JSPM's
RAJARSHI SHAHU COLLEGE OF ENGINEERING
TATHAWADE, PUNE-33
(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF AUTOMATION AND ROBOTICS

Department of AUTOMATION AND ROBOTICS

B. Tech Structure

(2019 Pattern)

Dr. A. M. Badadhe	Dr. Ram Joshi	Dr. R. K. Jain
BOS Chairman (A & R)	Dean Academics RSCOE, Pune	Director, RSCOE

DEPARTMENT OF AUTOMATION AND ROBOTICS

Vision:

To become an ecosystem in the domain of Automation and Robotics that develops competent multidisciplinary professionals, researchers and entrepreneurs striving for technology led socio-economic development of the nation.

Mission:

- To impart high quality education through best of the teaching-leaning process by using industry ready curriculum.
- To establish centres of excellence in the area of Automation and Robotics where ideas, innovations and research will synergize.
- To align the practices and initiatives with high ethical standards to meet the needs of the society and at large the nation.

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DEPARTMENT OF AUTOMATION AND ROBOTICS

Program Outcomes (POs)

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Program Specific Outcomes (PSOs)

At the end of this program, students will be able to -

PSO1: To integrate principles of engineering in multidisciplinary approach to find out the solutions for complex engineering problems.

PSO2: To design & develop the Automation & Robotics systems for various applications

PSO3: To make a career in Automation & Robotics through industry, entrepreneurship, research and academia while contributing to the continuous development of individual, organisation, society and nation at large.

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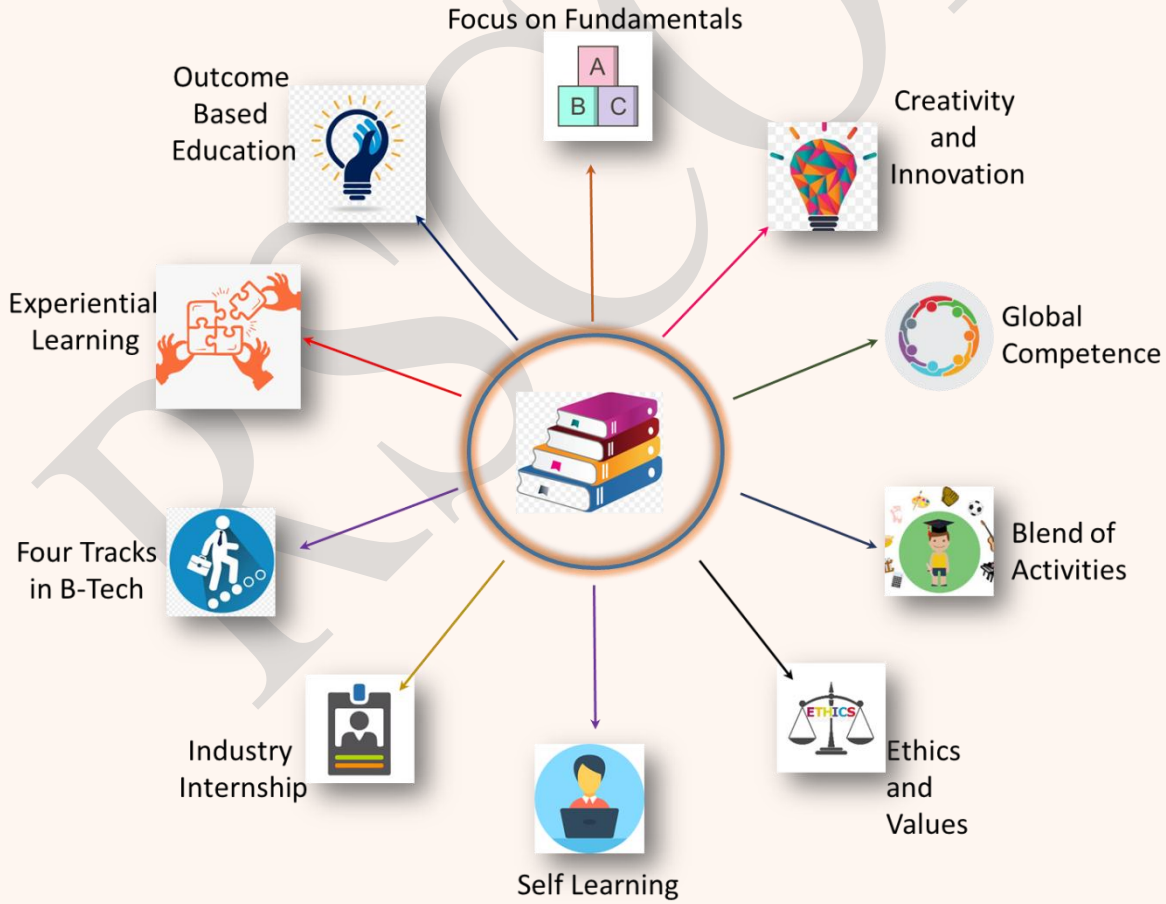
DEPARTMENT OF AUTOMATION AND ROBOTICS

Highlights of the Syllabus

The Curriculum of UG Program of **AUTOMATION AND ROBOTICS** has been designed in association with **Experts from Academics, industries / Corporate & Distinguish Alumni.** Major features of the curriculum are presented in the following diagram.



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Unique Features of the Curriculum

1. **Curriculum centered at Outcome Based Education:**
   The new Curriculum is based on student-centered instruction models that focus on measuring student performance through outcomes. The outcomes include subject knowledge, industry required skills and attitudes.
2. **Emphasize on Fundamentals:**
   The nature of the new curriculum is rigorous and well prescribed so that the students can spend more time on preparation and self-study. The students have to learn core subjects, solve practical based assignments and must attempt periodical quizzes. This will benefit them to grasp and keep a strong hold on fundamentals of Engineering in the most effective way.
3. **Experiential Learning:**
   The curriculum emphasizes on hands-on sessions along with theoretical information. The new curriculum considers Problem Based Learning (PBL) as a teaching pedagogy and includes different subjects that encourage the students for hands on learning through virtual labs, mini-projects, etc. Accordingly, the curriculum maintains good balance between theory and laboratory credits.
4. **Promote Creativity and Innovation:**
   Along with experiential learning, the curriculum also motivates the students to inculcate creativity and innovation. Apart from conventional lab, the curriculum provides a freedom for students to perform industry assignments, pilot projects, innovative development, etc.
5. **Inculcating Ethics and Values:**
   To improvise student's behavior, the curriculum has included systematic courses on ethics and values. The moral principles can help students to make right decisions, lead their professional lives and become ethical citizen.
6. **Blend of Curricular and Extracurricular Activities**
   The curriculum also gives importance of different activities like co-curricular, extra-curricular, sports, culture, etc. This will help to do all round development of students in all possible ways.
7. **Four Tracks in B-Tech:**
   By offering various courses/electives, flexibility in choosing work in specified field as:
   I. Industry Internship II. Entrepreneur

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III

Course Code	Course	Teaching Scheme			Semester Examination Scheme of Marks						Credits
					Theory			TW	LAB	TOTAL	TOTAL
		TH	TU	LAB	ISE (15)	MSE (25)	ESE (60)				
AR2101	Analog and Digital Circuits	3	0	2	15	25	60	-	25	125	4
AR2102	Electrical Machines and Drives	3	0	2	15	25	60	-	25	125	4
ES2102	Engineering Mathematics -III	3	1	0	15	25	60	25	-	125	4
AR2103	Strength of Materials	3	0	2	15	25	60	-	25	125	4
AR2104	Sensors and Instrumentation	3	1	2	15	25	60	25	25	150	5
AR2105	Engineering Design & Innovation-I	0	0	2	-	-	-	-	25	25	1
HS2104	Human Values and Ethics	0	0	2	-	-	-	-	25	25	1
AR2106	Audit Course- I	Online Certification Course in the area of Automation & Robotics									-
Total of Semester-III		**15**	**02**	**12**	**75**	**125**	**300**	**50**	**150**	**700**	**23**

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV

Course Code	Course	Teaching Scheme			Semester Examination Scheme of Marks						Credits
					Theory			TW	LAB	TOTAL	TOTAL
		TH	TU	LAB	ISE (15)	MSE (25)	ESE (60)				
AR2107	Principles of Automation & Robotics	3	0	2	15	25	60	-	25	125	4
AR2108	Manufacturing Technology and Metrology	3	0	2	15	25	60	-	25	125	4
AR2109	Automatic Control System	3	0	2	15	25	60	-	25	125	4
AR2110	Kinematics and Dynamics of Machines	3	1	2	15	25	60	25	25	150	5
AR2111	Hydraulic and Pneumatic Systems	3	0	2	15	25	60	-	25	125	4
AR2112	Product Development & Modelling Lab	0	0	2	-	-	-	-	25	25	1
HS2101/ HS2102/ HS2103/ HS2109	Language Proficiency-II: English/ German/ Japanese French	0	0	2	-	-	-	25	-	25	1
AR2113	Audit Course- II	Online Certification Course in the area of Automation & Robotics									-
Total of Semester-IV		**15**	**01**	**14**	**75**	**125**	**300**	**50**	**150**	**700**	**23**

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SEMESTER III Syllabus

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
AR2101- Analog and Digital Circuits

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week LAB:02Hours/Week	TH:03 LAB:01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Lab Evaluation: 25 Marks

Course Prerequisites: Basic electronics components such as transistor, op-amp and concept of basic circuit laws like KVL and KCL, Logic gates and Boolean algebra**.**

Course Objectives: This course emphasizes on effective knowledge of semiconductor devices -FET, BJT MOSFET and Op-Amp in the field of Electronics and telecommunication Engineering. It also gives insights on applications such as amplifiers, A-D and D-A converter and op-amp based circuits. The course is served to acquaint the students with the fundamental principles of digital logic and various digital devices used to implement logical operations on variables. This course gives the knowledge of classification of power supply like SMPS, LMPS on day to day basis.

Course Outcomes:
After successful completion of the course, students will able to:
CO1: Implement circuit and test the performance using FET and MOSFET Compose logical equations of digital systems using reduction techniques.
CO2: Explain small signal model of BJT and FET.
CO3: Classify the power amplifier circuits.
CO4: Demonstrate the linear and non-linear applications of Op-Amp
CO5: Implement combinational circuit with MUX/DEMUX, Comparator and explain sequential logic circuits and its application
CO6: Classification of power supply

Course Contents

UNIT-I	ELECTRONIC DEVICES	06Hours

Construction, working, characteristic, applications and Datasheet of Diodes, BJT, FET, MOSFET, IGBT, SCR, TRIAC

UNIT-II	AMPLIFIERS	08Hours

BJT Biasing and DC load line concept, BJT CE amplifier, and comparison of CE, CB and CC. Concept of frequency response.
Feedback Amplifiers: - Feedback Concept, Classification of amplifiers based on feedback topology, (Voltage, Current, Trans-conductance and Trans-resistance amplifiers), Effect of negative feedback on various performance parameters of an amplifier, Comparison of feedback topologies.
Power amplifiers: Classes of Power Amplifier such as Class A, Class B, Class AB, Class C and Class D amplifiers. Comparisons of power amplifiers.

UNIT-III	OP-AMP AND ITS APPLICATIONS	07Hours

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Introduction of Op-amp, Differential amplifier using op-amp, Instrumentation amplifier, V to I & I to V Converter, Precision Rectifiers, Study of comparator, Schmitt Trigger, Sample and hold circuit, square wave generators, triangular wave generators.		
UNIT-IV	**COMBINATIONAL LOGIC CIRCUITS**	**07Hours**
Standard representations for logic functions, minimization of logical functions using k map (up to 4 variables), don't care conditions. MSI devices like Comparators, Multiplexers, De-multiplexers, Encoder, Decoder, Code converters, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder and ALU.		
UNIT-V	**SEQUENTIAL LOGIC CIRCUITS**	**07Hours**
1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flop. Use of preset and clear terminals, Excitation table for flip flops, Conversion of flip flops, Application of flip flops: Counters, Shift registers (ring counters, twisted ring counters), ripple counters, up/down counters, synchronous counters.		
UNIT-VI	**POWER SUPPLY**	**07Hours**
Basic block diagram of Power supply, Linear regulated power supply: IC based fixed voltage and variable voltage regulator. SMPS: types of SMPS, block diagram of SMPS. Performance parameters of regulator. Specifications and design of linear regulated power supply.		

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly byinternal and external examiners.

- Total marks assigned are 25.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file.
- Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Experiments

	Analog Circuits – (Perform any five experiments from the following)
1	To verify DC operating point of single stage voltage divider bias CE amplifier
2	To implement single stage CE amplifier and calculate gain, I/P -O/P resistance
3	To simulate frequency response of single stage CE amplifier & find the bandwidth
4	To implement class power amplifier and verify its performance
5	To simulate volage series feedback amplifier and calculate gain, I/P-O/P resistance, band width: with and without feedback
6	Built and test precision half / full Rectifier.
7	Built and test Op-Amp as Smith Trigger
B	**Digital Circuits-** Perform all experiments
1	Verify the truth table for various types of logic gates: AND, OR, XOR, NAND, NOR, XNOR, and NOT
2	Design & implement Multiplexer

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3	Design & implement Demultiplexer
4	Design & implement MOD-N counter
5	Design three terminal variable voltage regulator for the following specifications using IC LM 317: i) O/P Voltage: 5 V to 15 V ii) O/P Current: 500 mA Calculate the load and line regulation

Text Books

T1. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGrawHill, 2000.

T2. Donald Neaman, "Electronic Circuit Analysis and Design",3rd Edition, Tata McGraw Hill.

T3. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education second and latest edition.

T4. S. Salivahanan&Bhaaskaran, "Linear Integrated Circuits", 1st Edition, Tata McGrawHill.

T5. R.P. Jain, "Modern digital electronics",4thEdition, Tata McGraw Hill Publication, 2009.

T6. Douglas L. Perry, "VHDL Programming by example" 4th edition Tata McGraw-Hill.

Reference Books:

R1. David A. Bell, "ElectronicDevicesandCircuits",5th Edition, Oxford press.

R2. R. L. Boylstad, L. Nashlesky, "Electronic Devices and circuits Theory", 9th Edition, Prentice Hall of India, 2006.

R3. D.Roy Choudhary, Shail Jain "Linear Integrated Circuits", New Age International.

Soclof, "Design and Applications of Analog Integrated Circuits", PHI.

R4. Anand Kumar, "Fundamentals of digital circuits" 4th Edition, Prentice Hall of India, 2016.

R5. John F. Wakerly, "Digital Design Principles and Practices‖", 3E, Prentice Hall.

R6. M. Morris Mano, Michael D. Ciletti ,"Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog", 6th Edition Pearson, 2018

R7. Lizy Kurian John ,Charles H. Roth ,"Digital System Design Using VHDL "2012.

On -Line Resources:

https://www.google.com/url?q=https://onlinecourses.nptel.ac.in/noc22_ee111

List of Tutorials:

1. Design 5V DC power supply
2. Design Mod N, Mod NN Counter

List of Projects:

1. Build and test circuits for different applications of Op-Amp (Such as Summing amplifier, Zero crossing detector, square wave generators, triangular wave generators …..)
2. Simulate 8:1 MUX using 74151 IC (Use Deldsim simulator)
3. Build 5V DC power supply

List of Course Seminar Topics:

1. Applications of BJT, FET, MOSFET, IGBT, SCR, TRIAC,Op-Amp
2. Applications of Shift registers, counters, Mux, Demux

List of Course Group Discussion Topics:

1. Discuss various new applications of analog and digital circuits

List of Home Assignments:

1. Draw schematics of Pulse Amplitude modulation system.

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2. Describe
    a. Pulse Code modulation and demodulation.
    b. 2.Delta modulation and demodulation.
    c. 3.Quadrature phase shift keying modulation and demodulation.
3. Compare
    a. 1.MUX and DMUX
    b. 2.Encoder and Decoder

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
AR2102-ElectricalMachinesand Drives

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week LAB:01 Hours/Week	TH:03 LAB:01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Lab Evaluation: 25 Marks

Course Prerequisites:Basic Electrical & Electronics engineering

Course Objectives:

To understand construction, working and operation of induction motor, synchronous machine and special purpose motors

To understand speed control methods of three phase induction motor.

To understand the application of induction motor, synchronous machine and special purpose Motors.

To Understand basics of electrical drives and its control

To understand and evaluate analyze dc and induction motor drives

Course Outcomes:

After successful completion of the course, students will able to:

CO1: learn the working principle and operation of single-phase transformer

CO2: learn the construction, working principle and characteristics of DC machines

CO3: describe the different parameters & speed control methods of three phase induction motor

CO4: explain construction, working principle of synchronous machine & apply special purpose motors for different application.

CO5: explain basics of electrical drives and its working.

CO6:analysis and understand of dc and induction motor drives

Course Contents

UNIT-I	TRANSFORMERS	07Hours
Constructional Details – Principle of Operation – EMF Equation — Transformer - No Load & Full load, Parameters Referred To HV/LV Windings – Equivalent Circuit – Voltage Regulation – losses & efficiency- Testing – open and Short Circuit Test – Polarity Test		
UNIT-II	D.C. MACHINES	07Hours
Constructional details – EMF equation – methods of excitation– characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. Motors- Armature reaction & commutation process		
UNIT-III	INDUCTION MOTORS	07Hours
Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – Losses and power stages- Torque & Slip characteristics - single-phase induction motors (only qualitative analysis).		
UNIT-IV	SYNCHRONOUSANDSPECIALMACHINES	07Hours

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Construction of Synchronous machines-types – induced emf – Generator on No load and full load – reluctance motor – stepper motor - servo motor- bldc motor- pmdc motor- armature reaction & its effect under different power factors		
UNIT-V	**BASICS OF ELECTRIC DRIVES AND CONTROL**	**07Hours**
Introduction, advantages of electric drives- components of electric drives system, selection factors, DC & AC drives, Speed control – classification- close loop control		
UNIT-VI	**DC AND INDUCTION MOTOR DRIVES**	**07Hours**
DC motors and their performance, starting, transient analysis, speed control, controlled rectifier fed drives, Induction motors, starting and speed control methods, V/P control, close loop control for induction motors.		

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- **Total marks assigned are 25.**
- **Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file.**
- **Final practical examination for specific practical and oral examination will be conducted**

List of Laboratory Experiments

1	Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
2	Polarity test on single phase transformer
3	Speed control of D.C. shunt motor.
4	Load test on D.C. shunt motor.
5	Load test on D.C. series motor
6	No load and blocked rotor tests on three phase induction motor (Determination of equivalent circuit parameters)
7	Load test on Three phase induction motor.
8	Direct Loading test on alternator
9	Rotor resistance speed control of three phase slip ring induction motor
10	Speed control of squirrel cage induction motor
11	Test on single phase full controlled rectified fed DC drive
12	Test on three phase full controlled rectified fed separately excited DC motor

Text Books:

T1. B.L. Theraja,–Electrical Technology Vol.II AC/DC Machines‖, S. Chand, 2008.
T2. Vedam Subramaniam,–ElectricDrives–Concepts and applications‖,Tata McGraw Hill Publishing Co.,Ltd., New Delhi 2003
T3. G.K. Dubey, –Fundamentals of Electric Drives", Alpha Science International Ltd. 2001.
T4. R.Krishnan,–ElectricMotor&Drives:Modelling,AnalysisandControl‖,PrenticeHall of India, 2001.

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REFERENCEBOOKS:

R1. J.B. Gupta,–Theory and Performance of Electrical Machines‖,J.K.Kataria&Sons,13th edition, 2004.
R2. Bimal K. Bose,–Modern Power Electronics and AC Drives", Prentice-hall of India Pvt. Ltd,2005.
R3.M.H.Rashid,"PowerElectronicCircuits,DevicesandApplications",PrenticeHallInternational,2007Edition, NewnessPublications,2006.
R4.H.Partab,–Artandscienceandutilizationofelectricalenergy‖,DhanpatRaiandSons, 1999

On-Line Resources:

https://onlinecourses.nptel.ac.in/noc22_ee111/preview,
https://nptel.ac.in/courses/108108077
https://nptel.ac.in/courses/108105131

List of Projects:

1. Practical implementation of Faradays Law.
2. Practical implementation of DC Motor.
3. Electromagnetic Lock.

List of Course Seminar Topics:

1. Transformer
2. Induction Motor
3. Synchronous Machines

List Of Group Discussion Topics:

1. Types of Transformers and Applications
2. Types of DC Motors and Applications
3. Recent Manufacturing Process and machines Used in Industry

List of home Assignments:

1. Sketch and explain phasor diagram for 1-phase transformer at ON Load.
2. Obtain the approximate equivalent circuit of asingle-phase transformer referred to primary side. Show all the parameters on it.
3. 3.Compare the two-winding transformer with autotransformer.
4. 4.Two single phase transformers A and B are connected in parallel and supplying a common load of 1000kVA at 0.8 p.f. lagging. The transformer A is of 750kVA and has ohmic drop of 3% and inductive drop of 5% at full load. The transformer B is of 500kVA and has ohmic drop of 2% and inductive drop of 4%. Determine the loading of each transformer.
5. 5.A 4-pole series motor has Z = 944, wave wound, flux/pole = 34.6 mWb. Gross torque 209 N-m, supply voltage = 500 V and R = 3 W. Calculate line current and speed.
6. 6.Compare simple LAP winding and WAVE winding of a DC machine with sketch.

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[ES2102]: Engineering Mathematics-III

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week TU: 01 Hours/Week	TH:03 TU: 01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks Term Work: 25 Marks

Course Prerequisites: Differential & Integral Calculus, Differential equations of first order & first degree, Fourier series, Algebra of Complex numbersand Vector algebra**.**

Course Objective:
To familiarize the students with concepts and techniques in Ordinary and Partial differential equations, Laplace transform & Fourier transform, Functions of a complex variable and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Solve higher order linear differential equations and its applications to model and analyse mass spring systems.
CO2: ApplyIntegral Transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.
CO3: Analyse Complex functions, Conformal mappings, Contour integration applicable to control theory and potential flow related to fluid dynamics
CO4: Perform Vector differentiation &integration, analyse the vector fields and apply to fluid flow problems.
CO5: Solve Partial differential equations such as wave equation, one &two dimensional heat flow equations.

Course Contents

UNIT-I	Linear Differential Equations (LDE) and Applications	08 Hours

LDE of nth order with constant coefficients, Complementary Function, Particular Integral,General method, short methods,Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modelling of mass-spring systems, free and forced damped and undamped systems.

UNIT-II	Transforms	07 Hours

Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.

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UNIT-III	Complex Variables	08 Hours
Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series, Residue theorem.		
UNIT-IV	**Vector Differential Calculus**	**08 Hours**
Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.		
UNIT-V	**Vector Integral Calculus and Applications**	**08 Hours**
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.		
UNIT-VI	**Applications of Partial Differential Equations (PDE)**	**08 Hours**
Basic concepts, modelling of Vibrating String, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier Transforms, Two-dimensional wave equation.		

Guidelines for Assessment/Guidelines for Tutorial and Term Work

i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit).

Text Books:

T1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
T2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

R1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
R2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
R3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
R4. Differential Equations, 3e by S. L. Ross (Wiley India).
R5. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).
R6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993)

MOOC(NPTEL) Courses:

NPTEL course on "Transform and Applications"
https://onlinecourses-archive.nptel.ac.in/noc19_ma04/course
NPTEL course on "Complex Analysis"
https://nptel.ac.in/courses/111/103/111103070/

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
AR2103: Strength of Materials

Teaching Scheme:	Credit	Examination Scheme:
TH:03Hours/Week TU:01 Hours/Week LAB:02 Hours/Week	TH:03 LAB: 02	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks LAB Evaluation : 50 Marks

Course Prerequisites: Engineering Mechanics, Force system, Equilibrium of forces and Centroid

Course Objective:
To understand Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit. The principal stresses and strains, and study the theories of failure to be estimated. The study distribution of various loading effects on beam for shear force and Bending moment. To estimate the torsional stresses on shaft and buckling of column.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Explain Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit
CO2: Investigate the Principal stresses and strains, and theories of failure
CO3: Establish the distribution of various loading effects on beam for shear force and Bending moment
CO4: Analyze the effects of bending and shear force on mechanical element
CO5: Calculate the slope and deflection of beams, thin cylinder and spherical shells.
CO6: Estimate the torsional stresses on shaft and buckling of column.

Course Contents

UNIT-I	Simple stresses and strains	06 Hours

Stress, strain, Hooke's law, Elastic Constants: Poisson's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Interrelation between elastic constants, uni-axial, bi-axial and tri-axial stresses. Stress-strain diagram for ductile and brittle materials, Stresses and strains in homogeneous and composite bars under concentrated loads and self-weight, Temperature stresses in simple members

UNIT-II	Principal stresses and strains	06 Hours

Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear. Graphical solution using Mohr's circle of stresses. Principal stresses in shaft subjected to torsion, bending moment and axial thrust (solid as well as hollow), Introduction to theories of failure

UNIT-III	Shear Force and Bending Moment Diagrams	06 Hours

Shear force and bending moment diagrams for statically determinate beams due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between the rates of loading, shear force and bending moment. Maximum bending moment and position of points of contra

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UNIT-IV	Stresses in Machine Elements	06 Hours

Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.
Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web

UNIT-V	Slope and deflection of beams, Thin Cylindrical and Spherical Shells	06 Hours

Relation between bending moment and slope, slope and deflection of determinate beams, Moment area method (Mohr's method), double integration method (Macaulay's method), derivation of formula for slope and deflection for standard cases, Castigliano's theorem
Thin Cylindrical and Spherical Shells, Circumferential stresses (Hoop stress), Longitudinal stresses, Radial stresses, Cylinders and Spheres due to internal pressure.

UNIT-VI	Torsion & Buckling of columns	06 Hours

Torsion: Stresses, strain and deformations in solid and hollow shafts, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts. Concept of equivalent torsion and bending moments
Buckling of columns: Concept of buckling of columns, derivation of Euler's formula for buckling load for columns with hinged ends, concept of equivalent length for various end conditions, limitations of Euler's formula, Rankine's formula, safe load on columns.

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly byinternal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file
- Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments (minimum -- to be covered)

1	Analysis of axially loaded mechanical components.
2	Determination of Principal stresses by M D Solids
3	Shear force and bending moment diagrams with different end conditions using ANSIS
4	Shear test of ductile material on Universal Testing Machine.
5	Experimental verification of flexural formula in bending for cantilever beam.
6	Measurement of stresses and strains in beams for different end conditions using strain gauges.
7	Experimental verification of torsion formula for circular bar.
8	Experimental verification of fatigue stresses and Factor of safety

Text Books:

T1. G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India

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T2. S.S. Rattan - Strength of Material – Tata McGraw Hill Publication Co. Ltd. S.
T3. Ramamurtham - Strength of material –DhanpatRai Publication.
T4. Timoshenko and Young - Strength of Materials - CBS Publication

Reference Books:

R1. Beer and Johnston - Strength of materials - CBS Publication.
R2. E.P. Popov - Introduction to Mechanics of Solids - Prentice Hall Publication.
R3. Singer and Pytel - Strength of materials - Harper and row Publication.
R4. B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi.
R5. Ramamruthu-, Strengths of Materials, DhanpatRai Publication.
R6. Timoshenko and Youngs -Elements of Strength of Materials, Affiliated East -West Press.
R7. Beer, Jhonston, DEwolf and Mazurek- Mechanics of Materials, TMHPvt Ltd., New Delhi.
R8. Nag and Chandra- Strength of Materials, Wiley India.
R9. R.S.Khurmi- Strength of Materials, S. Chand Publication.
R10. Shigley J.E. and Mischke C.R., Mechanical Engineering, Tata McGraw Hill

Online Recourses:

1. https://nptel.ac.in/courses/105105108
2. https://archive.nptel.ac.in/courses/112/101/112101095/
3. https://archive.nptel.ac.in/courses/112/106/112106141/
4. https://archive.nptel.ac.in/courses/112/107/112107146/
5. https://archive.nptel.ac.in/courses/112/107/112107147/
6. https://archive.nptel.ac.in/courses/112/102/112102284/

List of Tutorials:

1. Numerical on Shear Force and Bending Moment
2. Numerical on Stresses in Machine Elements
3. Numerical on Slope and deflection of beams
4. Numerical on Thin Cylindrical and Spherical Shells
5. Numerical on Torsion & Buckling of columns

List of Projects:

1. Design of shaft on the basis of torsional rigidity
2. Design of spring for IC engine valves.
3. Design of chain drive for Motorcycle

List of Course Seminar Topics:

1. Simple stresses and strains
2. Stress strain relation
3. Shear force and bending moment
4. Torsional equations
5. Torsion of shafts of non-circular sections
6. Eccentrically loaded columns

List of Group Discussion Topics:

1. DFMA
2. Types of fits & their selection for a particular application.

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3. Modes of failures
4. Factors to be considered in selection of factor of safety
5. Factors to be considered in selection of manufacturing method for mechanical element
6. Design for sustainability

List of Home Assignments:

1. Different types of failures in Gears & heat treatment
2. Different types of springs used in Mechanical Applications
3. Different types of Threads used in Mechanical Applications
4. Different types of Belt Drives used in Mechanical Applications
5. Different types of Bearings used in Mechanical Applications

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
AR2104 – Sensors and Instrumentation

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week	TH:03	In Sem. Evaluation:15 Marks
TU:01	TU:01	Mid Sem. Exam: 25 Marks
LAB:02Hours/Week	LAB:01	End Sem. Exam : 60 Marks
		LAB Evaluation : 25 Marks

Course Prerequisites: Basics of sensing elements, bridges and basic electronics Course

Course Objective:

1.To introduce the fundamentals of electrical measurements and instrumentation
2.To Understand basic principles of sensing various parameters
3. To Develop mathematical background of sensor design
4. To Learn selection of sensors for typical applications
5. To introduce students with different types ADCs and DACs.
6.To understand different analog and digital modulation methods and understanding of major building blocks of data communication system.

Course Outcome:

After successful completion of the course, students will able to:
CO1: Calibrate and monitor a variety of electronic instruments
CO2: Ability to design and conduct experiments for measurement.
CO3:Demonstrate an understanding of various types of sensors and transducers
CO4: To Learn selection of sensors for typical applications
CO5: Know the complete internal structure of ADCs and DACs. Perform the experiments, analysis on ADC and DAC ICs.

Course Contents

UNIT-I	INTRODUCTION	07 Hours

Basicsofmeasurement–Significanceofmeasurement–UnitsandStandards–Calibrationtechniques–Errorsin measurement–Generalizedmeasurementsystem–SensorsandTransducers–Classificationoftransducer–Static anddynamiccharacteristicsoftransducer–Sensorcalibrationtechniques. Criteria for selection of sensors- range, dynamic range, sensitivity, Linearity, response time, band width, accuracy, repeatability & precision, Resolution & threshold, type of output, size and weight, environmental conditions, interfacing.

UNIT-II	DISPLACEMENT, FORCE, PRESSURE AND TEMPERATURE SENSORS	07 Hours

Position / Displacement sensors - Potentiometric Sensor –Capacitive sensors – Inductive and Magnetic sensors – LVDT, RVDT, Eddy Current, Halleffect, Magneto resistive, Magneto strictive – Ultrasonic – Radar – Strain Gauge – Tactile Sensor – Piezo electricBellows,Membranes,andThinPlates–Piezo-resistiveSensors–Vacuumsensor–Thermo-sensitiveSensors–RTD– Thermistors–ThermoelectricContactSensors–OpticalTemperaturesensor –

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Pyrometers.		
UNIT-III	**OPTICAL, VIBRATION AND ACOUSTIC SENSORS**	**07 Hours**
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors, Vibrations sensors – accelerometers etc. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.		
UNIT-IV	**RANGE, HEADING AND ADVANCED SENSORS**	**07 Hours**
Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR) – Heading Sensors – GPS, Compass – Humidity sensor – Hygrometer – Radiation Sensors – Scintillation, Ionization detector – Gas Sensors – Bio sensor		
UNIT-V	**VISION BASED SENSORS**	**07 Hours**
Vision based sensors- Elements of vision sensor, image acquisition, image processing, edge detection, feature extraction, object recognition, pose estimation and visual serving, hierarchy of a vision system, CCD and CMOS Cameras, Monochrome, stereovision, night vision cameras, still vs video cameras, kinect sensor; Block schematic representations**.**		
UNIT-VI	**DATA ACQUISTION AND SIGNAL CONDITIONING**	**07 Hours**
Components of Analog & Digital DAQ system – Uses of Data Acquisition systems – DAQ Hardware & Software – Data Loggers – Amplification – Isolation – Filtering – Sample and Hold circuits – A/D and D/A Converters, Data Acquisition: Single channel and multi -channel data acquisition		

List of Laboratory Assignments/Experiments (minimum -- to be covered)

1	Testing of Sensor / Transducer (any two types) to calculate: accuracy, precision, span, range, error, resolution etc.
2	Experimentation on LVDT/ RVDT to plot its performance characteristics.
3	Measurement of Load / Force using Strain Gauge set up
4	Measurement of temperature using thermocouples/ thermistors/RTD/Pyrometer etc.
5	Testing of Photo conductive / photo voltaic / Photo resistive cell
6	Application of Laser sensor for flow/level/displacement/position etc. measurement
7	Trial on Range Sensors – RF beacons /Ultrasonic Ranging /Reflective beacons /Laser Range Sensor (LIDAR)
8	Performance of any one type of Vision based sensor for suitable application
9	Interfacing of sensor / transducer to DAQ system and monitor the o/p on computer.

Text Books:

T1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009

T2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

T3. Peter Elgar, "Sensors for Measurement and Control", Addison-Wesley Longman Ltd, 1998.

Reference Books:

R1.C.Sujatha,

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W . Dyer,S.A.,SurveyofInstrumentationandMeasurement,JohnWiley&Sons,Canada,2001
R2.HansKurtTönshoff(Editor),Ichiro, "SensorsinManufacturing"Volume1,Wiley-VCHApril2001.
R3.JohnTurnerandMartynHill,"Instrumentationfor EngineersandScientists", Oxford SciencePublications,1999.
R4.PatranabisD,"Sensorsand Transducers",2nd Edition,PHI,NewDelhi,2011.
R5.RichardZurawski,"IndustrialCommunication Technology Handbook"2nd edition,CRCPress,2015
R6. Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, 2014.

On-Line resources:

1. https://nptel.ac.in/courses/108108147
2. https://archive.nptel.ac.in/courses/108/105/108105064/
3. https://onlinecourses.nptel.ac.in/noc19_ee44/preview
4. http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/fundamental.html

List of Tutorials:

1. Design and implementation of weighing machine using load cell.
2. Design and implementation of liquid level indicator using electromechanical system.

List of Projects:

1.Measurement of temperature using thermocouple
2.Measurement of Displacement using L.V.D.T. and testing of its performance characteristics.
3. Measurement of Displacement using Linear and Rotary Encoders and compare their resolutions.

List of Course Seminar Topics:

1. Application of Laser sensor for flow/level/displacement/position etc. measurement
2. Application of MEMS and NANO sensors

List of Group Discussion Topics:

1. Latest application of Vision based sensors
2. Trends in MEMS
3. Applications of various sensors in biomedical field

List of Home Assignments:

1. Illustrate the difference between Accuracy and Precision.
2. Define the Calibration of an Instrument?
3. The true value of a voltage is 100V. The values indicated by a measuring instrument are 104, 103,105,103 and 105V. Calculate the Accuracy and Precision of the measurement.
4. Compare Sensors and Transducers
5. List out uses of various industrial applications of Temperature, position, force pressure, level,acoustic transducers.

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[ME2104]: Engineering Design & Innovation-I

Teaching Scheme:	Credit	Examination Scheme:
LAB:02 Hours/Week	LAB: 01	LAB Evaluation : 25 Marks

Course Objectives:

In Problem based Learning students will learn to Identify Engineering Problems in different areas and define them systematically for the purpose of solutions.Apply Problem Solving tools viz. root cause analysis, literature review, market study, design of experiments, rapid prototyping, and validation.Provide technical optimal and feasible solution to the identified problem.

Course Outcomes:

After successful completion of the course, students will able to:

CO1: Identify the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aims and objectives.
CO2: Analyze the results and arrive at valid conclusions
CO3: Propose a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.
CO4: Contribute to society through proposed solutions by strictly following professional ethics and safety measures
CO5: Use of technology in proposed work and demonstrate learning in oral and written form
CO6: Develop ability to work as an individual and as a team member.

Lab Contents

Guidelines for Assessment

- Idea Inception (kind of survey). (10%)
- Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
- Attended reviews, poster presentation and model exhibition. (10%)
- Demonstration (Poster Presentation, Model Exhibition etc). (10%).
- Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
- Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small applications using Arduino, design of control systems, development of various systems/ subsystems of BAJA/SUPRA/Robots/GoKart/ Sunrisers/Hackathon/ application development and similar activities/ System performance and analysis) (40%)
- Participation in various competitions/ publication/ copyright/ patent) (10%)

List of Laboratory Assignments/Experiments

1	Visit to a startup incubator/R&D facility/innovation centre to understand the approach towards problem solving. Eg.Vigyaan Ashram at Pabal, NCL Startup Incubator,

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	Pashan, Department of Technology, SPPU.
2	Problem definition, classification and identification. Preparing a list of 5 actionable problems.
3	Problem Solving Techniques: Root Cause Analysis of the problem.
4	Literature Review using tools such as Mendeley, Market Research and preparing initial survey report.
5	Introduction to software tools in engineering. Python, Creo, Catia, Ansys.
6	Design of Experiment/Design of Solutions. Defining the constraints and parameters of the solution, resources required, and also the expected outcome.
7	Solution Week 1: Drawing board approach, preparation of basic design.
8	Solution Week 2: Rapid Prototyping.
9	Solution week 3. Testing, Validation and Improvements
10	Report Writing. Concise report of 10 pages is to be prepared highlighting the problem, methodology and the final solution.
11	Presentation of the report and discussion each individual solution.
12	A mini-expo of PBL projects to be held at the end of semester at department level and/or college level if planned centrally. The aim is to bring about convergence of Problem Based Learning and product/service development and entrepreneurial experience for the students.
13	Visit to a startup incubator/R&D facility/innovation centre to understand the approach towards problem solving. Eg.Vigyaan Ashram atPabal, NCL Startup Incubator, Pashan, Department of Technology, SPPU.

Text Books:

T1: Dr. RaghunathMashelkar, Ravi Pandit, Leapfrogging to Pole Vaulting, Penguin Viking Publication, Jan 2019.

T2: Anil Gupta, Grassroots Innovation, Penguin Portfolio Publication, 1st May 2019

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[HS2101]: Language Proficiency –II: English

Teaching Scheme: TU:02Hours/Week	Credit TW: 01	Examination Scheme: Term Work : 25 Marks

Course Prerequisites: Vocabulary and grammar, Foundation English

Course Objective:
Inculcate the importance of Technical English Communication Skills. Also, to enhance their communicative competence. Enable the students to communicate with clarity and precision. Prepare the students to acquire structure and written expression required for their profession and enable them to acquire proper behavioural skills.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Solve questions based on Sentence Correction
CO2: Understand and Learn the importance of grooming properly
CO3: Introduce himself/herself and others effectively
CO4: Present PPTs in group meetings/ seminars and take stand for his/her beliefs
CO5: Speak effectively in vocal competitions.

Course Contents

UNIT-I	Application of Grammar to solve questions and to form sentences correctly	04 Hours
Sentence Correction- Subject -Verb agreement, Modifiers, Parallelism, Pronoun-antecedent agreement Verb time sequence, Prepositions		
UNIT-II	**Soft Skills**	**04 Hours**
Corporate Etiquettes, Body Language, Communication (Importance/Skills/Behaviors), Grooming (Dressing/Styling), Proxemics: Space Distance		
UNIT-III	**Presentation**	**06 Hours**
Speeches for different Occasions Self Introduction, Welcome Speech, Introductory Speech,Vote of Thanks Speech		
UNIT-IV	**Placement Essentials**	**06 Hours**
Power point Presentation (Individual/ Group) (On current trends/Travel Destinations/ Upcoming Opportunities etc.) Extempore- Orientation &Mock (Individual Extempore on current affairs/Abstract Topics/ Controversial topics/ Political Views)		
UNIT-V	**Orientation of Group Discussion**	**04 Hours**
Orientation of Group Discussion, Mock Group Discussion, Interview Mock Interview, Debate, Mock Debate		

Reference Books:

R1. K.R. Laxminarayanan, English for Technical Communication, SciTech, Sixth Edition, 2008
R2. William Sanborn Pfeiffer ,T.V.S. Padmaja ,Technical Communication: A Practical Approach,

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Pearson, Sixth Edition 2012
R3. A.K.Jain, Praveen Bhatia, A.M.Shaikh, Professional Communication Skills, S. Chand and Co: Fifth edition ,2009
R4. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hills publishing Company 2006
R5. F.T.Wood, Remedial English Grammar, Macmillan, 2007
R6. Andrea J. Rutherford, PhD. Basic Communication Skills for Technology, Pearson Education Asia,2001
R7. Exercises in Spoken English, Parts 1 and II CIEFL, Hyderabad, Oxford University Press
R8. Sanjay Kumar, Pushplata, Communication Skills, Oxford University Press, First edition ,2012

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[HS2102]: Language Proficiency –II: German

Teaching Scheme: PR: 2 Hours/Week	Credit PR:1	Examination Scheme: Term Work : 25 Marks

Course Prerequisites: Language Proficiency-I (German)

Course Objective: To build the students' proficiency in German language in reading, speaking, writing and listening as a step towards the A1 Level Goethe Institute Certification.

Course Outcome: After successful completion of the course, students will able to:

CO 1. Develop the skill to introduce themselves and schedule an appointment.
CO 2. Understand the Modal verb, vocabulary and rent agreement.
CO 3. Understand Dativ cases in grammar, set daily time table and activities.
CO 4. Summarize past tense and Dativ case pronouns.
CO 5. Explain everyday expressions and very simple sentences, which relate to the satisfying of concrete needs.
CO 6. Build basic sentence and build a good foundational vocabulary

Course Contents

UNIT-I	**Time, Preposition and Articles**	**4 Hours**
Grammar Revision; Akkusativ Case– Artikel, Verbs, Prepositions, learn to read and tell time, schedule and reschedule an appointment		
UNIT-II	**Modal Verb, Vocabulary House, rooms Furniture**	**4 Hours**
Modal Verben – when and how to use them and practice, Vocabulary – Houses, Rooms, Furniture, Rent and Agreement		
UNIT-III	**Past tense, dative cases Vocabulary Time Table and daily Activities**	**4 Hours**
Past tense – Praeteritum of haben and sein; understand the dativ case, Speak about the past,Vocabulary,time table and daily activities		
UNIT-IV	**Past tense –PII,Dative case Verbs Article and praposition**	**4 Hours**
Vocabulary – Clothes and Fashion, Past tense – Partizip 2, Dativ Case – Pronouns, Verbs, Artikel and Prepositions		
UNIT-V	**Personal pronouns of all cases of Vocabulary of Body parts and Vacation**	**4 Hours**
Vocabulary – Health and Body Parts, Illnesses and Healthcare system, Vocabulary - Vacation and Holidays; Personal Pronouns – all cases		
UNIT-VI	**Evaluation Activity**	**4 Hours**
Oral Evaluation and Activity- Mock Dialogue Vocabulary Dice, A Picture's Worth, Conversation Redo		

Text Books:

T1. Netzwerk Deutsch alsFremdsprache A1, Stefanie DenglerG
T2. German Vocabulary for Beginners -Dorota Guzik

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[HS2103]: Language Proficiency –II: Japanese

Teaching Scheme: PR: 2 Hours/Week	Credit PR:1	Examination Scheme: Term Work : 25 Marks

Course Prerequisites: Language Proficiency (Japanese)

Course Objective: To meet the needs of ever-growing industry with respect to language support.To get introduced to Japanese society and culture through language.

Course Outcome:

After successful completion of the course, students will able to:

CO 1: Develop ability of basic communication.
CO 2: Demonstrate the knowledge of Japanese script.
CO 3: Demonstrate basic reading, writing and listening skills

Course Contents

UNIT-I	Introduction to Japanese Language.	4 Hours

Hiragana basic Script, colors, Days of the week, Hiragana: modified Kana, double consonant, Letters combined with ya, yu, yo Long vowels, Greetings and expressions, Self-Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one 's age

UNIT-II	Katakana script.	4 Hours

Denoting things (nominal & prenominal demonstratives), Purchasing at the Market / in a shop / mall (asking & stating price). Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting & finishing time, Point in time (denoting the time when any action or the movement occurs). Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating to a certain place by a vehicle

UNIT-III		4 Hours

Introduction to Kanji Script, Describing one 's daily routine. To ask what someone does. Expressions of Giving & Receiving. Adjectives (Types of adjectives), Asking impression or an opinion about a thing / person / place that the listener, has experienced, visited, or met, Describing things / person / places with the help of the adjectives. Expressions of Like & Dislikes. Expressing one 's ability, hobby, Comparison between objects, persons & cities, which resulted from a certain action in the past.

UNIT-IV		4 Hours

Stating existence or a presence of thing (s), person (s), Relative positions, Counters, Expressing one's Desire & wants, Verb groups, Asking, Instructing a person to do something. Indicating an action or motion is in progress, Describing habitual action, describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition

Text Books:

T1. Minna No Nihongo, ―Japanese for Everyone‖, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
T2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCSInaugurates-Japan-centric-Delivery-Center-Pune.aspx

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[HS2104]: Human Values and Ethics

Teaching Scheme:	Credit	Examination Scheme:
TU:01 Hours/Week	TU: 01	LAB Exam : 25 Marks

Course Objective:
To distinguish between values and skills, and understand the need, basic guidelines, content and process of value education. Students imbibe basic knowledge to make informed ethical decisions when confronted with problems in the working environment. The Subject creates awareness about Ethics and Human Values. Future engineers to contribute to Society and human well-being.

Course Outcome: After successful completion of the course, students will able to:
CO1: Explain the need, content and process for value education.
CO2: Explain need of self, sensitization towards gender equality, build confidence, & manage stress
CO3: Describe natural acceptance of human values, competence in professional ethics.

Course Contents

UNIT-I	Concept of Human Values	06 Hours

Definition, Concept of Human Values, Need, Content, Process and relevance to present day. Aim of education and value education, Evolution of value-oriented education. Types of values, Components of value education. Understanding oneself and others, Johari Window- Concept, explanation, implementation; Goal achievement though SWOT Analysis and Time management matrix: Personal values and ethics – Types of values and their importance of values from students' perspective

UNIT-II	Value Education towards Personal Development	06 Hours

Self-analysis and introspection; sensitization towards gender equality, physically challenged, intellectually challenged. Respect to - age, experience, maturity, family members, neighbors, co-workers. Morals, values and Ethics, Integrity, Work ethic, Civic virtue, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, stress management.

UNIT-III	Ethics	06 Hours

What is Ethics, Definition of Ethics, importance of integrity Engineering Ethics: Purpose of engineering Ethics, Professional and professionalism, Professional roles to be played by engineers, Influence of ethics in family life

Guidelines for Assessment

There should be continuous assessment for the TW. Assessment must be based on continuous assessment based on work done,submission of work in the form of report / journal, timely completion, attendance, and understanding. At the end of the semester, the final grade for a Term Work shall beassigned based on the performance of the student.

Reference Books:
R1:William K. Frankena," Ethics", Second Edition, Pearson India Education Services Pvt.Ltd.
R2:Caroline Whitbeck,"Ethics in Engineering Practice and Research, Second Edition,Cambridge University Press.
R3: Charles E Harris, Micheal J Rabins, Engineering Ethics, Fourth Edition Cengagen Learning‖
R4: AAlavudeen," Professional Ethics and Human Values" Firewall, ISBN13: 8131803066.

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Academic Year – 2022-2023 Semester -III
[ME2105] AUDIT COURSES

The purpose of audit courses is to give general awareness about the social issues to the students. Students are expected to apply the scientific way to analyze the data and make use of their technical expertise to deal with the issues. The basic objective is to give a different learning experience in context with social issues.Assessment of the student's work will be done on the basis of assignments/reports/presentation/oral exam/test.

Criteria:

The student registered for audit course shall be awarded the grade PP (Audit Course Pass) and shall be included such TP grade in the Semester grade report for that course, provided student has at least 75% or above attendance and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with 'NP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Evaluation Criteria:

Guidelines for Conduction (Any one or more of following but not limited to)

• Lectures/ Guest Lectures • Visits (Social/Field) and reports • Demonstrations	• Surveys • Mini Project • Hands on experience on

Guidelines for Assessment (Any one or more of following but not limited to)

• Written Test • Demonstrations/ Practical Test • Poster presentation	• Presentations • IPR/Publication • Report

Audit Course- I

EL2106-C	Innovation Tools and Methods for Entrepreneurs
EC2107-A	Intellectual Property Rights and Patents
CE2106-B	Road Safety Management
ME2105-D	Online Certification

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[EL2106-C]: Audit Course-I: Innovation Tools & Methods for Entrepreneurs

Course Pre requisites: Basic knowledge of thermodynamics.

Course Objective:

- To understand depict user engagement in the solution and apply the knowledge for "Creativity and Design Thinking".
- To analyze various tools for competitor life and user journey map.
- To understand detailed specifications and USP of the product based on the competitor survey.

Course Outcome:

After successful completion of the course, students will able to:

CO1: understand structured approach to define the problem with every possible detail, identify conflicts and solve them

CO2: apply User Journey Map to the selected problem to show user interaction at various stages

CO3: analyze the solutions provided by competitors for effectiveness and gaps if any.

Course Contents

UNIT-I	Systematic Innovation
Define the problem in depth with all details, Trend prediction, Modeling the problem to identify tradeoffs and contradictions	
UNIT-II	**TRIZ**
Theory of Inventive problem solving (TRIZ), HIT Matrix, Scamper, Algorithms of brain storming and innovation, Functional analysis	
UNIT-III	**Frugal and Disruptive Innovation**
Biomimicry and frugal innovation for prototyping, Disruptive innovation	
UNIT-IV	**User Journey Map**
Map showing user interaction at every stage of product/service. Step-by-step process of UJM creation	
UNIT-V	**Competitor analysis**
Analysis of competitor and users for similar products, effectiveness of existing solutions and identifications of gaps	
UNIT-VI	**Product/Software Design Specifications**
Detailed specifications for better product design, detailed UI for software for clarity on user interaction, specify USPs of the product in comparison to the competitors	

Reference Books:

R1. Design Sprint, J. Knapp
R2. The Innovator's Toolkit, D. Silverstein, P. Samuel and N. DeCarlo
R3. ABC-TRIZ: Introduction to creative design thinking with modernTRIZ modeling, M. A. Orloff

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2020-2023 Semester -III
[EC2107-A]: Audit Course-I: Intellectual Property Rights and Patents

Course Prerequisites: NA

Course Objectives:

- To introduce fundamental aspects of Intellectual property Rights (IPR)
- To disseminate knowledge about types of IP like Patents, Copyrights, Trade Secrets
- To make students aware about current trends in IPR and their importance
- To motivate students for innovative thinking and making inventions

Course Outcomes:

After successful completion of the course, students will able to

CO1: Exhibit the concepts of Intellectual Property Rights
CO2: Differentiate among different IPR
CO3: Formulate and characterize innovative ideas and inventions into IPR
CO4: Demonstrate knowledge of advances in patent law and IP regulations

Course Contents

UNIT-I	**Overview of Intellectual Property**
Introduction and the need for intellectual property right (IPR) - Types of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret.	
UNIT-II	**Patents**
What is invention? Patentability criteria: Novelty, Non-Obviousness (Inventive Steps), Industrial Application, Non- Patentable Subject Matter, Patent Search, Patent Registration Procedure, Rights and Duties of Patentee, Assignment and license, Infringement	
UNIT-III	**Copyrights**
Concept of Copyright –Copyright Subject matter: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright – Infringement	
UNIT-IV	**Trademarks**
Nature of Trademarks - Different kinds of trademarks (, logos, signatures, symbols, well known marks, brand names, certification and service marks) – Trademarks that can't be registered– Trademarks registration procedure - Rights of holder and assignment and licensing of marks - Infringement	
UNIT-V	**Advances in IP Laws and Government policies**
Amendments and India`s New National IP Policy, Promoting IPR policy for Start-ups, Career Opportunities in IP - IPR in current scenario	

Reference Books:

R1**.** Niraja Pandey, Khush deep Dharni (2014), "Intellectual Property Rights", PHI
R2. Nithyananda K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited
R3. Mishra, "An introduction to Intellectual property Rights", Central Law Publications
R4. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[CE2106-B]: Audit Course-I: Road Safety Management

Course Objective:
To understand the road environment. Also, to inculcate decision making and behavioral skills necessary to survive in the road environment& understanding of the causes and consequences of accidents.To understand roles and responsibilities in ensuring road safety.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Explain traffic rules and characteristics of accident.
CO2: List the causes for accidents and their duties
CO3:Discuss the importance of multidisciplinary approach to planning for traffic safety and Rehabilitation.
CO4:Acquire a certificate of coordination/ participation in compulsory events based on the topic under Study.

Course Contents

UNIT-I	Introduction to Road Safety
Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash	
UNIT-II	**Planning for Road safety**
Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.	
UNIT-III	**Responsibility of Road accidents and Safety measures**
People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering – by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.	
UNIT-IV	**Road Safety Education**
Introduction to Road Safety Education. 5 P's of Road safety education: 1. Pre-school road safety education 2. Practical rather than theory education 3. Principles of own development as regards to road safety education 4. Presentations on road safety education 5. Place for road safety education in syllabus	
UNIT-V	**Road Safety Event**
Discussions on efforts done by Government on Road Safety. Celebration of Road Safety week or Workshop on Road Safety week/ Organization of seminar on Road Safety. This is to be entirely organized by students under the mentorship of concerned Head of the Department.	

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Reference Books:

R1. Kadiyali L.R., Traffic Engineering & Transport Planning, Khanna Publishers, 2003 CROWN AGENTS Ref: TEA/A369, 1995. (Unpublished contractors report for Ministry of Transport and Communications, Ghana). Road safety study and the institutional strengthening of the vehicle examination and licensing division.

R2. TRRL OVERSEAS UNIT, 1991. Towards safer roads in developing countries: a guide For planners and engineers. Crow Thorne: Transport and Road Research Laboratory

R3. Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996

R4. Indian Roads Congress, Road Safety Audit Manual, IRC:SP-88-2010

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Academic Year – 2022-2023 Semester -III
[ME2105-D]: Audit Course-I: Online Certification

Course Pre requisites: Basics analysis or design concepts of the selected course.

Course Objective: The objective of this course is, to prepare students to learn the courses using online teaching aids

Course Outcome:
After successful completion of the course, students will able to:
CO1: Use modern ICT tools for self-learning
CO2: Demonstrate the ability of self- learning
CO3: Demonstrate the ability to abreast with advance technologies.

Course Contents

The students should complete at least one Certification course which will be offered by NPTEL/Spoken tutorial/ Swayam/ IIT Bombay/ MOOC/or any other approved agency by the department during the same semester. The students should select the subjects relevant to Computer Engineering and which should not be included in the specified curriculum. Minimum duration of course should be 4 weeks and all assignments should be submitted. Certification done would be appreciated but not mandatory. In case a student does not go for certification, he/she should pass the internal test organized by department for the said course

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SEMESTER IV Syllabus

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV

AR2107-Principles of Automation and Robotics

Teaching Scheme:	Credit	Examination Scheme:
TH:03Hours/Week LAB:02Hours/Week	TH: 03 LAB:01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam: 60 Marks Term work: 25 Marks

Course Pre requisites: Knowledge of basic electronics and electrical engineering.

Course Objective:

- To help students gain essential and basic knowledge of automated systems
- To understand the applications of automation in various sector
- To outline the basic concepts of Industrial Robots and drive system.
- To plan and to analyze the design concepts and applications of end effectors
- To identify the appropriate sensors for various robotics applications.
- To introduce the concepts such as Direct and inverse kinematics, DH parameters related to robotics and enable the students to design appropriate robotic systems and program them.

Course Outcome:

After successful completion of the course, students will able to:

CO 1. Apply automation principles and strategies
CO 2. Identify the automation need, type and method
CO 3. Outline the fundamentals of robotics and its components
CO 4. Design appropriate end effectors for various applications
CO 5. Select the suitable sensors for real time working of robotic arm.
CO 6. Analyze kinematics of various manipulator configurations and Prepare Robot program for various industrial applications

Course Contents

UNIT-I	FUNDAMENTALS OF AUTOMATION	06 Hours

Definition, Types of Automation, Advantages, Goals and Issues in Automation, Industry 4.0, Components of an automatic system, Trends in Automation – PLC, DCS, SCADA, AI based Automation.

UNIT-II	APPLICATIONS OF AUTOMATION	06 Hours

Case Studies in Industrial Automation, Home Automation, Building Automation, Agricultural Automation, Medical Automation, Smart Cities and other applications, Future of Robotics and Automation

UNIT-III	FUNDAMENTALS OF ROBOTICS	07 Hours

Historical development of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames,

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Resolution, accuracy and precision of Robot, Work cell control		
UNIT-IV	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**	**09 Hours**
Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC-Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations		
UNIT-V	**ROBOT SENSORS**	**06 Hours**
Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Position sensors – Piezo Electric Sensor, LVDT, Resolvers, Encoders – Absolute and Incremental: - Optical, Magnetic, Capacitive, pneumaticPosition Sensors, Range Sensors- Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors, Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches, Machine vision		
UNIT-VI	**MATHEMATICAL MODELING AND PROGRAMMIN(OF A ROBOT**	**09 Hours**
General Mathematical Preliminaries on Vectors & Matrices, Link Equations and relationships, Direct Kinematics, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-ordinate System, inverse kinematics of two joints, DH Parameters, Jacobian Transformation in Robotic Manipulation Introduction to Robotic Programming, On-line and off-line programming, programming examples. Various Teaching Methods, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, various Textual Robot Languages, Typical Programming Examples such as Palletizing, Loading a Machine Etc. Robots in manufacturing and non- manufacturing applications, a robot-based manufacturing system, robot cell design considerations and selection of robot, Robot Economics, Functional Safety in Robotic Applications		

Text Books:

T1. Groover, M.P. Weiss, M. Nagel, R.N. &Odrey, N.G., Ashish Dutta, Industrial Robotics,
T2. Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. New Delhi
T3. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
T4. Groover M.P.-Automation, production systems and computer integrated manufacturing-
T5. Prentice Hall of India.

Reference Books:

R1. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
R2. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi, ISBN: 987-81-203-3418-2, 2012
R3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
R4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015.
R5. Mike Wilson, Implementation of Robotic Systems, ISBN: 978-0-124-04733-4
R6. www.roboanalyzer.com

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On-Line resources:

1. https://onlinecourses.nptel.ac.in/noc19_me78
2. https://onlinecourses.nptel.ac.in/noc19_me74
3. https://onlinecourses.nptel.ac.in/noc20_me58

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file

Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Demonstration of an automation systems in lab / industry.
2	Demonstration of various robotic configurations using industrial robot
3	Design and selection of Gripper/End effector
4	Robot programming and simulation for pick and place
5	Robot programming and simulation for Color identification
6	Robot programming and simulation for Shape identification
7	Robot programming and simulation for machining (cutting ,welding)
8	Robot programming and simulation for simple assembly process
9	Industrial visit for study the Industrial Automation and robotic applications

List of Tutorials:

1. Applications of proximity sensor in robot application
2. Applications of Photo Electric Sensors in robot application
3. Applications of Position sensors in robot application
4. Applications of encoders in robot application
5. Applications of Range Sensors in robot application
6. Applications of Machine vision in robot application

List of Projects:

1. Develop an automated system for Home Automation.
2. Develop an automated system using sensors for any of robotic application.
3. Develop an automated system for Industry application.

List of Course Seminar Topics:

1. Strategy in Industrial automation
2. Type and Classification of Robots
3. Touch Sensors

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4. Force and torque sensors
5. Safety Sensor
6. Machine vision
7. Robot configurations
8. Robot drive systems
9. Types of End Effectors

List of Course Group Discussion Topics:

1. Industry 4.0
2. Future of Robotics and Automation
3. AI based Automation
4. Robots in manufacturing and non- manufacturing applications
5. A robot-based manufacturing system
6. Robot cell design considerations and selection of robot

List of Home Assignments:

1. Direct Kinematics
2. Inverse Transformations
3. Composite Rotation matrix
4. Homogenous Transformations
5. Inverse kinematics of two joints,
6. DH Parameters
7. Various Teaching Methods
8. Survey of Robot Level Programming Languages,
9. A Robot Program as a Path in Space
10. Various Textual Robot Languages
11. Robot Economics.
12. Functional Safety in Robotic Applications

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV
AR2108-Manufacturing Technology and Metrology

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week LAB:02Hours/Week	TH: 03 LAB: 01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks LAB Evaluation: 50 Marks

Course Prerequisites: The student should have completed two semesters of UG Engineering

Course Objective:

- To understand various conventional manufacturing and finishing processes
- To Classify, describe and configure the principles of various joining processes
- To understand various non-conventional manufacturing processes
- Generate CNC program for appropriate machining processes like turning and milling.
- Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
- Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.

Course Outcome:

After successful completion of the course, students will able to:

CO1: Student should be able to apply the knowledge of various manufacturing processes.
CO2: Classify and Explain different joining processes
CO3: Identify and implement advanced manufacturing processes.
CO4: Generate CNC program for Turning / Milling processes and generate tool path using CAM software.
CO5:Understand the methods of measurement, selection of measuring instruments / standards of measurement and gauge design
CO6: Learn the applications of advance metrology into various manufacturing systems

Course Contents

UNIT-I	MANUFACTURING PROCESSES	07 Hours

Primary processes – Casting –Forging – Forming – Extrusion-wire drawing process – Rolling Machining operations – Milling – types of operations, types of milling machines, milling cutters Turning – types of operations, tool holders, inserts, operating conditions, work holding devices, Milling and drilling jigs and fixtures. Grinding – types of operations.

UNIT-II	JOINING PROCESSES	07 Hours

Joiningprocesses–Welding–Gaswelding–ArcWelding,shieldedmetalarcwelding,submergedarcwelding, GTAW, plasma arc welding, ultrasonic welding, friction welding, resistance spot welding,resistanceseamwelding,studwelding,percussionwelding–Soldering–techniques,typesofsoldersand fluxes- Adhesive bonding-types of adhesives-curing techniques.

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Selection of joining process for various applications, case studies**.**

UNIT-III	ADVANCES IN MANUFACTURING PROCESSES	07 Hours

Non-conventional processes – EDM, ECM, USM, EBM, LBM, IBM, WJM, AWJM, LJM, ECG, PCM, process capabilities, applications, fused ion beams -principle and application, abrasive water jet machining.

Net shape and near net shape manufacturing, additive manufacturing, Powder metallurgy, selective laser sintering and selective laser melting, fused deposition modelling, laminated object manufacturing, laser engineered net-shaping, laser welding, stereo-lithography, LIGA process;

Rapid prototyping, introduction, product prototyping, solid modelling, reverse engineering, process chain, advantages of RP (Basic concepts). Selection of rapid prototyping process and design considerations

UNIT-IV	CNC MACHINES AND PROGRAMMING	07 Hours

Numerical controlled Machines – CNC machines, basic structures of machining and turning centers. Tools, tool holders and tool indexing. Axis configurations and fundamentals of CNC codes. Datum and tool offset settings, Incremental and absolute programming, canned cycles. Practical programming (simple) examples in milling and turning using G, M codes. APT programming

UNIT-V	LINEAR AND ANGULAR MEASUREMENTS	07 Hours

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT-VI	ADVANCES IN METROLOGY	07 Hours

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file

Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Introduction to workshop safety, measuring instruments and operating instructions.
2	Casting of the component.
3	Hot working process/ Sheet Metal work and die penetration test.
4	ProgrammingandoperationofaCNCLathe
5	ProgrammingandoperationofaVMC
6	Manufacturing of a component using 3D printing
7	Measurement of TaperAngle usingSine Bar
8	Opticalprofileprojector–studyofprofileofgeartooth,screwthreads.

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9	Toolmaker's microscope–to study cutting tool geometry, screw threads.
10	Tool wear and surface finish measurement.
11	Dimensional measurement of machined components using,boregauge,airgaugeand Height master

Text Books:

T1. Manufacturing Engineering and Technology, Kalpakjian and Schmid, Prentice Hall, New Jersey, 2013.
T2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons, Inc,New Jersey, 2010.
T3. Mechatronics by HMT, Tata McGraw Hill, 2010.
T4. Manufacturing Engineering, D.K. Singh, Ane Books India, 2008
T5. Manufacturing Processes for Engineering Materials, Kalpakjian and Schmid, Pearson Education, 5/e.
T6. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.
T7. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
T8. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

Reference Books:

R1. RAO, Manufacturing Technology-Vol 2 3e, McGraw Hill Education India, 2013
R2. RAO, Manutacturing Technology-Vol 1 4e, McGraw Hill Education India, 2013
R3. Cyril Donaldson and George H LeCain, Tool Design,TMH
R4. Handbook of Fixture Design – ASTME
R5. Campbell J. S., Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1999
R6. P R Beeley, Foundry Technology, Elsevier, 2001
R7. Richard W. Heine, Carl R. Loper, Philip C. Rosenthal, Principles of Metal Casting,Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
R8. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006.
R9. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000
R10. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
R11. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.

On-Line resources:

1. https://onlinecourses.nptel.ac.in/noc19_me44
2. https://onlinecourses.nptel.ac.in/noc21_me89
3. https://onlinecourses.nptel.ac.in/noc22_me28
4. https://onlinecourses.nptel.ac.in/noc19_me47
5. https://onlinecourses.nptel.ac.in/noc19_me45
6. https://onlinecourses.nptel.ac.in/noc19_me70
7. https://onlinecourses.nptel.ac.in/noc19_me46
8. nptel.ac.in/courses/112106179
9. www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/

List of Tutorials:

1. CNC/ VMC Part programming
2. Practical study of different operations on VMC Machine

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List of Projects:

1. Automation in various measurement techniques
2. Manufacturing of various products using CNC simulator software.
3. Manual Roller Bending Machine
4. Bench Tapping Machine
5. Mini Belt Grinder Project

List of Course Seminar Topics:

1. Non-conventional processes
2. Conventional processes
3. Reverse engineering
4. Rapid prototyping
5. 3-D Machine Vision System
6. Autocollimator
7. Laser Interferometers
8. CMM
9. Joining processes

List of Course Group Discussion Topics:

1. Industrial Revolution 4.0
2. Application of AI in Manufacturing
3. Industrial applications of Metrology
4. Digital Manufacturing and Design
5. Intelligent Machining

List of Home Assignments:

1. Advanced manufacturing processes.
2. 3 D printing technology.
3. Surface roughness measurement instruments.
4. Survey for component manufactured by Lathe/Milling/Drilling/Shaper machine
5. Survey for parts manufactured by super finishing processes

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV
AR2109-Automatic Control System

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week LAB:02 Hours/Week	TH: 03 LAB: 01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks LAB Evaluation: 50 Marks

Course Pre requisites: Basic electrical systems and basic transforms such as Laplace and Z transforms

Course Objective: This course provides an introduction to the elements of control systems and their modeling using various techniques. The objective of this course is to analyze (Introduce) the systems in time and frequency domain which predict the stability of control systems.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Model a physical and electrical system and visualize its input-output relationships by means of block diagrams and Signal flow graph.
CO2: Analyze a linear control system in time and frequency domain using graphical methods.
CO3: Model and analyze the control system using state space analysis.
CO4: Visualize the concept of PID controllers and analyze digital control system using transfer function.

Course Contents

UNIT-I	INTRODUCTION	07Hours
Introduction to control system-Basic elements of control system- Open and Closed loopcontrol systems-Differential equation representation of physical systems-Transfer function, Force – Voltage, Force – Current analogy		
UNIT-II	**MATHEMATICAL MODELING**	**07 Hours**
Mathematical modeling of electrical and mechanical systems (Translational and Rotational) Analogous system -Block diagram reduction techniques- Signal flow graph, Masson's Gain Formula		
UNIT-III	**TIMEDOMAINANALYSIS**	**07 Hours**
Time response analysis-Analysis of transient and steady state behavior of control systems- Standard test signals –Time response of First order system- step, ramp and impulse response analysis-Second order system – step response analysis- steady state error- generalized error co-efficient–Response with P, PI, PD and PID controllers		
UNIT-IV	**STABILITYANALYSISANDROOTLOCUS**	**07 Hours**
Concepts of stability-Location of poles on s-plane forstability-Routh-Hurwitz stabilitycriterion-RootlocusTechniques		
UNIT-V	**FREQUENCYDOMAINANALYSIS**	**07 Hours**
Frequency response-Frequency domain specifications- Correlation between time domain and frequency domain specifications-Bode plot- Stability analysis using Bode plot- transfer function from Bode plot, Nyquist stability criterion & Plot		

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UNIT-VI	STATE SPACE ANALYSIS	07 Hours

State space model of a control system-Statespace representationusingphysical,phaseandcanonicalvariables-diagonalcanonicalform-Jordancanonicalform, State transition matrix, state observer, eigen values and eigen vectors

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file

Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments (Any eight to be performed)

1	Simulation of a typical second order system and determination of step response and evaluation of tim domain specifications.
2	Evaluation of effect of pole location on stability
3	Transfer function of any physical systems (AC Servomotor/ Two Tank System/Temperature control/ Level control)
4	Study and testing of D.C. Motor Position control System.
5	Control of level/Pressure/Temperature using PID controller.
6	To obtain Nyquist plot for a given transfer function of the system using MATLAB.
7	To obtain Bode plot for a given transfer function of the system using MATLAB.
8	To plot the root locus for a given transfer function of the system using MATLAB
9	To investigate the effect of P, PI and PID controller on time response of second order system.
10	Experimental study of time response characteristics of R-L-C second order system: Validation using simulation.
11	Experimental determination of DC servo motor parameters for mathematical modeling, transfer function and characteristics.
12	Simulation of state transition matrix by various methods using MATLAB.

Text Books:

T1. Benjamin C. Kuo, "Automatic Control Engineering", 7th Edition Prentice Hall of India Pvt. Ltd.

T2.I. J. Nagrath, M. Gopal, Control Systems Engineering‖, Fifth Edition, New Age International,NewDelhi,2011.

Reference Books:

R1. R. Ananda Natarajan, P. Ramesh Babu, Control Systems Engineering‖, Second edition, SciTech Publications, 2005.

R2. BenjaminC.Kuo,AutomaticControlSystems‖,SeventhEdition,PHI Learning, New Delhi, 1997

R3. KatsuhikoOgata,DiscreteTimeControlSystems‖,SecondEdition,PHI Learning, New

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On-Line Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me13/preview
2. https://nptel.ac.in/courses/108101037
3. https://onlinecourses.nptel.ac.in/noc20_me39/preview

List of Tutorials:

1. Numerical on Routh-Hurwitz criteria
2. Numerical on Block diagram reduction techniques
3. Numerical on Bode Plot
4. Write down first order system and derive equation when step input is given
5. Explain time domain analysis why it required?
6. Explain Frequency domain analysis and difference between time domain and frequency domain

List of Projects:

1. Intelligent illumination control system (using Arduino / Raspberry Pi)
2. Modelling of automotive suspension system in Simulink
3. Smart security system for intruder detection (using Arduino / Raspberry Pi)
4. Mobile App controlled home automation using microcontroller board (using Arduino /Raspberry Pi)
5. Bluetooth controlled smart water management system for apartments (using Arduino / Raspberry Pi)
6. Intelligent motor speed control system using Mobile App (Arduino).

List of Course Seminar Topics

1. Closed Loop speed control of Induction Motor
2. Mechatronic design - concept, need, applications, clarifications
3. Role of system models in modifications and improvement
4. Control systems in industry
5. Mechatronics and industry 4.0
6. Mechatronics and Robotics

List of Course Group Discussion Topics:

1. Mechatronic design Vs traditional design
2. IOT - functions and limitations
3. Mechatronics and medical science
4. Various controllers
5. SCADA Systems - scope and limitations

List of Home Assignments:

1. Write down second order system equation and write different condition of zeta
2. Explain special cases of rouths Hurwitz criterion
3. Draw bode plot for different pole conditions.

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV
AR2110-Kinematicsand Dynamics of Machines

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week	TH:03	In Sem. Evaluation:15 Marks
LAB:02 Hours/Week	LAB:01	Mid Sem. Exam: 25 Marks
TU:01 Hours/Week	TU:01	End Sem. Exam : 60 Marks
		LAB Evaluation : 50 Marks

Course Prerequisites: Engineering Mathematics, Engineering Physics, Engineering Mechanics.

Course Outcome:

1:To represent kinematic behavior of different machine elements and mechanisms for industrial application.
2: To develop competency in drawing velocity and Acceleration diagram for simple and complex mechanism
3To synthesize mechanism using graphical method.
4: To develop competency in understanding of theory of all types of gears
5: To develop competency in drawing of cam profile.
6: To understand the balancing and vibration

Course Outcome:

After successful completion of the course, students will able to:

CO1: Identify mechanisms in real life applications**.**
CO2: Determine velocity and acceleration of mechanisms by graphical and analytical method.
CO3: Understand the synthesis of simple mechanism for different positions.
CO4: Understand the fundamentals of gear theory which will be prerequisite for the gear design.
CO5: Understand cam jump phenomenon and design cam profile for given follower motion.
CO6: Understand balancing and vibration effects.

Course Contents

UNIT-I	INTRODUCTION OF MECHANISMS	07 Hours

Classification of mechanisms – Terminology and definitions – Degree of freedom, Mobility – Kutzbachcriterion,Gruebler'scriterion–Grashof'sLaw–Kinematicinversionsoffour-barchainandslidercrankchains– Limitpositions–Mechanicaladvantage–TransmissionAngle–Descriptionofsomecommonmechanisms–Quickreturn mechanisms,Straightlinegenerators, UniversalJoint–rockermechanisms.

UNIT-II	KINEMATICS OF LINKAGE MECHANISMS	07 Hours

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points– Coriolis component of Acceleration – Introduction to linkage synthesis problem. Introduction to simulation software

UNIT-III	KINEMATICSOFCAM MECHANISMS	07 Hours

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Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT-IV	GEARSANDGEARTRAINS	07 Hours

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

UNIT-V	FRICTION	07 Hours

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives Friction in brakes- Band and Block brakes, Bearings and lubrication– Friction clutches

UNIT-VI	BALANCINGANDVIBRATION	07 Hours

StaticandDynamicbalancing–Balancingofrevolvingandreciprocatingmasses–Balancing machines – free vibrations – Equations of motion – natural Frequency – DampedVibrationbendingcriticalspeedofsimpleshaft.

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file

Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Demonstration of Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker,Oscillatingcylinder Mechanisms.
2	Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.
3	Velocity and acceleration analysis using relative velocity and relative acceleration method (Graphical Method).
4	Cams–Camprofile drawing,Motion curvesandstudyofjumpphenomenon
5	To generate gear tooth profile by using rack as a cutter
6	To determine the holding torque of epicyclic gear train
7	a)Balancingofrotatingmasses.(b)Balancingofreciprocatingmasses.
8	Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
9	VibrationofEquivalentSpringmasssystem–undampedanddampedvibration
10	Whirlingofshafts–Determinationofcriticalspeedsofshaftswithconcentratedloads

Text Books:

T1. Ambekar A.G., Mechanism and Machine Theory‖ Prentice Hall of India, New Delhi, 2007

T2. Shigley J.E., Pennock G.R and Uicker J.J., ―Theory of Machines and Mechanisms‖, Oxford University Press, 2003

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Reference Books:

R1. Thomas Bevan, ―Theoryof Machines‖, CBS Publishers and Distributors, 1984.
R2. Ghosh. A, and A.K. Mallick, ―Theory and Machine‖, Affiliated East-West Pvt. Ltd., NewDelhi, 1988.
R3. Rao.J.S. and DukkipattiR.V.Mechanisms andMachines‖, Wiley-Eastern Ltd., NewDelhi, 1992.
R4. John Hannah and Stephens R.C., Mechanics of Machines‖, Viva Low Prices StudentEdition, 1999.
R5. V.Ramamurthi,MechanismsofMachine,NarosaPublishingHouse,2002.
R6. RobertL.Norton,DesignofMachinery,McGraw-Hill,2004.

On-Line resources:

1. https://nptel.ac.in/courses/112104121
2. https://nptel.ac.in/courses/112106270
3. https://nptel.ac.in/courses/112104114
4. https://nptel.ac.in/courses/112105268

List of Tutorials: (Any Three)

1. Problems on ICR Method
2. Problems on Velocity and acceleration analysis
3. Problems on Synthesis of mechanism
4. Problems on epicyclic gear train.
5. Problems on spur gear.
6. Problems on Cam and follower (Graphical Method)
7. Problems on Gyroscope.
8. Problems on balancing.

List of Projects:

1. Design of mini conveyor using Geneva mechanism.
2. Design of six speed constant mesh gear box.
3. Design and fabrication of kinematic walker.
4. Design of film frame by Geneva mechanism.
5. Design of industrial conveyor using four bar mechanism.
6. Design of gear train using any modeling software.
7. Study of advanced differential gear box.
8. Stress analysis of spur gear using analysis software.
9. Simulation of planetary gear box.
10. Simulation of gear box.
11. Simulation of cam and follower mechanism.

List of Course Seminar Topics:

1. Mechanism and Machines.
2. Geneva mechanism.
3. Straight line generating mechanism.
4. Chebyshev spacing.
5. Synthesis of mechanism.
6. Types of gear box.
7. Types of gear train.

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List of Course Group Discussion Topics:

1. Types of mechanisms.
2. Gear box.
3. Gear train.
4. CVT
5. AMT & CVT
6. Manual and automatic transmission.
7. Gyroscope.
8. Synthesis of mechanism.
9. ICR method and analytical method for velocity analysis of mechanism.
10. Continuous variable transmission and automatic transmission.
11. Types of cams.
12. Types of followers
13. Advanced and regular cam curves
14. Cam jump phenomenon
15. Stabilization of sheep and four-wheeler.

List of Home Assignments Design

1. Force analysis of spur gear
2. Numerical analysis of Four bar chain mechanism.
3. Tabular method for epicyclic gear train.
4. Design of four bar chain mechanism.
5. Design of slider crank mechanism.

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S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV
AR2111-Hydraulics and Pneumatics

Teaching Scheme:	Credit	Examination Scheme:
TH:03 Hours/Week LAB:02 Hours/Week	TH:03 LAB:01	In Sem. Evaluation:15 Marks Mid Sem. Exam: 25 Marks End Sem. Exam : 60 Marks LAB Evaluation : 50 Marks

Course Pre requisites: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics

Course Objective:

- To provide student with knowledge on the application of fluid power in process Construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

Course Outcome:

After successful completion of the course, students will able to:

CO1: Understand the Fluid power and operation of different types of pumps.
CO2: Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.
CO3: Understand the Different types of Hydraulic circuits and systems
CO4: Understand the working of different pneumatic circuits and systems
CO5: Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems

Course Contents

UNIT-I	FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS	07 Hours

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

UNIT-II	HYDRAULIC ACTUATORS AND CONTROL COMPONENTS	07 Hours

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

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UNIT-III	HYDRAULIC CIRCUITS AND SYSTEMS	07 Hours
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.		
UNIT-IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**07 Hours**
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.		
UNIT-V	**TROUBLE SHOOTING AND APPLICATIONS**	**07 Hours**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs**.**		

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly by internal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file

Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Design and making of simple pneumatic and hydraulic circuits using basic components.
2	Simulating Cylinder: Sequencing, Reciprocating, synchronizing and Speed control Hydraulic Circuits.
3	Develop systems for automatic reciprocating actuator using electro – pneumatic elements
4	Construction and testing of a hydraulic actuator circuit for any suitable application.
5	Built a Electro-hydraulic circuit for suitable application.
6	Design and Simulation of hydraulic circuits using simulation software
7	Design and Simulation of pneumatic circuits using simulation software
8	Design Report of Hydraulic / Pneumatic System for any industrial application.

Text Book:

1.Anthony Esposito, ―Fluid Power with Application‖, Pearson Education (Singapore) Pvt. Ltd, Delhi, India, 2003.

2. Majumdar S.R., ―Oil Hydraulics Systems- Principles and Maintenance‖, Tata McGraw-Hill, 2001.

Reference Books:

1. Anthony Lal, ―Oil hydraulics in the service of industry‖, Allied publishers, 1982.

2. Dudelyt, A. Pease and John T. Pippenger, ―Basic Fluid Power‖, Prentice Hall, 1987.

3. Majumdar S.R., ―Pneumatic systems – Principles and maintenance‖, Tata McGraw Hill, 1995

4. Michael J, Prinches and Ashby J. G, ―Power Hydraulics‖, Prentice Hall, 1989.

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5. Shanmugasundaram.K, ―Hydraulic and Pneumatic controls‖, Chand & Co, 2006.

On-Line resources:

1. Oil Hydraulics and Pneumatics - Course (nptel.ac.in)
2. NPTEL :: Mechanical Engineering - Fundamentals of Industrial Oil Hydraulics and Pneumatics

List of Tutorials:

1. Numerical on gear pump
2. Numerical on vane pump
3. Numerical on hydraulic actuators
4. Numerical on hydraulic accumulator

List of Projects:

1. Design and analysis of hydraulic circuits
2. Design and analysis of Pneumatic circuits
3. Design and analysis of Industrial circuits

List of Course Seminar Topics:

1. Application of Pascal Law
2. Application of logic gates in pneumatic systems
3. Fault finding in Fluid power systems
4. Applications of Industrial Fluid Power
5. Governing laws of pneumatic system
6. Types of fluids
7. Properties of fluids
8. Fail safe circuits
9. Hydraulic press circuit

List of Course Group Discussion Topics:

1. Types of DCVs
2. Types of FCVs
3. Types of PCVs
4. Special Valves for Pneumatics systems
5. Special Valves for Hydraulicsystems
6. Types of pumps for Fluid Power systems

List of Home Assignments:

1. Design of pumping system for given application
2. Design of gear pump
3. Design of double acting cylinder
4. Selection criteria of hydraulic pumps for Fluid Power systems

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(An Autonomous Institute Affiliated to SavitribaiPhule Pune University,Pune)

S. Y. B. Tech (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -IV
[ME2109]: Product Development & Modeling Lab

Teaching Scheme: LAB:02Hours/Week	**Credit** PR: 01	**Examination Scheme:** LAB Evaluation: 50 Marks

Course Prerequisites: Engineering Graphics

Lab Contents

Guidelines for Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly byinternal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file
- Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Introduction to product design to create new ideas.
2	Development of ideas through a process that leads to new products.
3	Create scale model of new product using Rapid Prototyping.
4	Introduction to Modeling software like CATIA, CREO, NX.
5	Develop 3D models of all parts in details by applying advanced tools-I.
6	Develop 3D models of all parts in details by applying advanced tools-II.
7	Create assembly using all parts with appropriate constraints.
8	Creating Production Drawing and animation for assembly (minimum 5 parts).
9	**Assignment** i. Assignment based on Industrial drawing ii. Assignment based on Innovative creation like future base design.

Reference Books:

R1. N. D. Bhatt and V.M. Panchal, Machine Drawing, Charoter Publications
R2. ASME Y14.5 – 2009
R3. Ibrahim Zeid, Mastering CADCAM, McGraw-Hill
R4. Help manuals and tutorials of referred software

Online Resources:

https://nptel.ac.in/courses/112/104/112104230/

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S. Y. B. Tech (Automation and Robotics Engineering)

Academic Year – 2022-2023 Semester -IV

[ME 2110]: Interpersonal Skills (Soft Skills)

Teaching Scheme: LAB:02 Hours/Week	Credit LAB: 01	Examination Scheme: LABEvaluation : 50 Marks

Guidelines for Assessment/Guidelines for Lab /TW Assessment

Practical/Oral examination based on the practical's performed in the lab. The Performance will be assessed jointly byinternal and external examiners.

- Total marks assigned are 50.
- Continuous assessment will be carried out based on attendance, lab performance, and timely submission of lab file
- Final practical examination for specific practical and oral examination will be conducted

List of Laboratory Assignments/Experiments

1	Skill training, Employability training, Pre-job trainings.
2	Introduce yourself with SWOT analysis
3	Life Skill Management.
4	Development of leadership qualities and Public speaking skills.
5	Group discussion on environment protection.
6	Confidence Management.
7	A group discussion on importance of personality development.
8	Assignment on Goal Setting and Time Management.
9	Assignment on Team building and assigning work distribution.
10	Assignment on computer ethics (Social impact of computers)
11	Assignment **On the Job Training** (OJT) and apprenticeships shall form an integral part of a skills based program.

Reference Books:

R1. Campbell, J., Baikaloff, N., & Power, C. (2006). Towards a global community: Educating for tomorrow's world. Dordrecht: Springer

R2. Boston Consulting Group (2010), Winning in Emerging Market Cities: A Guide to the World's Largest Growth Opportunity, Boston Consulting Group, Boston

R3. M. Govindarajan, S. Natarajan, V.S. Senthil Kumar, "Professional Ethics and Human Values", PHI Learning Press

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S. Y. B. Tech. (Automation and Robotics Engineering)
Academic Year – 2022-2023 Semester -III
[ME2111]AUDIT COURSES

The purpose of audit courses is to give general awareness about the social issues to the students. Students are expected to apply the scientific way to analyse the data and make use of their technical expertise to deal with the issues. The basic objective is to give a different learning experience in context with social issues.Assessment of the students work will be done on the basis of assignments/reports/presentation/oral exam/test.

Criteria:

The student registered for audit course shall be awarded the grade NP (Audit Course Pass) and shall be included such TP grade in the Semester grade report for that course, provided student has at least 75% or above attendance and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

Evaluation Criteria:

Guidelines for Conduction (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Poster presentation
- Presentations
- IPR/Publication
- Report

Audit Course- II

HS2107	Engineering Economics
HS2108	Indian Traditional Knowledge
ME2111-C	Innovations in Agriculture Engineering
ME2111-D	Online Certification

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Academic Year – 2022-2023 Semester -IV
[HS2107]: Audit Course-II: Engineering Economics

Course Objective:
To introduce the essentials of economics. Also to increase economic knowledge and how the markets work. and understand the basics of market competition.To understand how International Markets work and their principles and to understand how start-ups to be initiated.

Course Outcome:
After successful completion of the course, students will able to:
CO1: Explain the nature of markets and competition
CO2: Discussthe Basic Concepts of Economics, Micro and Macro
CO3: Enumerate the importance of how industries behave
CO4: Justify the basis in our day-to-day life to gain personal financial control
CO5: List the steps to begin start-up culture and economics
CO6: Discussthe finance generation and funding rounds

Course Contents

UNIT-I	Basic Concepts of Economics
Introduction, Definitions, Overview of Micro and Macro Economics, Explanation of theories of demand, supply and market equilibrium and Economics Basics – Cost, efficiency and scarcity, Opportunity Cost	
UNIT-II	**Micro Economics**
Differences and Comparison, Theories of Utility and Consumers Choice, Competition and Market Structures, Markets and Prices, Market Failures, Income Distribution and Role of Government	
UNIT-III	**Macro Economics**
Aggregate Demand and Supply, Economic Growth and Business Cycles, The role of the Nation in economic activity, New Economic Policy in India, Fiscal Policy, GDP and Inflation, Consumption, savings and investments, Commercial and Central banking	
UNIT-IV	**Introduction to Industrial Economics**
Behavior of firms: Strategies with regard to entry, pricing, advertising, and R & D and innovation. The development of Firms and Market and Industrial Structure: Stochastic models of firm growth, and market structure, inter-industry differences in growth rate variance, economies of scale, technical change mergers and market concentration.	
UNIT-V	**Role of Industrial Economics**
Development of Competitive capabilities: Role of Technology and Skills, FDI and Technology Transfer, Technological Spillovers, Globalization and Technology Intermediation.	

Text Books:

T1. Baumol, William J., Economic Theory and Operations Analysis, [Prentice Hall India Ltd.] FourthEdition, 1985.
T2. Sloman, John H., Economics [Prentice Hall India Ltd.] Second Edition, 1994.

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T3. Varian, Hal, ` Intermediate Microeconomics: A Modern Approach, Fifth Edition [Norton, 1999].
T4. P.A. Samuelson & W.D. Nordhaus, Economics, McGraw Hill, New York, 1995.
T5. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975.
T6. R. Pindyck and D.L. Rubinfeld, Microeconomics, Macmillan Publishing Company, New York, 1989.

Reference Books:

R1. R.J. Gordon, Macroeconomics 4th Edition, Little Brown & Co., Boston, 1987.
R2. William F. Shughart II, the Organization of Industry, Richard D. Irwin, Illinois, 1990.

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S. Y. B. Tech (Automation and Robotics Engineering)
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[HS2108]: Audit Course-II: Indian Traditional Knowledge

Course Prerequisites: Introduction of Indian Culture

Course Objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and Nature. Emergence of Indian society.Develop a better appreciation and understanding of Traditions and Practices of India.

Course Outcome:

After successful completion of the course, students will able to:

CO 1: Explain basics of Indian Traditional knowledge.

CO 2: Develop positive attitude towards Indian thoughts and traditions.

Course Contents

UNIT-I	Indian Society

Structure of Indian Society, Indian Social Demography-Social and Cultural,Differentiations: caste, class, gender and tribe; Institutions of marriage, Indian constitution. Affirmative Action Program of the Government- various reservations and commissions

UNIT-II	Yoga and Holistic Health Care

Knowledge of the basic perspectives on health and disease from yoga and Ayurveda relevant to the practice of yoga therapy, including the concepts of subtle anatomy.

UNIT-III	Social Development

Scientific approach to the study of human beings. Evolution of human kind, social change and evolution. Industrial revolution. National policy on education, health and health care and human development.

Text Books:

T1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition.

T2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.

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Academic Year – 2022-2023 Semester –IV
[ME2111-C]: Audit Course-III: Innovations in Agriculture Engineering

Course Prerequisites: Knowledge of Mathematics, Physics, and Chemistry is necessary, Out of box/ unconventional thinking for solving typical problems, Adapting analytical tools traditionally, Application oriented thinking of learnt topics

Course Objective:

- To develop holistically built thinking habit needed for innovative ideas.
- To aware about key field of agriculture contributing to sustenance and development of a mankind.
- To expose students roles and responsibilities of building a nation through engineering insights in agriculture
- To update with innovations and technological advancements in respective fields of engineering

Course Outcome:

After successful completion of the course, students will able to:

CO1: Discuss what is thinking, its tools and process and its application to innovation
CO2: Explain and develop application of innovation in engineering
CO3: Use important terms like national productivity, sustainable development and inclusive growth
CO4: Demonstrate the various technologies in agriculture
CO5: Apply Interdisciplinary Engineering applications in Agriculture

Course Contents

UNIT-I	Thinking and thinking process

Thinking and thinking tools: Thinking, Types of thinking, Top-Down (Analysis) & Bottom-Up (Synthesis) thinking and combination of, Judgment and Creativity, Concept Maps Connecting the ideas, Generating ideas. Communicating ideas. Systems thinking and beyond. Critical thinking. Definition of innovation. Example of application of thinking process to any one practical innovation

UNIT-II	Engineering Innovation and its scope

Incremental, radical and disruptive Innovation. Scope of innovation: Product innovation, Process innovation, Position innovation, Paradigm innovation. Innovation within the engineering profession. Awareness about latest technological advancements.

UNIT-III	Agriculture and innovation

Definition of agriculture, Role of Agriculture in our life and in national productivity. Concept of sustainable development and inclusive growth. India's urban awakening. Innovation in agriculture and its types. Importance of agriculture innovation.

UNIT-IV	Developing technologies in agriculture

Favorable conditions for Agriculture innovation. Dynamics of Innovation System. Role and responsibility of Engineers in agricultural innovations and making India the net exporter of major agricultural produces. FIN Ovation Awards. Ideas on developing technologies in agriculture viz. Vehicle automation, Engine emissions technology, Fire suppression technology etc. The future of

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robotics on farms.	
UNIT-V	**Interdisciplinary Engineering in Agriculture**
Technological innovations that are revolutionizing Indian agriculture. Case study presenting Interdisciplinary Engineering application in Agriculture.	

Text Books:

T1. Kasser, J., E., 2015. Holistic Thinking: Creating Innovative Solutions to Complex Problems: Volume 1 (Solution Engineering). Create Space Independent Publishing Platform; 2 edition.

T2. Wenwu Zhang, 2011. Intelligent Energy Field Manufacturing: Interdisciplinary Process Innovations. CRC Press, Taylor & Francis Group.

T3. Educating engineers to drive the innovation economy, 2012. Publisher: The Royal Academy of Engineering, London.

Reference Books:

R1. Crowder, J., A., Carbone, J., N., Demijohn, R., 2016. Multidisciplinary Systems Engineering: Architecting the Design Process. Springer Publishing.

R2. India's urban awakening: Building inclusive cities, sustaining economic growth, 2010. Mckinsey Global Institute report.

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Academic Year – 2022-2023 Semester –IV
[ME2111-D]: Audit Course-I: Online Certification

Course Prerequisites: Basics analysis or design concepts of the selected course.

Course Objective: The objective of this course is, to prepare students to learn the courses using online teaching aids

Course Outcome:
After successful completion of the course, students will able to:
CO1: Use modern ICT tools for self-learning
CO2: Demonstrate the ability of self- learning
CO3: Demonstrate the ability to abreast with advance technologies.

Course Contents

The students should complete at least one Certification course which will be offered by NPTEL/Spoken tutorial/ Swayam/ IIT Bombay/ MOOC/or any other approved agency by the department during the same semester. The students should select the subjects relevant to Computer Engineering and which should not be included in the specified curriculum. Minimum duration of course should be 4 weeks and all assignments should be submitted. Certification done would be appreciated but not mandatory. In case a student does not go for certification, he/she should pass the internal test organized by department for the said course

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