational and Logical Operations
2.8 Plotting 2D and 3D graphs
2.9 Applications – Solving linear systems of equations, Curve fitting and Interpolation

3. Programming using MATLAB

3.1 Introduction – M-Files, User Input/output, Script-Files and Function-Files
3.2 Control Flow – For Loops, While Loops, If-Else-End Constructs, Switch-Case Constructs, Try-Catch Blocks

3.3 Functions – Function Construction Rules, Input and Output Arguments, Scope of Variables, Function Handles, Anonymous Functions, Nested Functions, Private Functions, Overloaded Functions
3.4 Exchanging Data with MAT-Files
3.5 Low level File I/O

PART – B

4. Modelling and Simulation using MATLAB/Simulink

4.1 Introduction to Graphical Programming
4.2 Simulink Basics
4.3 Creating Models using Blocks and Signals
4.4 Running Simulations and Analyzing Results
4.5 Modeling and Simulating Dynamic Systems

5. Robotics System Toolbox

5.1 Features of Robotic System Toolbox
5.2 Building Robot Models
5.3 Coordinate System Transformations
5.4 Inverse Kinematics and Dynamics
5.5 Trajectory Tracking
5.6 Using Robot Operating System (ROS)

REFRENCES/SUGGESTED LEARNING RESOURSES:

1. RudraPratap, “Getting Started with MATLAB 7”, Oxford University Press, 2009
2. Duane Hanselman and Bruce Littlefield, “Mastering MATLAB 7”, Pearson Education, 2009
3. S. J. Chapman, “Programming in MATLAB for Engineers”, Brooks/Cole Thomson Learning, 2004.
4. Agam Kumar Tyagi, “MATLAB and Simulink for Engineers”, Oxford University Press, 2012

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MODELLING AND SIMULATION USING MATLAB LAB

Course Code	ER-6002 (Same as RA 6002)
Course Title	**MODELLING AND SIMULATION USING MATLAB LAB**
Number of Credits	1 (L-0,T-0, P-2)
Prerequisites	Basic Engineering Mathematics
Course Category	PC

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**.**

PRACTICALS:

1. Write a MATLAB program for inverse kinematics of 3-link planar robotic arm.
2. Write a MATLAB program for plotting joint angles and torque for a 2-link planar robotic arm
3. Robot programming and simulation for pick and place
4. Robot programming and simulation for Colour identification
5. Robot programming and simulation for Shape identification
6. Robot programming and simulation for machining (cutting, welding)
7. Robot programming and simulation for writing practice
8. Robot programming and simulation for any industrial process(Packaging, Assembly)
9. Robot programming and simulation for multi process.
10. Use of Robotic Systems Toolbox for building robot models.
11. Use of Robotic Systems Toolbox for forward/inverse kinematics/dynamics in robots.

REFRENCES/SUGGESTED LEARNING RESOURSES:

1. RudraPratap, “Getting Started with MATLAB 7”, Oxford University Press, 2009
2. Duane Hanselman and Bruce Littlefield, “Mastering MATLAB 7”, Pearson Education, 2009
3. S. J. Chapman, “Programming in MATLAB for Engineers”, Brooks/Cole Thomson Learning, 2004.
4. Agam Kumar Tyagi, “MATLAB and Simulink for Engineers”, Oxford University Press, 2012

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